Motivated Processing of Fear Appeal and Disgust Images in Televised Anti-Tobacco Ads

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Abstract. The current study experimentally tested the effects of two types of content commonly found in anti-tobacco television messages – content focused on communicating a health threat about tobacco use (fear) and content containing disgust-related images – on how viewers processed these messages. In a 2×2 within-subjects experiment, participants watched anti-tobacco television ads that varied in the amount of fear and disgust content. The results of this study suggest that both fear and disgust content in anti-tobacco television ads have significant effects on resources allocated to encoding the messages, on recognition memory, and on emotional responses. Most interesting, although messages high in both fear and disgust content were rated the most unpleasant and arousing, these same messages reduced corrugator responses, accelerated heart rate, and worsened recognition memory. Implications for the study of motivated processing and for the construction of anti-tobacco messages are discussed.

Keywords: defensive responding, disgust, fear appeals, motivated processing

Introduction

The interaction of emotion and cognition in processing mediated messages is a dynamic and complex phenomenon. Mediated messages are packed with content that varies widely in the presence of emotionally powerful stimuli that might motivate individuals to process the message in distinct ways. This experiment was designed to advance theory by exploring how different combinations of fear appeal and disgust-related images engage cognitive and emotional processing during exposure to televised anti-tobacco ads.

Fear appeal, message content focused on communicating a threat, is a common message strategy in health campaigns. While extensive research has explored the impact of fear-based health messages on persuasion (see de Hoog, Stroebe, & de Wit, 2007, for a recent review), there are still significant gaps in understanding how individuals process such messages. Further, fear appeals are extremely complex messages, often with multiple emotional characteristics (Dillard & Nabi, 2006; Dillard & Peck, 2001; Dillard, Plotnick, Godbold, Freimuth, & Edgar, 1996). Two such characteristics are audiovisual information about a threat to one’s health and negative graphic images (e.g., tobacco-damaged organs, body bags). While message producers may think that the combination of these characteristics intensifies perception of a significant health threat, they may not realize that the combination of distinct forms of emotional content might lead to nuances in cognitive/emotional processes that could impact the effectiveness of fear appeals.

Wakefield and colleagues, in a review of antismoking ads, pointed out the degree to which fear appeals have been used to persuade individuals not to smoke, and called for more research on the impact of negative graphic images in these messages (Wakefield, Flay, Nichter, & Giovino, 2003). One form of negative graphic images in anti-tobacco ads are those likely to be perceived as gross or nauseating. We refer to these as disgust-related images. Fear appeal and disgust-related images could have significant interactions on the dynamics of cognitive/emotional processes engaged when individuals view messages that vary in the presence of both features. The specific goal of this experiment was to see how the presence of fear appeal and disgusting images, both uniquely and interactively, stimulate cognitive and emotional processing of message content.

A major theoretical assumption made in this study is that human motivation drives both cognition and emotion. This assumption underlies what has become known as the motivated processing framework under which scholars consider specific patterns of motivational activation elicited by stimuli to be the primary determinant of cognitive/emotional processing (Lang, 2006; Lang, Bradley, & Cuthbert, 1997). Motivational activation consists of appetitive and aversive activation (Cacioppo, Gardner, & Berntson, 1997). Appetitive activation motivates individuals to approach or engage with stimuli, while aversive activation motivates withdrawal or defensive responding to stimuli (Cacioppo, Gardner, & Berntson, 1999). In general, pleasant stimuli evoke appetitive, and unpleasant stimuli elicit aversive activation (Bradley & Lang, 2000). Mediated messages depict all sorts of pleasant and unpleasant stimuli capable of evoking varying patterns of appetitive and aversive activation, which in turn has been found to impact cognitive/
emotional processing of the message (Bradley, Angelini, & Lee, 2007; Lang, Park, Sanders-Jackson, Wilson, & Wang, 2007; Leshner, Bolls, & Thomas, 2009).

This study applies a motivated processing theoretical framework to investigate cognitive/emotional processing of televised anti-tobacco messages. The unpleasant nature of anti-tobacco message content means that most of these ads evoke varying levels of aversive activation. When anti-tobacco messages have the goal of presenting the consequences of tobacco use in unpleasant terms, they are unlikely to evoke strong appetitive activation.

Previous research has rarely included an attempt to identify patterns of aversive activation evoked due to the presence of various forms of message content and resulting cognitive and emotional processes engaged during message exposure. The unique dynamics of cognitive and emotional processing resulting from aversive activation are likely the foundation of responses observed in previous studies of fear appeal health messages (e.g., Roskos-Ewoldsen, Yu, & Rhodes, 2004; Witte, 1994). Applying a motivated processing theoretical framework and measuring cognitive/emotional processes resulting from aversive activation, time-locked to message exposure, should enable this study to contribute original insight into individuals’ responses to unpleasant content in health messages.

This experiment involved manipulating the level of fear appeal and disgust-related images in televised anti-smoking ads, and observing the resulting cognitive/emotional processing of the message. The following paragraphs provide theoretical reviews of fear and disgust appeals before turning to the motivated processing perspective, which we used to generate our hypotheses.

Theoretical Models of Fear Appeals

Theoretical models describing the persuasive impact of fear appeals identify the importance of motivation. The earliest formal model was Hovland, Janis, and Kelley’s (1953) drive reduction model, which conceptualized fear as a drive-evoking emotional tension that individuals are motivated to reduce. This model proposed a curvilinear relationship between the intensity of a fear appeal and persuasion. A second theoretical model to emerge was Rogers’ (1983) protection motivation theory (PMT). This model focused on threat appraisal as the key process influencing how individuals respond to fear appeal messages. Threat appraisal was proposed to include an evaluation of the severity of the threat, vulnerability to the threat, response efficacy – the perceived ability of the recommendation to avert the threat, and self-efficacy – the perceived ability to engage in the recommended action.

The theoretical model that has spawned the most recent research on fear appeals is Witte’s (1992) extended parallel process model (EPPM). The EPPM, an extension of PMT, describes two processes individuals can engage in in response to a fear appeal message. Danger control is a process in which individuals are motivated to adopt message recommendations to control their perceived danger, and fear control is a process in which individuals are motivated to control evoked fear through defensive processing or avoidance. In order for either process to be evoked, a fear appeal message has to present a threat that is relevant and perceived to be severe. Witte proposed that response efficacy and self-efficacy determine which process will be evoked. Danger control should be evoked when both forms of efficacy are high; fear control should be engaged when either form of efficacy is low.

Several observations can be made about these theoretical models. First, all of the models appear to incorporate a general view of motivation as a drive that moves individuals favorably toward message recommendations or unfavorably away from confronting the presented threat. This view makes sense in light of how the earliest research on motivation conceptualized it as consisting of approach and withdrawal processes and behaviors (Janis & Feshbach, 1953; Kraus, El-Assal, & DeFleur, 1966). Second, defensive processing in some form appears to underlie responses to fear appeal messages. The models do not formally articulate the dynamics of defensive processing of a fear appeal but rather focus on identifying either adaptive or maladaptive responses to message recommendations believed to result from message processing. Finally, none of the proposed models describe nuances in cognitive/emotional processes engaged while an individual processes a fear appeal. This theoretical gap prevents most research on fear appeals from indexing mental processes engaged during exposure to messages (Lang, Potter, & Bolls, 2009). Witte and Allen (2000) acknowledged the need to gain an understanding of underlying processes engaged during message exposure that might sway an individual toward danger or fear control responses. In their recent meta-analysis, De Hoog et al. (2007) found 187 empirical studies on fear appeals and noted a lack of research that included measures of information processing.

Theoretical Description of Disgust

Disgust has been formally recognized as one of the basic emotions (Izard, 1977; Lazarus, 1991). Researchers studying human emotion have studied disgust elicited by unpleasant, highly arousing stimuli such as scenes of mutilation and contamination (e.g., Haidt, McCauley, & Rozin, 1994). Disgust has been defined as an emotional response characterized by a specific facial expression, mild physiological manifestation of nausea, feelings of revulsion, and withdrawal from the disgusting object (Davey, 1994). It is believed to have developed as a defensive response to potential contamination from dirty or impure objects (Lazarus, 1991; Rozin, Haidt, & McCauley, 1993). Early theorizing about disgust focused on the response associated with food perceived to be revolting, but it is now recognized that disgust is elicited by a host of nonfood items as well (Power & Dalgleish, 2008). Haidt et al. (1994) identified seven categories of disgust-eliciting stimuli: food (e.g., contamination), animals (e.g., rats, insects), body product (e.g., urine, excrement), sex (e.g., certain sexual acts, incest), body envelope...
violations (e.g., surgery, organs, puncture wounds), death, and hygiene (e.g., dirt, germs).

There is some conceptual overlap between disgust and fear; however, those who subscribe to discrete emotion theory typically view them as separate and distinct basic emotions. Disgust, similar to fear, is fundamentally a defensive response to highly arousing, unpleasant stimuli (Newhagen, 1998). The dominant distinguishing feature of disgust is the perception that a stimulus is repulsive (Woody & Teachman, 2000). In an attempt to identify disgust as a specific theoretical concept, Nabi (2002) noted that disgust is best described by the colloquial “grossed out” and is associated with nausea and avoidance. These perceptions are independent of one’s fear evoked by a stimulus.

Fear and Disgust as Message Content

Features of media content are often defined by the emotional state supposedly induced, as illustrated by terms like “fear appeal” used to label types of content. Under this approach researchers cannot claim they have manipulated level of fear appeal in messages unless the messages considered to be “high fear appeal messages” actually have the effect of making participants feel afraid. Defining media content in this manner is in essence defining it according to its presumed effect. O’Keefe (2003) argues that conceptualizing media content according to concrete properties that can be manipulated during message production provides the most theoretical and practical value for media processes and effects research. This is the approach taken in this experiment.

The defining concrete feature of a fear appeal is message content directed at communicating a threat to the well-being of targeted individuals (Dillard, 1994). In practice, fear appeals are executed by writing copy in a way that directly associates the targeted behavior (e.g., tobacco use) with a threat (e.g., disease, death). Threats in anti-tobacco ads can range in severity from death and disease to less physically severe threats such as difficulty in breathing during moderate exercise. Conceptualizing fear appeal in this way makes the term “threat appeal” a more accurate description of message content examined in this experiment. Thus, the term “threat appeal” will be employed to denote the message feature that associates behavior with a health threat.

Disgust is more difficult to define as a concrete message feature because an extensive body of research on disgust in media messages is lacking, especially when compared with the literature on fear appeals. There has been limited media research on what Nabi (1998) called disgust-eliciting visuals. Nabi studied the impact of disgust-eliciting visuals in film clips about the use of animals in medical research. She described disgust-eliciting content as “very graphic images of monkeys being inflicted with head injuries” (p. 476). Such stimuli can be concretely identified based on the categories of disgust elicitors identified by Haidt et al.’s (1994) seven domains of disgust elicitors. The negative graphic images that seem to most often occur in anti-tobacco disgust messages are animals (e.g., insects), body product (e.g., urine), body envelope violations (e.g., organs), and hygiene (e.g., germs).

Motivated Processing of Media Messages

Threat appeal and disgust-related images are undoubtedly motivationally important features of message content. A recent theoretical model that aids understanding of how motivationally important media content is processed is Lang’s (2006) limited capacity model of motivated media message processing (LC4MP). The fundamental proposition of the LC4MP is that individuals have limited cognitive resources to allocate to mental tasks involved in processing message content. During exposure to a message, resources must be allocated to encoding incoming information, retrieving information from long-term memory to make sense of message content, and storing information from the message in memory. Under this model, media content is conceptualized as a stream of information consisting of motivationally relevant stimuli that evokes varying patterns of appetitive and aversive motivational activation which in turn influence cognitive/emotional processing. Lang and colleagues have found that various levels of appetitive and aversive activation evoked by a message indeed impact both resource allocation and emotional experience (Lang et al., 2007).

Arousal has been found to specifically affect information processing of television messages (Lang et al., 1995), and has been recognized as a significant dimension of human emotion (Lang, Greenwald, Bradley, & Hamm, 1993). Strength of aversive activation is the aspect of motivational activation most relevant to this study. Threat appeal and disgust-related images are both negatively arousing yet structurally distinct enough that variation in these contents within anti-tobacco ads might evoke significant differences in aversive activation. Variation in aversive activation could engage dynamic temporal differences in cognitive/emotional processing across the types of messages examined here: low threat / low disgust, high threat / low disgust, low threat / high disgust, and high threat / high disgust. The LC4MP proposes that stronger aversive activation increases cognitive resources allocated to encoding a message up to a point at which resources are shifted away from encoding to better support defensive responding to extremely unpleasant/arousing content (Lang, 2006).

The most recent research on the human defensive response suggests that it is increasingly activated across time, during exposure to increasingly unpleasant/arousing stimuli. This process of responding to a threat from initial encounter to overt action has been called the defensive cascade (Bradley, 2000; Lang, et al., 1997), and consists of a combination of cognitive/emotional processes that unfold over time in response to increasing levels of aversive activation. During exposure to unpleasant/arousing pictures, individuals have been found to initially increase cognitive resources allocated to encoding; but as unpleasantness and arousal increase, individuals begin showing signs of stronger and stronger defensive responding (Bradley, Codispoti, Cuthbert, & Lang, 2001). The view of the defensive
response as consisting of a cascade of cognitive/emotional processes unfolding over time to increasing levels of aversive activation is more nuanced than the popular psychology view of the defensive response as consisting only of fight or flight responses. The defensive cascade model suggests that defensive responding probably begins at relatively lower levels of aversive activation and consists of increased processing of unpleasant/arousing stimuli with a gradual withdrawal from processing as aversive activation becomes more intense. Full-fledged fight or flight responses are likely to occur only at extremely high levels of aversive activation (Bradley, 2000). Most content found in anti-tobacco ads is unlikely to evoke such an extreme level of aversive activation, so the more nuanced implication for cognitive/emotional processing of the message due to an individual being in the early stages of the defensive cascade is of the most relevance here.

The LC4MP and the defensive cascade model suggest that cognitive/emotional processes engaged during exposure to anti-tobacco ads will vary according to how far into the defensive cascade viewers are pushed due to the unpleasant/arousing nature of message content. This makes it important to consider how far into the defensive cascade anti-tobacco ads that contain threat and disgust-related images in different combinations are likely to push viewers. Lang and colleagues have used self-reported ratings of unpleasantness and arousal to index aversive motivational activation and explore the various stages of the defensive cascade in their research on defensive responding to unpleasant/arousing pictures (Lang & Bradley, 2008). The assumption is that pictures rated as more unpleasant and arousing will push viewers further into the defensive cascade. Self-report ratings ought to provide similar insight into defensive responding to the anti-tobacco ads examined in this experiment.

The first step in exploring how threat appeal and disgust-related images in anti-tobacco ads impact an individual’s progress into the defensive cascade is to explore the independent effect of these features on aversive activation. Disgust-related picture content has been found to evoke stronger aversive responses than fear-related picture content as evidenced by corrugator muscle activity, a facial muscle located along the brow involved in the expression of negative emotion (Yartz & Hawk, 2002). In addition, individuals have also been found to rate disgusting pictures as significantly more unpleasant than fear-related pictures (Balaban & Taussig, 1994). As separate and distinct forms of message content, it appears that ads containing disgust-related images might be more aversive than ads containing threat appeals. Further, anti-tobacco ads that contain both a threat appeal and disgust-related images should evoke a stronger aversive response than ads with only one of the content features. Therefore, a proposed order of aversive activation according to combinations of threat and disgust emerges for both unpleasantness and arousal ratings.

**Hypothesis 1 (H1):** Unpleasantness ratings will be greatest for high threat / high disgust ads, followed by low threat / high disgust, then high threat / low disgust, then low threat / low disgust.

**Hypothesis 2 (H2):** Arousal ratings will be greatest for high threat / high disgust ads, followed by low threat / high disgust, then high threat / low disgust, then low threat / low disgust.

The next outcome domain to consider is resource allocation. Encoding fundamentally involves directing cognitive resources externally toward stimuli in the environment (Lang, 2006). Cognitive resources are initially allocated to encoding unpleasant stimuli (Bradley, 2000). Researchers studying media content have found that unpleasant content is effective at increasing cognitive resources allocated to encoding, as evidenced by significant cardiac deceleration during exposure to unpleasant messages (Bolls, Lang, & Potter, 2001; Lang, Dhillon, & Dong, 1995; Lang, Newhagen, & Reeves, 1996). Although individuals initially increase cognitive resources to encoding unpleasant stimuli, the hallmark of the defensive cascade is a gradual withdrawal from stimuli that are increasingly unpleasant and arousing. Withdrawing from increasingly unpleasant/arousing stimuli involves the withdrawal of cognitive resources from encoding.

Heart rate decelerates as an individual allocates more cognitive resources to encoding information into working memory (Lang, 1994). Researchers examining the defensive cascade during exposure to unpleasant/arousing pictures have found that heart rate initially decelerates until aversive activation increases to the point of motivating defensive withdrawal of resources; at which time heart rate accelerates (Bradley, 2000; Bradley et al. 2001). Viewers should allocate more cognitive resources to encoding increasingly aversive anti-tobacco ads up to the point at which the message evokes a level of aversive activation high enough to push viewers into the stage of the defensive cascade, where a gradual withdrawal of resources begins. This level of aversive activation seems likely to be achieved solely during exposure to high threat / high disgust messages. The temporal dynamics of cardiac deceleration should vary according to the precise level of aversive activation evoked by each ad type. If high threat / high disgust ads push viewers to the point in the defensive cascade where they begin to withdraw cognitive resources from encoding the message, then these ads should evoke the weakest pattern of cardiac deceleration across ad exposure. Low threat / high disgust ads were previously predicted to be more aversive than high threat / low disgust ads but probably do not push viewers to the point of significantly withdrawing cognitive resources from encoding the message; thus, low threat / high disgust ads should evoke the strongest pattern of cardiac deceleration across ad exposure. High threat / low disgust ads then should evoke a pattern of cardiac deceleration across ad exposure that is stronger than the pattern of cardiac deceleration observed for high threat / high disgust ads but weaker than the pattern observed for low threat / high disgust ads. This leads to the following hypothesis:

**Hypothesis 3 (H3):** Cardiac deceleration across time will be greatest during exposure to low threat / high disgust, followed by high threat / low disgust, then...
high threat / high disgust televised anti-tobacco ads. Low threat / low disgust ads should show the least cardiac deceleration.

To the extent that progression into the defensive cascade affects cognitive resources allocated to encoding an aversive media message, recognition of message content could also be affected. Message recognition – an indicator of how well content was encoded into working memory – is an important indicator of message effectiveness. Unless information contained in an anti-tobacco ad is recognizable, the message has not gotten through to the intended target at a level that could potentially affect attitudes and behavior. Thus, recognition of aversive anti-tobacco ad content is both theoretically and practically interesting to examine.

The impact of fear appeal and disgusting images in anti-tobacco ads was previously explored in a similarly designed experiment (Leshner et al., 2009). Leshner and colleagues exposed participants to the same messages used in the present study – recording heart rate during exposure to the messages and testing recognition of visual content in the ads. They found a negative effect on recognition of visual scenes contained in anti-tobacco ads with high fear / high disgust content. Visual recognition specifically decreased for high fear messages when the onset of a disgusting image occurred. Further, the onset of disgusting visual images in high fear messages was found to evoke cardiac acceleration, presumably indicating that cognitive resources were being withdrawn from encoding message content. The present study was designed to replicate the exploratory work by Leshner and colleagues indicating that disgusting images in high fear anti-tobacco ads evoke an aversive response – as evidenced by cardiac acceleration – and build on that research by examining the impact of aversive activation on audio recognition. Recognition of audio content in televised messages has been found to be more difficult than recognition of visuals in the message (Lang, Potter, & Bolls, 1999), but the pattern of results should be the same.

Hypothesis 4 (H4): There will be a threat × disgust interaction on audio recognition such that for high threat messages, audio from low disgust messages will be better recognized than audio from high disgust messages. For low threat messages, audio from high disgust messages will be better recognized than audio from low disgust messages.

How might progression into the defensive cascade impact strength of the negative emotional response displayed while viewing aversive anti-tobacco ads? In processing aversive media content, it would seem that at the point in the defensive cascade where resources are withdrawn from encoding, the goal is to avoid highly aversive message content. The reason humans even have a defensive motivational system is to help us avoid or confront aversive stimuli in our environment (Bradley, 2000). In the context of viewing ads containing a threat appeal and/or disgust-related images it makes the most sense that progression into the defensive cascade would lead to message avoidance rather than responses reflective of confronting or fighting against the message. Witte’s fear control response evoked by fear appeal messages appears to be a form of defensive avoidance (Witte, 1992, 1998).

The benefit of withdrawing cognitive resources from encoding highly aversive media content would seem to be to dampen or blunt the real-time experience of negative emotional responding. Dampening or blunting negative emotional response has been identified as a specific strategy we humans use to regulate our emotions (Gross, 1998, 2002; Gross & Levenson, 1993). This strategy has been observed in children as a way to cope with their emotions felt while viewing scary media content (Hoffner, 1997). It is likely that young adults viewing aversive anti-tobacco ads would employ a similar strategy in coping with negative emotion evoked by threat appeal and disgust-related images.

The corrugator muscle, located just above the eyebrow, has been extensively used to index the strength of negative emotional responding to media content (Lang, et al. 2007; Potter, LaTour, Braun-LaTour, & Reichert, 2006). Activity in this facial muscle is positively related to negative emotional responding across time (Tassinary & Cacioppo, 2000). If young adults are pushed far enough into the defensive cascade to begin withdrawing cognitive resources from encoding high threat / high disgust ads, then negative emotional responding ought to strongly increase up to a point, then clearly decrease. Low threat / high disgust ads, as a highly aversive ad type that likely does not push viewers to the point of withdrawing cognitive resources, should evoke a generally increasing level of negative emotional response across exposure. Thus, corrugator muscle activity across the 30 s of ad viewing ought to be strongest for low threat / high disgust, followed by high threat / high disgust, then high threat / low disgust anti-tobacco ads. This leads to Hypothesis 5:

Hypothesis 5 (H5): There will be a threat × disgust × time interaction such that corrugator muscle activity across time will be highest during exposure to low threat / high disgust, followed by high threat / high disgust, then high threat / low disgust televised anti-tobacco ads. Low threat / low disgust ads will show the lowest level of corrugator activity.

Method

This study employed a 2 (threat appeal: low/high) × 2 (disgust images: low/high) × 6 (message) × 4 (order) mixed model repeated measures experiment. Exposure to anti-tobacco ads low or high in threat appeal and disgust-related images was manipulated within subjects. Message was a replication factor and was run within subjects. Participants viewed six anti-tobacco television advertisements in each threat appeal × disgust images condition, for a total of 24 ads. Participants were randomly assigned to view the advertisements in one of four random orders.
Independent Variables

Threat Appeal

Threat appeal was conceptualized as message content that depicted a health threat to which an individual using tobacco would be vulnerable. Half of the ads that participants viewed contained threat appeal; the other half did not.

Disgust-Related Images

A disgust-related image was conceptualized as the visual depiction of stimuli that can be categorized into one of the disgust domains developed by Haidt et al. (1994). The most common disgust images included in the stimulus ads involved the visual depiction of violation of the body envelope (organs, deformity caused by operations), body product (blood), or hygiene (filth). Half of the ads that participants viewed contained disgusting images; the other half did not.

Dependent Variables

Aversive Activation

Activation within the aversive motivational system was conceptualized as a significant underlying dimension of emotional response. Unpleasant emotional response is reflective of activation in the aversive motivational system. Aversive activation was indexed by having participants rate how “unpleasant” each ad made them feel. These ratings were obtained on 9-point response scales anchored by the terms “not at all” and “extremely.”

Arousal

Arousal was also measured on a 9-point self-report scale where participants were instructed to rate how calm or excited each ad made them feel.

Attention

Attention was conceptualized as cognitive resources allocated to encoding information in short-term memory. Heart rate was measured in this experiment as a physiological indicator of resource allocation. Heart rate was measured by placing 8-mm Ag/AgCl electrodes over participants’ forearms. Heart rate was collected as milliseconds between R-spikes in the QRS complex of the cardiac cycle (see Brownley, Hurwitz, & Schneiderman, 2000), and converted to beats per minute averaged for each second of data collection. Heart rate was measured for a 5-s baseline prior to each stimulus ad and time locked to ad exposure.

Audio Recognition

Audio recognition was conceptualized as how well information from the audio track of a commercial was encoded into short-term memory (Lang, 2006). Audio recognition was measured by playing brief audio clips (2 s) for participants, then requiring participants to indicate (by pressing one of two buttons on a keyboard) whether or not they believed the audio was from one of the ads they had viewed during the experiment. Two 2-s audio clips were randomly selected from each ad to construct the targets. One clip came from each half of each ad, but no clips were extracted from first or last 5 s of the ad. Forty-eight foils were selected in a similar fashion from other anti-tobacco ads not used in this study.

Emotional Response

Corrugator muscle activity was collected as a physiological indicator of negative emotional response. The corrugator muscle is located just above the eye socket on the brow. Activation of this muscle has been associated with increases in negative emotional experience (Cacioppo, Petty, Losch, & Kim, 1986; Lang, et al. 1993). Corrugator muscle activity was measured by placing 4-mm Ag/AgCl electrodes over the muscle location on participants. The raw signal was amplified at 50 kHz and filtered using 13-Hz high pass and 1,000-Hz low pass filters. Muscle activity was sampled at a rate of 20 Hz and averaged for each second of data collection. The signal was collected for a 5 s baseline prior to each ad and synchronized with ad exposure.

Stimuli

There were two steps in choosing stimuli for this study. First, 64 anti-tobacco ads were pooled from national and statewide anti-tobacco campaigns, based on the researchers’ perceived level of threat and presence/absence of disgust-related images in the messages. Messages focused on either attacking the tobacco industry or promoting benefits of avoiding tobacco were not included in this pool. Second, these 64 ads were pretested for presence of threat and disgust-related content. To help verify our selections, the presence of threat and disgust content in messages was measured in a pretest by having 22 university students rate the 64 ads on how much the content in each ad was described by the following six criteria: scary, fearful, frightening, sickening, repulsive, and gross (scale: 1–5). The first three items indexed threat content (Dillard & Anderson, 2004; Cronbach’s $\alpha = .985$); the last three items indexed disgust content (Nabi, 2002; Cronbach’s $\alpha = .960$). Participants were instructed to focus on rating the content, and not on rating how they felt. A factor analysis was conducted on the six items (PAF extraction; direct oblimin rotation). A clean 2-factor solution was confirmed (93% variance explained). According to both the pattern and structure matrices, the three threat items loaded strongly on one factor while the three disgust items loaded strongly on the other.

Based on the students’ ratings, 24 messages were selected as the stimuli for the experiment by testing the threat means vs. the disgust means. All threat-disgust significance levels were assessed via paired-samples $t$ test. Twenty-four ads, six for each of the four experimental...
conditions, were identified based on this analysis. The ads are listed in the Appendix.

Procedure

Participants (N = 49, 43 female) were nonsmoking undergraduate students enrolled in a journalism class at a large Midwestern university. The data from three participants were not analyzed due to equipment malfunction. Participants completed the experiment one at a time in a research lab. Informed consent was obtained from all participants upon entering the lab. Researchers prepped participants for the collection of physiological data. The computer program MediaLab (Jarvis, 2006) controlled the presentation of all instructions, stimulus messages, recognition task, and questionnaire items. Participants viewed the ads on a 32-in. color LCD monitor while seated in a comfortable chair that was locked in the reclining position. Participants viewed an ad, completed a self-report battery, and then repeated. Upon completing the self-report scales for the last ad, participants were given a distracter task consisting of viewing a 1 min 30 s comedy video clip in order to clear short-term memory and minimize lingering emotional responses prior to the recognition task. Participants then completed the recognition task and were debriefed, thanked, and dismissed. The entire study took approximately 45 min to complete.

Data Analysis

Heart rate and corrugator data were analyzed as change from baseline and submitted to a 2 (threat appeal) × 2 (disgust images) × 6 (ad) × 29 (time) repeated measures ANOVA. The stimulus ads were not all exactly 30 s long, thus, only 29 s of data were analyzed. Change from baseline was computed for each second of viewing an ad by subtracting each second of heart rate and corrugator activity collected during exposure to that message from the value of the last second of baseline data. Data analysis revealed that for all physiological interaction terms with time the sphericity assumption was violated, thus, Huynh-Feldt degrees of freedom adjustments were made. However, the original degrees of freedom are cited in the results to aid interpretation.

Self-reported ratings of unpleasantness and arousal were submitted to single-factor repeated measures ANOVA with repeated contrasts. Audio recognition accuracy was calculated as percentage of hits (correct recognition of a target clip). Sensitivity (A') and criterion bias (B'') were computed for signal detection analysis of the audio recognition data. All audio recognition data were submitted to a 2 (threat appeal) × 2 (disgust images) × 6 (ad) repeated measures ANOVA.

Results

Hypothesis 1

H1 predicted that there would be a serial order of unpleasantness ratings, such that low threat / low disgust would be rated the least unpleasant, high threat / low disgust would be rated next most unpleasant, low threat / high disgust would be rated third most unpleasant, and high threat / high disgust would be rated most unpleasant of all the messages. After averaging unpleasant ratings across the six messages for each condition, a single-factor repeated measures ANOVA was conducted with repeated contrasts. Repeated contrasts compare contiguous variable pairs. Overall, unpleasantness ratings varied as a function of message type, F(3, 43) = 64.87, p < .001, η²part = .82. Figure 1 shows this relationship.

The contrast for low threat / low disgust (M = 4.09, SD = 1.10) versus high threat / low disgust (M = 5.43, SD = 1.06) was significant and in the predicted direction, F(1, 45) = 55.85, p < .001, η²part = .55. The contrast for high threat / low disgust versus low threat / high disgust (M = 6.51, SD = 1.23) was significant and in the predicted direction, F(1, 45) = 37.54, p < .001, η²part = .46. Finally, the contrast for low threat / high disgust versus high threat / high disgust (M = 7.03, SD = 1.02) was also significant and in the predicted direction, F(1, 45) = 20.28, p < .001, η²part = .31. H1 was supported.

Hypothesis 2

H2 predicted that there would be a serial order of arousal ratings, such that low threat / low disgust would be rated the least arousing, high threat / low disgust would be rated next most arousing, low threat / high disgust would be rated third most arousing, and high threat / high disgust would be rated the most arousing of all the messages. After averaging arousal ratings across the six messages for each condition, a single-factor repeated measures ANOVA was conducted with repeated contrasts. Overall, arousal ratings varied as a function of message type, F(3, 45) = 37.34, p < .001, η²part = .723, and are also shown in Figure 1. The contrast for low threat / low disgust (M = 3.57, SD = 1.42) versus high threat / low disgust (M = 4.10, SD = 1.53) was significant and in

![Figure 1. Self-report unpleasantness and arousal ratings.](image-url)
the predicted direction, \( F(1, 45) = 10.88, p = .002, \eta^2_{\text{part}} = .20 \). The contrast for high threat / low disgust versus low threat / high disgust (\( M = 4.76, SD = 1.41 \)) was significant and in the predicted direction, \( F(1, 45) = 27.02, p < .001, \eta^2_{\text{part}} = .38 \). Finally, the contrast for low threat / high disgust versus high threat / high disgust (\( M = 5.06, SD = 1.45 \)) was also significant and in the predicted direction, \( F(1, 45) = 8.99, p = .004, \eta^2_{\text{part}} = .17 \). H2 was supported.

Hypothesis 3

H3 predicted a Threat \( \times \) Disgust \( \times \) Time interaction such that there would be greater cardiac deceleration across the 30 s of viewing for low threat / high disgust messages, followed by high threat / low disgust, then high threat / high disgust, with low threat / low disgust showing the least cardiac deceleration. Analysis of the heart rate data indeed found a significant Threat \( \times \) Disgust \( \times \) Time interaction, \( F(29, 756) = 5.84, p < .01, \eta^2_{\text{part}} = .18 \). Figure 2 shows that as predicted, the greatest cardiac deceleration was observed during exposure to low threat / high disgust anti-tobacco messages. Further, cardiac deceleration was greater for high threat / low disgust messages than for high threat / high disgust. Finally, messages that had low levels of both threat and disgust showed the least amount of cardiac deceleration across the time of the ad. H3 was supported.

A closer look at Figure 2 shows that for high threat messages, disgust did not lead to as much cardiac deceleration from baseline, particularly from the 19-s point and beyond. A more detailed examination of the heart rate data suggests that differences in cardiac deceleration from baseline are particularly pronounced in second 19 through second 23 of message exposure. To further examine the heart rate data, especially where heart rate for disgust messages diverged as a function of threat, additional analyses were conducted. First, high disgust messages were identified in which the onset of a disgust image appeared between the 19- and 23-s mark into the ad. Three of the high disgust messages in the high threat condition and four of the high disgust messages in the low threat condition were identified as candidates for this analysis. Beats per minute (BPM) change was computed from heart rate data calculated at the 18th second for each message. A repeated measures ANOVA was conducted on these messages between second 19 and second 24 of the ads. Specifically, we were looking for a Threat \( \times \) Time interaction, such that heart rate decelerated over time for the low threat condition but accelerated over time for the high threat condition. Sphericity was violated, but the associated adjusted degrees of freedom are presented in their nonadjusted values to aid interpretation. There was a significant Threat \( \times \) Time interaction, \( F(5, 145) = 14.47, p < .001, \eta^2_{\text{part}} = .333 \). As Figure 3 shows, heart rate for the low threat condition decelerated shortly after the onset of a disgusting image, while it accelerated shortly after onset in the high threat condition. This pattern of cardiac response suggests participants withdrew cognitive resources from encoding at the point where disgust images occurred in the high threat messages.

Hypothesis 4

H4 predicted a Threat \( \times \) Disgust interaction on audio recognition such that for high threat messages, audio from low disgust messages will be better recognized than audio from high disgust messages. For low threat messages, audio from high disgust messages will be better recognized than audio from low disgust messages. Audio recognition was analyzed for accuracy and two signal detection parameters: sensitivity and criterion bias. For audio recognition accuracy, there was a significant Threat \( \times \) Disgust interaction, \( F(1, 45) = 15.78, p < .01, \eta^2_{\text{part}} = .26 \). As displayed in Figure 4, the presence of disgust images was found to improve recognition accuracy for messages low in threat, and decrease recognition accuracy for messages high in threat. The ads with the most accurate audio recognition were those that contained a threat appeal without the presence of disgust images.

Figure 2. Heart rate by time for fear and disgust. BPM = beats per minute.

Figure 3. Heart rate for high disgust messages as a function of fear. BPM = beats per minute.

Figure 4. Audio recognition for low and high threat and disgust conditions.
Because the heart rate data suggested a dissociation of resource allocation between high and low threat messages that were high in disgust content, we conducted an analogous analysis on the recognition accuracy data. Since these were messages in which there was an onset of a disgust image after the 18th second of the ad, we analyzed the recognition trials for the second half of these same messages. Since resources appeared to be withdrawn for messages high in both threat and disgust content in the second half of messages, we should see a concomitant reduction in recognition accuracy for this message type compared with messages high in threat but low in disgust. Indeed, recognition for high threat / high disgust audio content in the second half of messages ($M = 0.78, \ SE = 0.03$) was significantly less than recognition for high threat / low disgust, $M = 0.89, \ SE = 0.02, F(1, 43) = 12.84, p = .001, \ \eta^2_{\text{part}} = .23$.

To further explore the results on recognition memory, a signal detection analysis of the data was performed (Shapiro, 1994). Sensitivity ($A'$) and criterion bias ($B''$) was computed for each of the four conditions and is displayed in Table 1. There was a significant Threat $\times$ Disgust interaction for $A'$, $F(1, 45) = 15.28, p < .001, \ \eta^2_{\text{part}} = .26$. The presence of disgust images increased recognition sensitivity for anti-tobacco ads low in threat but decreased sensitivity for messages high in threat. $A'$ was highest for high threat ads that did not contain disgust images and lowest for ads low in threat that did not present disgust images. Although messages high in threat had the highest $A'$, messages low in threat but high in disgust increased $A'$, whereas disgust decreased $A'$ for messages high in threat.

Analyses also revealed a significant Threat $\times$ Disgust interaction, $F(1, 45) = 7.83, p < .01, \ \eta^2_{\text{part}} = .15$, on criterion bias such that participants were most liberal (i.e., more willing to guess) for ads that contained a threat appeal but did not present disgust images, but they were most conservative (i.e., less willing to guess) for ads that did not contain either threat appeal or disgust images. Thus participants were both most sensitive and most confident in their responses for ads incorporating a threat appeal but without disgust images, and least sensitive and least confident in their response for ads without either message content feature. Both the $A'$ and $B''$ analyses add further support to the hypothesis that the presence of disgust related images in anti-tobacco ads improves memory for audio material when the message does not also include a threat appeal. However, threat appeal messages were better remembered when there was no disgusting image.

**Hypothesis 5**

H5 predicted a Threat $\times$ Disgust $\times$ Time interaction such that the corrugator muscle activity across time would be highest during exposure to low threat / high disgust messages, followed by high threat / high disgust, then high threat / low disgust, and finally, low threat / low disgust. Examination of corrugator activity change from baseline revealed a significant Threat $\times$ Disgust $\times$ Time interaction, $F(28, 1232) = 3.32, p = .003, \ \eta^2_{\text{part}} = .07$, which is displayed in Figure 5. While the presence of disgust related images led to stronger corrugator response for both low threat ads and high threat ads, the strongest corrugator response occurred during exposure to ads that contained high disgust but low threat. H5 was supported.

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**Table 1. Sensitivity and Criterion Bias for Audio Recognition Memory Data as a Function of Ad Fear and Disgust**

<table>
<thead>
<tr>
<th></th>
<th>Sensitivity ($A'$)</th>
<th>Criterion bias ($B''$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low fear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low disgust</td>
<td>.85 (.08)</td>
<td>.25 (.38)</td>
</tr>
<tr>
<td>High disgust</td>
<td>.88 (.08)</td>
<td>.12 (.45)</td>
</tr>
<tr>
<td>High fear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low disgust</td>
<td>.92 (.05)</td>
<td>.09 (.58)</td>
</tr>
<tr>
<td>High disgust</td>
<td>.90 (.05)</td>
<td>.04 (.55)</td>
</tr>
</tbody>
</table>

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**Figure 4.** Recognition accuracy for fear and disgust.

**Figure 5.** Corrugator activity for combinations of fear and disgust over time.
Discussion

This study was designed to inform how people process threat appeals, by investigating the cognitive and emotional impact of disgust-related images used in recent televised anti-tobacco messages. Disgust-related images represent a message feature that is capable of engaging distinct cognitive and emotional processes during exposure to threat appeal anti-tobacco ads. Significant interactions between threat appeal and disgust-related images were found on all dependent measures obtained in this experiment. These measures included online physiological indicators of cognitive and emotional processing as well as postexposure self-reported measures of emotional response and recognition.

Based on the pattern of unpleasant ratings in this study, anti-tobacco messages that present a physical threat accompanied by visual images of disgust-related images appear to engage the aversive motivational system. The highest unpleasant ratings found in this study were for ads that contained both fear appeal and disgust-related images, which were also the most arousing. Activation of the aversive motivational systems seems to have pushed viewers into the defensive cascade, which has consequences for cognitive resources allocated to encoding the anti-tobacco ads and message recognition. Increased aversive activation as a result of combining fear appeal and disgust-related images was found to lead to fewer resources allocated to encoding the message, as evidenced by cardiac acceleration. It is interesting to note that the pattern of cardiac acceleration found in the present study replicates the pattern of cardiac acceleration found by Leshner and colleagues (2009) during exposure to the same high fear / high disgust anti-tobacco messages. Cardiac acceleration was particularly pronounced in seconds 19-23 in both experiments and was found to specifically occur at the onset of disgusting images. Results obtained in both studies offer support for Lang’s (2006) proposition that aversive activation reaches a point where there is some defensive withdrawal of cognitive resources from encoding a message.

It is interesting to note how audio recognition data obtained in this experiment somewhat mirrors heart rate data, which was used to index resources allocated to encoding. As long as resources required to encode a message do not exceed resources allocated to encoding, then ads that evoke strong cardiac deceleration should also show better recognition. The presence of disgust-related images in anti-tobacco ads without a threat appeal increased cardiac deceleration and led to more accurate audio recognition relative to ads that contained neither threat appeal nor disgust-related images. On the other hand, the presence of disgust images in ads with a threat appeal led to a significant pattern of cardiac acceleration and less accurate audio recognition relative to threat appeal messages that did not include disgust-related images. It is important to note that threat appeal anti-tobacco ads were found to have better audio recognition overall than ads that did not include a threat appeal, regardless of the presence or absence of disgust images.

The corrugator results also mirrored the heart rate and recognition data, in that messages that contained both threat and disgust resulted in a dampened response compared with messages high in disgust but low in threat. That heart rate accelerated at the onset of disgust images, recognition decreased, and corrugator activity was dampened when viewing the ads that combined both threat and disgust, possibly indicates progression into the early stages of the defensive cascade – to the point of cognitive and emotional withdrawal. Together, these data strongly suggest that, when the goal is to enhance encoding of message content into memory, the combination of threat and disgust in a single anti-tobacco message is probably not a good strategy. If a televised anti-tobacco campaign is going to focus on severe health threats, then individual ads should not also present disgusting images such as diseased organs. The results of this experiment indicate that such messages may engage aversive motivational activation at a level that results in defensive responses capable of diminishing message effectiveness.

Conclusions drawn here need to be considered in light of limitations of the current study that also lead to several interesting possibilities for future research. Inferences about aversive activation in this experiment were based on self-reported unpleasantness ratings for each stimulus ad. Self-report data do not directly index motivational activation as experienced during message exposure. If indeed there is some defensive withdrawal of cognitive resources from encoding threat appeal ads that also present disgusting images, then this may also have led to a weaker corrugator muscle response relative to the ads that contained disgusting images without any threat appeal. This is highly speculative. Much more research needs to be done to directly test possible defensive responses to features of health messages and the implication for cognitive and emotional processing of ads. This also points to the need to further develop methods of measuring aversive activation evoked by media content. Self-report ratings like those obtained in this study have a degree of face validity, but the development of reliable and valid physiological indicators of motivational activation would significantly advance the capability of scholars to apply a motivated processing theoretical perspective to the study of media processes and effects.

There are important characteristics of individuals that are capable of affecting cognitive and emotional processing of anti-tobacco messages that were not investigated in this study. One such characteristic considered in previous research is sensation seeking (e.g., Donohew, Palmgreen, & Lorch, 1994). A somewhat related yet distinct individual characteristic showing a lot of promise in understanding individual differences in information processing has to do with resting levels of appetitive and aversive activation (Lang, Shin, & Lee, 2005). These characteristics may be of particular value because they vary by sex, and thus, may inform the findings of this study, since there were few male participants ($n = 6$). This study also did not include an examination of how variation in individuals’ tobacco use might influence processing of anti-tobacco messages. Messages used in this study were general prevention messages that would be relevant to young adults regardless of whether they currently use tobacco products.
However, it is possible that individuals addicted to tobacco might have stronger defensive responses to such messages that affect cognitive and emotional processing of anti-tobacco ads. Examination of these individual characteristics was beyond the goals of this study. Future research should include a systematic analysis of how individual differences lead to variations in the pattern of cognitive and emotional processing reported here.

This experiment focused on threat appeal and disgust-related images because they are common attributes in anti-tobacco messages. Certainly there are other emotional appeals that appear in such messages. Future experiments in this area should examine these additional emotional appeals that could involve evoking a wide range of feelings such as anger and guilt. Media messages produced as part of health campaigns are indeed complex emotional stimuli. Scientific understanding of cognitive and emotional processes engaged by such complex media content will require researchers to systematically parse specific elements of message content and then observe patterns of emotional and cognitive processing as a result of message exposure. It is hoped that the present study has taken a step in that direction.

References


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## Appendix

### Anti-Tobacco PSAs Used in the Study

<table>
<thead>
<tr>
<th>High fear / high disgust</th>
<th>High fear / low disgust</th>
</tr>
</thead>
<tbody>
<tr>
<td>– Pam Difference</td>
<td>– Airplane</td>
</tr>
<tr>
<td>– Pam Can’t Breathe</td>
<td>– Breath</td>
</tr>
<tr>
<td>– Eye</td>
<td>– Counter</td>
</tr>
<tr>
<td>– Surgery</td>
<td>– London Suffering</td>
</tr>
<tr>
<td>– Debi – Addiction</td>
<td>– Christy Turlington</td>
</tr>
<tr>
<td>– Bowl Cleaner</td>
<td>– Grapes</td>
</tr>
<tr>
<td>Low fear / high disgust</td>
<td>Low fear / low disgust</td>
</tr>
<tr>
<td>– Artery</td>
<td>– Carrot</td>
</tr>
<tr>
<td>– Tar Lung</td>
<td>– Face</td>
</tr>
<tr>
<td>– Smelly, Puking Habit –</td>
<td>– Real Stories – Gloucester</td>
</tr>
<tr>
<td>Theatre Snacks</td>
<td>– Urinal</td>
</tr>
<tr>
<td>– Bucking Bronco</td>
<td>– Rappers</td>
</tr>
<tr>
<td>– Grasshopper</td>
<td>– “Que Sera Sera”</td>
</tr>
<tr>
<td>– Addicted Ashtray</td>
<td></td>
</tr>
</tbody>
</table>

*Note. PSA = Public Service Announcement.*