Lee, S. & **Potter, R.F.** (in press). The impact of emotional words on listeners' cognitive and emotional responses in the context of advertising. *Communication Research*.

The impact of emotional words on listeners' emotional and cognitive responses in the context of advertisements

Abstract

The study examined how individual words occurring in mediated messages impact listeners' emotional and cognitive responses. Scripts from actual radio advertisements were altered by replacing original words with target words that varied in valence—either positive, negative, or neutral. The scripts were then reproduced by non-professional speakers. Real-time processing of the target words was examined through the use of psychophysiological measures of dynamic emotional and cognitive responses collected from subjects (n=55) and time-locked to the stimuli. Recognition memory provided a measure of encoding efficiency. As predicted listeners had greater frown muscle responses following the onset of negatively valenced words compared to positively valenced words. Results also showed that positively valenced words elicited orienting responses in listeners but negatively valenced words did not. Recognition data show that positively valenced words were encoded better than neutrally valenced words, followed by negatively valenced words, which was consistent with the finding for the impact of emotional words on orienting responses.

Keywords: emotional words, orienting response, valence, memory, audio processing

The impact of emotional words on listeners' emotional and cognitive responses in the context of advertisements

Emotion is innate, universal, and crucial to the quality and variety of human experience (Dolan, 2002). Therefore, it is not surprising that most mass-appeal mediated messages contain emotional content (Schwab & Schwender, 2011) and perhaps equally expected is the fact that many studies demonstrate the ability of such content to trigger emotional responses in an audience (Bolls, Lang, & Potter, 2001; A. Lang, Newhagen, & Reeves, 1996; Potter, LaTour, Braun-LaTour, & Reichert, 2006). Furthermore, substantial evidence supports the idea that emotional content influences the cognitive responses of the audience, such as the amount of cognitive resources allocated to message processing (A. Lang, Park, Sanders-Jackson, Wilson, & Wang, 2007; Leshner, Bolls, & Wise, 2011), the level of scrutiny given to message arguments (DeSteno, Petty, Rucker, Wegener, & Braverman, 2004; Wegener, Petty, & Smith, 1995), and the subsequent storage of message content into long-term memory networks (A. Lang et al., 1996). However, in much of this research the levels of valence variables have been operationalized globally—that is, that which social scientists varied was the summative emotional tone of the message. We are aware of no research that has explored the cognitive processing and emotional response to changes in content valence at a much more local level in media messages—namely, using individual spoken words as the level of analysis.

Words are important components of mediated messages, with writers taking pride in their craft by carefully selecting "just the right word," according to message type and target audience in order to maximize information delivery, emotional response, and persuasion (Shaw, 2012; Sugarman, 2007). Research has shown that the careful choice of words to speak to particular audiences impacts how individuals describe their perceptions of the messages (Rovinelli &

Whissell, 1998; Whissell, 1998; Whissell & McCall, 1997). However, little research has been done to better understand the *actual processing* of media messages at the level of the individual word. As communication theories move increasingly toward conceptualizing interactions between messages, audiences, and the environments in which they exist as dynamic and complex systems (Lee & Lang, 2015; Weber, Tamborini, Westcott-Baker, & Kantor, 2009), a more precise understanding of rapid changes in processing becomes increasingly important. That is why research such as this, focusing on the cognitive and emotional processing of one of the primary semantic building blocks in auditory communication—the single word—is worthwhile. Plus, empirical evidence showing that individual words have impact on attention, emotional response, and/or subsequent memory for persuasive messages would support the argument that writing professionals need the time to craft messages at such a fine level of detail. However, if such data cannot be found then an argument could be made that such a level of fine-tuning is unnecessary since it is the *global* valence of persuasive messages that carries the most weight in message design.

Therefore, this study was designed as a starting point for collecting evidence to better understand the rapid and dynamic cognitive and emotional changes that occur during the processing of single words in auditory messages. It was also designed, however, to strike a balance between ecological validity and experimental control in the creation of the experimental stimuli. Pursuit of the former started with the transcription of actual radio commercials as base scripts for the stimulus messages. Using actual advertisements allowed individual target words of varying valence to occur within an overall context similar to that experienced in everyday mediated interactions. Furthermore, these starting scripts were selected such that they varied systematically in global valence based on pre-test measures. Half of the messages were rated as neutral in global valence and the other half were rated as more globally positive. This allowed the current study to compliment the comparatively large literature exploring the impact of global emotional valence on processing, while expanding the question to add analyses of the immediate, bottom-up processing of the onset of individual words. Furthermore, by varying both the target words and the global context in which they occur, this experimental design explored the interactions between the more automatic processing of the individual word onset and the top-down influence of global positive or neutral emotional tone.

Internal validity concerns were addressed when making the final stimuli by having the selected scripts with the altered target words read by non-professional announcers. This limited the impact of “tools of the trade” employed by voiceover professional such as changes in pitch or the use of vocal prosody (Rodero, Potter, & Prieto, 2017; Potter, Jamison-Koenig, Lynch, & Sites, in press). Furthermore, by having the final stimuli consist of only the spoken word, all messages were devoid of auditory structural features shown to impact cognitive response (i.e., voice change, special effect, background music, see Potter, 2000; Potter & Choi, 2006; Potter, Lang, & Bolls, 2008).

Motivational System Activation by Single Words

Hypotheses were derived according to the framework provided by the Limited Capacity Model of Motivated Mediated Message Processing (LC4MP: A. Lang, 2006a; A. Lang, 2006b). Within this framework human beings are described as biological agents with two independent motivational systems—approach/appetitive and avoidance/defensive (Cacioppo & Berntson, 1994; A. Lang, 2006a, 2006b)). These systems evolved to promote (via the appetitive system) and protect (via the defensive system) the species, and act automatically and independently to modulate emotion, cognition, and behavior.

The various activation levels of the appetitive and defensive systems influence the individual's experience of emotion: positive feelings stem from the activation of the appetitive system and negative feelings stem from the activation of the defensive system. Mediated stimuli have been found to activate the underlying motivational systems like any real stimuli in a physical environment —positive mediated stimuli activate the appetitive system and negative mediated stimuli activate the defensive system (Reeves & Nass, 1996). A wide range of mediated stimuli such as images, sounds, printed text, movies, video games, and Web-based media has been shown to activate motivational systems in audiences such that emotional responses, measured by self-reports and physiological responses, are generally congruent with the valence and activating potential of the mediated stimuli (A. Lang et al., 2007; A. Lang & Yegiyan, 2011; Lee & Lang, 2009; Wang, Lang, & Busemeyer, 2011; Wise, Eckler, Kononova, & Littau, 2009; Yegiyan & Lang, 2010).

If we view persuasive message processing as a dynamic interaction between (among other things) the listener's two independent motivation systems and the ongoing stream of semantic meaning resulting from the enunciation of each word in the message, then this study's most general hypothesis is that positive words will activate the appetitive system and negative words will activate the defensive system. More specifically, it is predicted that the motivational system activation will be evident in measures of physiological systems shown to correlate with each. For example, emotional reaction to sensory stimuli is reflected in facial muscle activity as shown by facial electromyography (EMG: Potter & Bolls, 2012). Facial EMG measures have been extensively used to identify the degree to which an emotional response is positive or negative in a real-time basis (Bolls et al., 2001; Cacioppo, Petty, Losch, & Kim, 1986; Hazlett & Hazlett, 1999; Larsen, Norris, & Cacioppo, 2003). For instance, facial EMGs were employed by

Hazlett and Hazlett (1999) as an indicator of viewers' emotional responses to television advertisements compared to self-reported emotional experience. As predicted, participants' smile muscle (zygomatic) responses increased during positive ads and frown muscle (corrugator) responses increased during negative ads. In fact, facial EMGs were able to more effectively discriminate emotional responses to specific ads than self-reported measures. Similar findings have been published using audio messages. Bolls et al. (2001) assessed the validity of using facial EMGs in response to radio ads of different valence in their global emotional tone. The results were in line with the predictions: greater zygomatic responses were elicited across the duration of the entire 30s ads when their global emotional tones were positive than when they were negative. Similarly, across the full 30s duration the corrugator response to negative ads increased sharply, while declining slightly during globally positive ads.

For the current study, however, it is important to establish that facial EMG measures can capture brief changes in automatic physiological emotional responses, not merely those measured more globally. Hietanen, Surakka, and Linnankoski (1998) showed increased corrugator responses to brief vocal expressions (as rapid as 400ms) of anger but not during brief vocal expressions of contentment. Facial EMG was also used to capture participants' physiological emotional responses toward emotion-evoking spoken words by Wexler and colleagues (1992) who employed three types of dichotic stimulus pairs including a positive/neutral word pair, a negative/neutral word pair, and a neutral/neutral word pair and then compared if responses captured in facial EMG responses differed when the stimuli were heard either consciously or unconsciously. The results showed that even unconscious processing of the valence change across single word pairs led to changes in corrugator and zygomatic responses in the predicted direction.

Findings such as these suggest that the local-level valence of individual emotional words in radio ads will affect facial EMG measures. Since each emotional target word in the current stimulus messages is roughly 250ms in duration, and is instantly followed by string of words that make up the content of the ongoing mediated message as a whole, the window in which we expect this effect to be detectable is quite narrow. Therefore, the following hypotheses are predicted:

H1: Listeners will have greater corrugator responses in the 500ms following the onset of negative target words compared to positive target words.

H2: Listeners will have greater zygomatic responses in the 500ms following the onset of positive target words compared to negative target words.

Interaction Between Global and Local Valence in Motivational System Activation

In general, the ultimate goal of persuasive mediated messages is to generate an intended behavior in the audience: getting them to quit smoking, or to not drive drunk, or to vote for a candidate, donate to a charity, or buy a product (Petty, Briñol, & Priester, 2009; Shevy & Hung, 2013). To help induce this behavioral change, many advertisements use a creative strategy employing content and structural features which evoke positive emotional experiences. For instance, over 80 percent of TV ads in the United States contain music (Allan, 2008; Furnham, Abramsky, & Gunter, 1997), a structural message component that is expected to lead to a positive attitude about the advertisement (Stout & Leckenby, 1988). These creative strategies are based on findings showing positive emotion leads to more positive attitudes toward the ads, which ultimately lead to positive brand attitudes and greater purchase intent (Holbrook & Batra, 1987; Morris & Boone, 1998; Ray & Batra, 1983; Rossiter & Percy, 1991; Rovinelli & Whissell, 1998).

However, the extent to which creative scenarios in persuasive messages result in top-down states of positivity varies. In the current study, this variance allowed investigation of interactions between the localized change in valence due to the onset of individual target words and the global valence of the message. Pre-test valence ratings of the starting scripts, prior to insertion of the valenced target words, were collected and the scripts divided into two groups: one of ads neutral in global tone and the other of ads that were more positive globally.

A component of the LC4MP is a phenomenon known as the *positivity offset,* the fact that in relatively non-threatening situations the appetitive/approach motivation system is more active than the aversive/avoid system (Lang, 2006a; Cacioppo et al., 2000). It was predicted that while the ads written with a neutral global tone would result in a slight activation of the appetitive system in participants—due to the positivity offset—they would be in a greater state of approach when listening to the globally positive ads. In other words, it could be expected that greater physiological indicators of appetitive system activation (increased zygomatic muscle group activation and decreased corrugator muscle group activation) would be present when target words occurred during globally positive messages compared to globally neutral ones. If this were the case, then there would be a top-down/bottom-up mismatch when negative target words occurred in any of the messages, but this mismatch would be even greater during globally positive messages compared to globally neutral ones. Conversely, during a globally positive ad the occurrence of a positive target word would lead to an intensified activation of the appetitive motivational system; whereas the occurrence of a negative word would trigger the activation of the aversive system and a diminishment of appetitive system activation. Previous research (Potter et al., 2006) has demonstrated such EMG responses to valence mismatches across a 30s time frame. Combining these with the aforementioned evidence that EMG is sensitive to rapid changes such as the onset of individual words, the following hypotheses are proposed:

H3: Listeners will have greater corrugator responses in the 500ms following the onset of negative target words in globally neutral messages compared to those in positive messages.

H4: Listeners will have greater zygomatic responses in the 500ms following the onset of positive target words in globally positive messages compared to those in neutral messages.

Motivational System Activation and Cognitive Resource Allocation

Individual audience members are cognitive processors with a limited number of resources available to allocate for the processing of mediated messages (Lang, 2006a). The allocation of much of the available cognitive resources at any one time is the result of controlled processes—those driven by the interests, goals, and desires of the individual. Nevertheless, some cognitive resource allocation occurs independent of the individual's conscious control. Information that is novel in structure or content (e.g., cuts, edits, sound effects, voice changes) elicits automatic resource allocation to encoding in the form of the orienting response (OR). Similarly, information that is particularly emotional activates one or both motivational systems and thereby also elicits automatic allocation of cognitive resources to processing the environment. This study conceptualized the emotional target words as motivationally relevant stimuli and predicted that the presentation of individual emotional words would elicit automatic resource allocation to encoding them.

Numerous studies have reported that emotional words are remembered better than neutral ones (e.g., Colombel, 2000; Doerksen & Shimamura, 2001; Kensinger, Brierley, Medford, Growdon, & Corkin, 2002; LaBar & Phelps, 1998; Phelps, LaBar, & Spencer, 1997; Rubin & Friendly, 1986). Furthermore, the presentation of emotional words enhanced episodic memory of past events compared to non-emotional words (Christianson & Safer, 1996; Doerksen & Shimamura, 2001). Previous studies employing event-related brain potentials (ERPs) demonstrate automatic preferential processing for emotional words (Herbert, Junghofer, & Kissler, 2008; Kissler, Herbert, Peyk, & Junghofer, 2007; Kissler, Herbert, Winkler, & Junghofer, 2009; Schacht & Sommer, 2009). For instance, in experiments where participants silently read word sequences that varied in their emotional valence, ERPs initially deflected negatively around 200-300ms after onset. This N200 is well regarded as an indication of cognitive processing of general meaning. However, negative deflection has been shown to be even greater for positive and negative words compared to neutral ones, even when the participants were not explicitly instructed to attend to any specific word more than to others (Herbert et al., 2008; Kissler et al., 2007). Such enhanced early posterior negativity has been suggested to reflect preferential processing to emotional stimuli—seemingly effortless, if not completely automatic, selective processing of emotionally significant words (Kissler et al., 2009).

This N200 has been identified as one of the physiological markers of the OR, which is a hard-wired automatic allocation of cognitive resources toward encoding environmental novelty or symbols with learned associations to appetitive or aversive situations (A. Lang, 2000, 2006a; Öhman, 1979; Sokolov, 1963). Another physiological marker of the OR is cardiac deceleration in either a cubic or quadratic trend in the first few heartbeats following onset (Potter & Bolls, 2012). Lang and colleagues found participants' cardiac deceleration in response to camera changes in video regardless of the similarity in content across the different camera shots (A.

Lang, 1990; A. Lang, Geiger, Strickwerda, & Summer, 1993; Thorson & Lang, 1992). The onset of visual novelty in Web sites also results in phasic cardiac reactions (Diao & Sundar, 2004; Wise, Kim, & Kim, 2009) although the finding seems to be much less robust. Further, there is strong evidence that cardiac orienting responses are elicited during participants' exposure to emotional mediated content, however much of that has been conducted using visual stimuli. Emotional still images, for example, have been shown to cause greater cardiac deceleration, particularly for negative images compared to positive. However, cardiac deceleration was greatest for arousing images, compared to calm ones, regardless of valence (P. J. Lang, Bradley, & Cuthbert, 1997). Lang, Chung, Lee, & Zhao (2005) found greater cardiac deceleration following the onset of textual representations of individual words on a computer screen when the words were highly emotional and taboo products (e.g., *tobacco*) than non-emotional products matched for word length and category (e.g., *chalk*).

Potter et al., (2008) established a list of auditory structural features that demonstrate cardiac orienting, reporting indications of automatic resource allocation following the onset of music, production effects, sound effects, funny voices, and a word associated with sex. These auditory features were also found to increase recognition memory for the information presented after their onset compared to information presented immediately before.

Based on the LC4MP and these previous findings, this study predicted that emotional target words would elicit cardiac orienting responses by activating their respective motivational systems.

H5: Compared to the onset of neutral target words, listeners will exhibit cardiac orienting responses following the onset of positive and negative target words and have greater recognition memory for them.

As mentioned, the global valence of a messages provides a top-down context in which individual words are processed. Cognitive processing of words differs when they are processed in isolation, in a syntactic structure, or in a coherent narrative, since each of these contexts supports a different level of top-down semantic representation (Xu, Kemeny, Park, Frattali, & Braun, 2005). ERP data shows the amplitude of the N400 is reduced following the onset of words that are semantically congruent with the global discourse compared to these that are semantically incongruent (for review, see Brown & Hagoort, 2000). This is also found in behavioral data in studies like Foss and Speer (1991) who had participants listen to a set of narratives in which the levels of semantic relatedness of local (preceding words) and global (topic of discourse) contexts to target words were manipulated and showed that participants responded faster to target words when they occurred within a related global context regardless of the level of their sematic relatedness to the local context.

Thus, this study hypothesized that processing of the individual target words would be influenced by the context associated with the global emotional valence of the ads. Emotionality signals the audience the significance of stimuli, thus orienting to emotional words can be found in both a congruency condition (i.e., positive words in positive ads and neural words in neutral ads) and a contrast condition (negative words in positive ads). However, we are unaware of any studies that particularly tested these global/local effects using persuasive messages such as radio ads as stimuli. Therefore, the following research question was asked:

RQ1: How do the valence of individual target words and the global valence of the ad interact to affect cardiac orienting response and recognition?

Methods

Experimental Design

This study employed a 3 (Target Word Valence) × 2 (Word Valence Repetition) × 2 (Global Message Valence) × 8 (Message Repetition) × 4 (Order of Presentation) mixed factorial design experiment. *Order of Presentation* was the only between subjects factor, with four levels representing the systematic orders of message presentation to which subjects were randomly assigned. The rest of the factors were within subjects. *Target Word Valence*, conceptually defined as the relative positivity or negativity of the stimulus target word, had three levels: positive, negative, and neutral. *Word Valence Repetition* had two levels representing the two target words that occurred for each of the three different valence levels within a single message. *Global Message Valence,* conceptually defined as the global emotional tone of the stimulus message in which the target words appeared, had two levels, positive and neutral. *Message Repetition* had eight levels representing the eight messages within each of the two different levels of Global message valence.

Stimuli

This study used sixteen, 60-second radio advertisements specifically created as experimental stimuli. To choose these final stimuli, forty ads were initially selected from a set of approximately 400 ads obtained on CD or recorded off air. Selection was based on the criteria of being approximately sixty seconds in duration, voiced by a single announcer, and featuring brands and products of interest to the eventual study participants (e.g. frozen pizza, office supplies, greeting cards). The verbal contents of these ads were transcribed and the scripts rated by two male and two female research assistants blind to the study hypotheses using the 9-point Self Assessment Manikin (SAM) arousal and valence scales (SAM: Bradley, Greenwald, Petry,

& Lang, 1992). The final sixteen starting scripts were selected to best match product categories and topical themes across levels of global message valence such that the results of repeated measures ANOVAs on pre-test ratings were significantly different in global valence ($M_{positive}$=6.69, sd= .21 $M_{neutral}$=5.03, sd = .28; $F(1, 3) = 18.69$, $p < .05$, $\varepsilon^2 =.86$) but not in arousal ($M_{positive}$=4.88, sd= 1.32, $M_{neutral}$=4.16, sd= .70 ; $F(1, 3) = 1.94$, $p = .258$, $\varepsilon^2 =.39$).

After selecting the 16 ad scripts, target words were placed into each: two positive (e.g., *perfection* or *adorable*), two negative (e.g., *painful* or *miserably*) and two neutrally valenced (e.g., *truck* or *reserved*). The words were chosen based on the normative valence and arousal ratings of Affective Norms for English Words database (ANEW: Bradley & Lang, 1999). Twenty-three of the words appeared in the original scripts. The remaining were selected from the ANEW data base and used to replace words that originally appeared in the scripts or inserted into the scripts in locations deemed complimentary to the general purpose of the particular advertisement. The target words and the reported normed means for self-reported valence and arousal from the ANEW are reported in Tables 1-3. ANOVA shows significant main effects for valence, $F(5,95) = 266.05$, *p.* < .001. Bonferroni post-hoc analyses show significant differences for normed values for valence across all differing combinations of Global Message Valence and Word Valence, but no differences when compared within a single level of Word Valence across levels of Global Message Valence. For example, Positive Words in Positive Messages had significantly more positive valence ratings than all other combinations except Positive Words in Neutral Messages, which were not statistically significant in their ratings. Similarly, there were significant main effects for arousal, $F(5,95) = 52.06$, *p.* < .001. Post-hoc analyses show neutral words in both messages were significantly less arousing than all other combinations, with no other significant comparisons.

To prevent target words from occurring next to each other, at least a 5-to 6-second interval was required between each target word. Finally, the ad scripts were recorded by native English speakers (8 males and 8 females) who were not professional voice announcers. In the end, sixteen messages were produced: eight positive calm global valence and eight neutral calm global valence messages—each with different target words (2 positive, 2 negative, and 2 neutral) in each. Sample globally neutral and globally positive scripts, with their adjusted target words, are available in Appendix 1, and the entire set of scripts is available from either author.

Dependent Variables

Phasic Emotional Response. Facial EMG was used to operationalize the valence response to target emotional words. Participants' corrugator activity provided an index of negative emotional response and zygomatic activity indexed positive emotional response (Potter & Bolls, 2012). A sampling rate of 20 times per second was used for the collection of EMG data. Based on the brief duration of each target word, and the expectation that ongoing processing of each subsequent word would impact the EMG muscle response, peak amplitude EMG activity was aggregated per quarter second (250ms). For the EMG data analyses, change scores were computed by subtracting a data point from the pre-onset baseline.

Cognitive Resource Allocation. Cardiac response was used to test for the hypothesized increase in cognitive resource allocation following the onset of target emotional words in the audio stimuli. The cardiac response was operationalized using the interbeat interval (IBI) recorded in milliseconds. The orienting response was identified as either a monophasic or biphasic cardiac response curve pattern in the IBIs of the four heart beats following the onset of each target emotional word (Potter & Bolls, 2012).

Encoding. Audio recognition was used to operationalize the encoding of the emotional target words. In the recognition task, participants heard target and foil words randomly presented and indicated in a forced yes/no task if they remembered hearing them in the stimuli ads. Foil words were selected to match targets according to grammatical form and ANEW ratings for both valence and arousal. A total of 96 targets (6 targets x 16 messages) and 96 foils were recorded by the same native English speakers who recorded the stimuli messages. Foils were included merely to provide variance in the memory task. Subsequently, because hypothesis 5 did not make claims about changes in sensitivity or criterion bias, the proportion of correct responses to target words was calculated as the operationalization of encoding.

Experimental Procedure

Fifty-five subjects (24 female; M_{age} = 20.65) recruited from undergraduate media courses at a Midwestern university completed the experiment for course credit. Each provided informed consent prior to participating individually in a research lab. All participants were told that the study was interested in their evaluation and cognitive response to radio advertisements. They were asked to pay a full attention to the messages.

In order to prepare the skin surface for physiological data collection, the participant's palm was lightly hydrated with distilled water and the forearms and facial areas cleaned and gently abraded with a cotton pad saturated with rubbing alcohol and pumice. A total of nine electrodes were placed on the subject: two on the non-dominant hand to collect skin conductance, three on the forearms to collect heart rate, two on the cheek for zygomatic response and two above the eyebrow for corrugator response.

After electrode preparation, the study protocol was explained to the participant and a sample radio ad presented to help them acclimate to the procedure. Participant questions were addressed prior to any experimental stimuli being played. All messages were presented via MediaLab software (Jarvis, 2004) through Sony MDR-V150 over-ear headphones. Physiology data were collected with Coulbourn bioamplifiers and a Coulbourn skin conductance coupler. Data were sampled via a Labmaster AD/DA board controlled by VPM data acquisition software (Cook, 2000). After each message the participant provided self-reported valence and arousal ratings using the 9-point SAM scale (Bradley et al., 1992) presented on a 17-inch flat screen computer display. Following the presentation of the experimental stimuli, each participant watched a 5-minute excerpt from a nature documentary as a distraction task and then completed the audio recognition protocol. Each data collection session lasted approximately 75 minutes.

Statistical Design

The dynamic nature of the stimuli used in this experiment meant that target words were followed immediately in the auditory stream by non-target words, each having an impact on the psychophysiological measures being collected (Cacioppo, Tassinary, & Berntson, 2000; Potter & Bolls, 2012). For that reason, the appropriate time window in which to expect to see the impact of the expected small effects of the Target Word Valence factor was very short. The measurement of the four IBIs following the onset of target words meant that the statistical model for the hypotheses about cardiac orienting was a 3 (Target Word Valence) × 2 (Word Valence Repetition) × 2 (Global Message Valence) × IBI (4) × 4 (Order of presentation) repeated measures ANOVA.

The rapid response activation of the facial muscles meant that subsequent words following target words would be expected to rapidly impact the zygomatic and corrugator results. Therefore, data from a 500ms window was used to test the EMG hypotheses; with the peak amplitude EMG data aggregated every 250ms. Using the zero value of the word onset point in the statistical model then allowed for a 3 (Target Word Valence) × 2 (Global Message Valence) × 3 (Time) x 4 (Order of Presentation) repeated-measures ANOVA to be performed. Degrees of freedom for all analyses were adjusted using the Greenhouse-Geisser correction to account for the violation of the assumption of sphericity that is commonplace in psychophysiological data. The critical value of p was .05.

Results

Manipulation Check

In order to address the hypotheses concerning interactions between bottom-up responses to the onsets of target words occurring within messages varying in global valence, it was necessary to ensure that participants reported differences in their experienced top-down emotional states as a result of the two levels of Global Message Valence. Repeated measures ANOVAs on the self-reported SAM valence scores collected following each message returned statistically significant results, $F(1, 54) = 76.45$, $p < .001$, $\varepsilon^2 = .59$. In line with the pretest ratings of the written scripts, stimuli in the positive level of Global Message Valence (M = 5.90, sd = .98) were rated more positively than those in the neutral level of the factor (M = 4.89, sd = .98). The experimental participants also found the positive messages more arousing (M = 4.38, sd = 1.32) than the negative messages (M = 3.72, sd = 1.30), and this difference was statistically significant, $F(1, 54) = 38.26$, $p < .001$, $\varepsilon^2 = .42$.

Phasic Valence Responses to Emotional Words

Hypothesis 1 predicted that participants would have greater corrugator responses following the onset of negative target words compared to positive target words. The main effect of Target Word Valence on corrugator response was significant (F (2, 102) = 6.08, $p = .003$, $\varepsilon^2 = .11$). The change in corrugator responses elicited by emotional words was highest for negative (M = .012, SD = .05), followed by neutral (M =.001, SD=.03) and positive words (M = -.006, SD

= .05). The interaction effect of Target Word Valence by Time on corrugator activity was also significant (F (4, 204) = 4.26, p = .002, ε^2 =.08) and is shown in Figure 1.

-- Figure 1 here --

Hypothesis 2 predicted that participants would have greater zygomatic responses following the onset of positive target words compared to negative target words. The main effect of Target Word Valence on zygomatic response was significant (F (2, 110) = 3.07, p = .05, ε^2 =.05). The change in zygomatic responses elicited by emotional words was highest for positive words (M = .003, SD = .035), followed by negative (M =-.001, SD=.034) and positive words (M = -.007, SD = .04). And the interaction effect of Target Word Valence x Time on the peak amplitude of zygomatic responses per quarter second approached signficance (F (4, 216) = 2.29, p = .06, ε^2 =.03). The patterns of mean score over time indicated that zygomatic responses over time was highest for positive words as predicted, but followed by negative words, and then, neutral words, which was lowest. Thus, hypothesis 2 was not supported.

The interaction between Target Word Valence, Global Message Valence, and Time on EMG activation was not significant. Hypotheses 3 and 4 were therefore, not supported.

Cognitive Resource Allocation to Emotional Words

This study argued that both emotionality of individual words and the global context (i.e., advertisements) can influence resource allocation to processing the words in radio ads. Hypothesis 5 predicted that the onset of target words that were either positive or negative would lead to a momentary increase in attentional cognitive resource allocation through motivational system activation while the onset of a neutrally valenced target words would not. Furthermore, it was hypothesized that the brief but automatic increase in resource allocation to encoding would lead to greater recognition for positive and negative target words compared to neutral target words.

When using heart time to identify the presence of an orienting response, IBI scores are expected to increase indicating overall deceleration of the heart rate in real time. The main effect of Target Word Valence on IBI was significant, F (2, 94) = 6.85, p = .002, ε^2 = .13, as was the interaction of Target Word Valence x Time (F (6, 282) = 2.36, p = .031, ε^2 = .05). This interaction is shown in Figure 2.

-- Figure 2 here --

To confirm the occurrence of an orienting response, each individual cardiac response curve (CRC) was submitted to a trend analysis (Graham & Clifton, 1966; Graham, 1979). As predicted, there was a significant cubic trend in the CRC following positive target word onsets (F (1, 50) = 10.17, p = .002) indicative of an orienting response to onset. However neither negative nor neutral target words produced significant trends. The main effect of Target Word Valence on correct recognition for target words was significant (F (2, 108) = 55.31, p < .001, ε^2 = .50). Positive target words had the best recognition (M = .68, SD =.16) followed by neutral words (M = .56, SD =.14). Negative target words had the lowest recognition score (M = .50, SD = .15). Therefore, Hypothesis 3 is partially confirmed in that participants have cardiac orienting responses to the onset of positive target words, but not negative, and this is also reflected in better recognition memory for positive target words.

It was possible that the partial disconfirmation of Hypothesis 3 was due to a significant interaction between the Global Message Valence and the Target Word Valence. Research Question 1 explored this, and was addressed by testing the 3-way interaction analysis between these two factors and IBI. Results were significant, F (6, 282) = 2.36, p = .031, ε^2 = .05, and are shown in Figure 3. Trend analyses of the cardiac response curves for all valenced target word onsets were performed separately for each level of message valence. There were significant trends indicative of the orienting response for onsets of positive words in both neutral messages, F_{cubic} (1, 50) = 8.70, p = .005 and positive messages, F_{cubic} (1, 50) = 5.18, p = .027. The quadratic trend in the CRC following neutral word onsets in positive messages approached significance, $F_{quadratic}$ (1, 50) = 3.72, p = .059, however the trend was in the opposite direction of that required by an orienting response. Negative target words had no effect when occurring in globally neutral messages, and only a linearly accelerating effect on heart rate in messages of positive global valence.

--Figure 3 here--

The interaction of Target Word Valence and Global Message Valence was significant (F (2, 108) = 25.19, p < .001, ε^2 = .31). As can be seen in Figure 4, positive target words occurring during messages of positive global valence resulted in the best subsequent recognition. This was followed by positive or neutral target words in globally neutral messages. The poorest recognition memory, with scores only slightly above chance levels, was when the target word was negative regardless of global message valence.

--Figure 4 here--

Discussion

Communication researchers are increasingly recognizing that interactions between messages and human beings are quite dynamic in nature. At any one moment of a human/message interaction, the human cognitive system is processing the physical environment in which it is occurring, the multiple inputs arriving from different internal systems working to establish hemodynamic balance, and the particular elements of the message driving automatic and controlled allocation of cognitive resources. Yet, much of our literature still focuses on how global changes in message independent variables can lead to an overall summative effect in audiences. For example, in the domain of audio messages—the area of focus for this manuscript—the presence or absence of inducements to use mental imagery (Bolls, 2002; Bolls & Lang, 2003), variance in the vocal pacing of the speaker (Rodero, 2016), and the presence or absence of auditory complexity (Potter & Choi, 2006) have all been shown to impact dependent variables measured after message exposure or physiological indices recorded and analyzed across the entire message. The goal of the current experiment was to move closer to understanding the dynamic nature of the communication process by seeing whether controlled and systematic changes in individual words used to construct an overall audio message would result in measurable local effects.

Our results suggest that such a localized impact does occur on both the emotional and cognitive response systems. Using corrugator (frown) muscle activity as a physiological index of emotional response, data supported our prediction that negative target words such as *headache* and *suspicious* resulted in significantly increased corrugator activation compared to the response to neutral words (*curtain, lazy)* and positive words (*dancer*, *triumphant*). In fact, as predicted, the frown muscle activation decreased immediately—within a 500 *ms* window—following the onset of positive words. This motivational system response to the onset of valenced semantic content also had a significant impact on the extent to which cognitive resources were dynamically allocated to message processing at the very local level. Using average interbeat intervals (IBIs) in heart rate for the first four beats following word onset, our results show that positive words resulted in orienting responses indicative of automatic allocation of cognitive resources to message encoding. No such orienting response pattern were demonstrated for neutral words or negative words when collapsed across the overall global tone of the message. Statistically significant interactions in the IBI patterns across the overall emotional tone of the message, however, suggest that the dynamic interaction at the local level is dependent upon overall context. When the global valence tone of the message was neutral—in other words, when humor or positive affect was not a central creative strategy in the message—the listener's automatic cognitive response only occurred following the onset of positive words with little IBI variance at all in response to neutral or negative words. When the overall tone of the message was positive, however, the onset of words that ran counter to that global valence elicited cardiac acceleration indicative of cognitive withdrawal. This cardiac acceleration was found in a stepwise manner, with only slightly increases in heart rate (demonstrated by lower IBIs) for the first two heart beats following the onset of netural words but dramatic but increasing cardiac acceleration for all four beats subsequent to the onset of strongly negative words in the midst of a positive message.

Interpreting the corrugator and IBI data as a combined psychophysiological response pattern (Cacioppo et at. ,2000), it is possible that the emotional nature of the negative words is processed whenever they occur—indicated in the EMG main effect without an interaction across global tone—but that when emotional mismatch exists between the positive global message tone and the negative or neutral word onsets, the cognitive system attempts to gate out the processing resources in the very short term as a way of reacting to the dissonance. Memory data supports this conclusion, with percent correct recognition of audio probe targets was significantly dampened when there was this emotional mismatch—that is, when testing for negative or neutral target words that occurred within globally positive messages.

Although replication and extension of this initial investigation into the question is warranted, the current results suggest a few practical applications. First, the data so seem to indicate that individual words matter—they have a demonstrable impact on the dynamic interaction that takes place between a listener and a message. Advertising copywriters do need to be encouraged to search for just the right word, or at least ones that match the emotional tone of the message being created. Because we used the ANEW database as our corpus for word selection, it seems that an easily implicated recommendation would be to attempt to widely circulate this list of over 1000 words—and their corresponding normed for self-reported valence, dominance, and arousal—to audio producers and educate them about how they may be able to guide creative decision making. Educational opportunities would also seem possible within media departments or schools at universities where quantitative researchers and creative producers often are colleagues united in the goal of creating liberally-educated future communicators trained to be as effective as possible.

The current results would also suggest that a creative strategy of creating emotional dissonance by introducing negative words in positive, or even neutral, messages—perhaps with the intention of startling listeners into increasing attention to processing—may actually backfire. Physiological indices of attention and emotion, along with subsequent recall memory measures, all point to positive words being used in advertising, with the biggest effect in our data being seen when strongly positive words were used in overall positive messages.

Limitations and Possible Future Directions

In designing this study, tough decisions needed to be made which resulted in unavoidable limitations. Most of these focused on the fact that this study provided a first exploration into the very immediate impact of individual words in radio messages on cognition and emotional response. One such limitation results from our decision to limit the levels of our global message valence factor to two: neutral and positive. We did so because anecdotally we believe these to be the most frequently occurring tones employed in radio advertising. Necessarily, though, our data is silent as to whether or not the results generalize to globally negative messages. Fear appeals are certainly a creative strategy sometimes used in radio messages, and future research should see whether positive target words occurring in globally negative fear appeal messages result in similar dissonant responses.

We also chose to strip as many possible confounding variables from the stimuli as possible, in order to best isolate the impact only of the valence associated with the semantic meanings of each target word. This was done by using non-professional voice talent to record the scripts once target words had been identified and inserted. Future research may wonder whether the effects we found will be effected if professional announcers are used.

Although our design would have been improved by having a target word from each level of Target Word Valence appear twice in each 1/3 of the message (e.g., early, middle, and late), this proved to be quite difficult given our goal of creating realistic sounding persuasive sentences in the advertising copy. We also did not ensure that two target words from the same level of the valence factor did not appear consequtively. We encourage future explorations in this area to consider more carefully controlling these parameters and/or exploring ways in which close proximity of target words of different valence impact processing.

Lastly, this study employed facial EMG measures to operationalize negative and positive responses to individual target words during the auditory messages. A possible limitation of using EMG is the difficulty in guaranteeing valid measurement of valence given the cross-talk between the many motor action units located in the face (Hess, 2009). However, to ensure the highest possible validity in our measurements we followed standard practices for accurate electrode placement (Fridlund & Cacioppo, 1986; Hess, 2009; Potter & Bolls, 2012).

Another criticism of the use of facial EMG measurement is the inability to ensure validity given the multiple ways in which the facial muscles respond to different contexts. For example, corrugator activity has occasionally been used to index effects of cognitive load (Van Boxtel & Jesserun, 1993; Waterink & vanBoxtel, 1994). However, we believe that the multiple message design of this experiment helped to guard against confounding variables across the multiple instances of, say, negatively valenced target words. Furthermore, particularly when valence and/or mood are factors in an experimental design, the impact of cognitive load on facial EMG measures tend to be overshadowed by the affective response (see Silvestrini & Gendolla, 2009). Our corrugator activity results were generally robust and as predicted by theory. On the other hand, the results on the zygomatic activity showed that smile muscle activity following the onset of negative words was greater compared to that following the onset of neutral words, a different pattern predicted by theory. Further the interaction effect between word valence X time only approached statiscal significance ($p = .06$). It is possible that the unexpected pattern and the lack of statistical significance may reflect a generally recognized concern that zygomatic muscle activity tends to correspond to many other influences besides positive valence of the situation (Larsen et al., 2003). Future research may want to see whether other muscle groups, such as the orbicularis oculi, is more reliably responsive to the onset of individual positively-valenced words.

References

Allan, D. (2008). A content analysis of music placement in prime-time television advertising. *Journal of Advertising Research, 48*, 404-417. doi:10.2501/S0021849908080434

Bolls, P. D., Lang, A., & Potter, R. F. (2001). The effects of message valence and listener arousal on attention, memory, and facial muscular responses to radio advertisements. *Communication Research, 28*, 627-651. doi:10.1177/009365001028005003

Bradley, M. M., Greenwald, M. K., Petry, M. C., & Lang, P. J. (1992). Remembering Pictures - Pleasure and Arousal in Memory. *Journal of Experimental Psychology-Learning Memory and Cognition, 18*, 379-390. doi:10.1037/0278-7393.18.2.379

Bradley, M. M., & Lang, P. J. (1999). Affective norms for English words [CD-ROM]. Gainesville, FL: NIMH Center for the Study of Emotion and Attention, University of Florida.

Cacioppo, J. T., & Berntson, G. G. (1994). Relationship between Attitudes and Evaluative Space - a Critical-Review, with Emphasis on the Separability of Positive and Negative Substrates. *Psychological Bulletin, 115*, 401-423. doi:10.1037/0033-2909.115.3.401

Cacioppo, J. T., Petty, R. E., Losch, M. E., & Kim, H. S. (1986). Electromyographic activity over facial muscle regions can differentiate the valence and intensity of affective reactions. *Journal of Personality and Social Psychology, 50*, 260-268. doi: 10.1037/0022-3514.50.2.260

Cacioppo, J. T., Tassinary, L. G., & Berntson, G. G. (2000). Psychophysiological Science. In J. T. Cacioppo, L. G. Tassinary, & G. G. Berntson (Eds.), *Handbook of Psychophysiology* (Vol. 2nd): Cambridge University Press.

Christianson, S.-A., & Safer, M. A. (1996). Emotional events and emotions in autobiographical memories. In D. C. Rubin (Ed.), *Remembering our past: studies in autobiographical memory* (pp. 218-243): Cambridge University Press.

Colombel, F. (2000). The processing of emotionally positive words according to the amount of accessible retrieval cues. *International Journal of Psychology, 35*, 279-286. doi:10.1080/002075900750047996

Cook, E. W., III. (2000). *VPM reference manual*. Birmingham, AL: Author.

DeSteno, D., Petty, R. E., Rucker, D. D., Wegener, D. T., & Braverman, J. (2004). Discrete emotions and persuasion: The role of emotion-induced expectancies. *Journal of Personality and Social Psychology, 86*, 43-56. doi:10.1037/0022-3514.86.1.43

Diao, F., & Sundar, S. (2004). Orienting response and memory for web advertisements. *Communication Research, 31*, 537-567. doi:10.1177/0093650204267932

Doerksen, S., & Shimamura, A. P. (2001). Source memory enhancement for emotional words. *Emotion, 1*, 5-11. doi:10.1037/1528-3542.1.1.5

Dolan, R. J. (2002). Emotion, cognition, and behavior. *Science, 298*, 1191-1194. doi:10.1126/science.1076358

Foss, D. J., & Speer, S. R. (1991). Global and local context effects in sentence processing. In R. R. Hoffman & D. S. Palermon (Eds.), *Cognition and the symbolic processes: Applied and ecological perspectives* (pp. 115-139). Hillsdale, NJ: Lawrence Erlbaum.

Fridlund, A. J., & Cacioppo, J. T. (1986). Guidelines for Human Electromyographic Research. *Psychophysiology, 23*(5), 567-588.

Furnham, A., Abramsky, S., & Gunter, B. (1997). A cross-cultural content analysis of children's television advertisements. *Sex Roles, 37*, 91-99. doi:10.1023/A:1025692804434

Hazlett, R. L., & Hazlett, S. Y. (1999). Emotional Response to television commercials: Facial EMG vs. self-report. *Journal of Advertising Research, 39*, 7-23. Retrieved from http://gandrllc.com/

Herbert, C., Junghofer, M., & Kissler, J. (2008). Event related potentials to emotional adjectives during reading. *Psychophysiology, 45*, 487-498. doi:10.1111/j.1469-8986.2007.00638.x

Hess, U. (2009). Facial EMG. In E. Harmon-Jones & J. Beer (Eds.), *Methods in Social Neuroscience* (pp. 70-91). NewYork, NY: Guilford Press.

Hietanen, J. K., Surakka, V., & Linnankoski, I. (1998). Facial electromyographic responses to vocal affect expressions. *Psychophysiology, 35*, 530-536. doi:10.1017/S0048577298970445

Holbrook, M. B., & Batra, R. (1987). Assessing the role of emotions as mediators of consumer responses to advertising. *The Journal of Consumer Research, 14*, 404-420. doi:10.1086/209123

Jarvis, B. G. (2004). Medialab Research Software (Version 2004). New York, NY: Empirisoft.

Kensinger, E. A., Brierley, B., Medford, N., Growdon, J. H., & Corkin, S. (2002). Effects of normal aging and Alzheimer's disease on emotional memory. *Emotion, 2*, 118-134. doi:10.1037/1528-3542.2.2.118

Kissler, J., Herbert, C., Peyk, P., & Junghofer, M. (2007). Buzzwords: early cortical responses to emotional words during reading. *Psychological Science, 18*, 475-480. doi:10.1111/j.1467-9280.2007.01924.x

Kissler, J., Herbert, C., Winkler, I., & Junghofer, M. (2009). Emotion and attention in visual word processing--An ERP study. *Biological Psychology, 80*, 75-83. doi:10.1016/j.biopsycho.2008.03.004

LaBar, K. S., & Phelps, E. A. (1998). Arousal-mediated memory consolidation: Role of the medial temporal lobe in humans. *Psychological Science, 9*, 490-493. doi:10.1111/1467-9280.00090

Lang, A. (1990). Involuntary attention and physiological arousal evoked by formal features and mild emotion in TV commercials. *Communication Research, 17*, 275-299. doi: 10.1177/009365090017003001

Lang, A. (2000). The limited capacity model of mediated message processing. *Journal of communication, 50*, 46-70. doi:10.1111/j.1460-2466.2000.tb02833.x

Lang, A. (2006a). Motivated cognition (LC4MP): The influence of appetitive and aversive activation on the processing of video games. In P. Messarsis & L. Humphries (Eds.), *Digital Media* (pp. 237-256): Peter Lang Publishing.

Lang, A. (2006b). Using the limited capacity model of motivated mediated message processing to design effective cancer communication messages. *Journal of communication, 56*, S57-S80. doi:Doi 10.1111/J.1460-2466.2006.00283.X

Lang, A., Chung, Y., Lee, S., & Zhao, X. (2005). It's the Product: Do risky products compel attention and elicit arousal in media users? *Health Communication, 17*, 283-300. doi:10.1207/s15327027hc1703_5

Lang, A., Geiger, S., Strickwerda, M., & Summer, J. (1993). The effects of related and unrelated cuts on television viewers' attention, processing capacity, and memory. *Communication Research, 20*, 4-29. doi:10.1177/009365093020001001

Lang, A., Newhagen, J., & Reeves, B. (1996). Negative video as structure: Emotion, attention, capacity, and memory. *Journal of Broadcasting & Electronic Media, 40*, 460-477. doi:10.1080/08838159609364369

Lang, A., Park, B., Sanders-Jackson, A. N., Wilson, B. D., & Wang, Z. (2007). Cognition and emotion in TV message processing: How valence, arousing content, structrual complexity, and information density affect the availability of cognitive resources. *Media Psychology, 10*, 317-338. doi:10.1080/15213260701532880

Lang, A., & Yegiyan, N. (2011). Individual differences in motivational activation influence responses to pictures of taboo products. *Journal of Health Communication, 16*, 1072-1087. doi:10.1080/10810730.2011.571336

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). Motivated attention: Affect, activation and action. In P. Lang, R. Simons, & M. Balaban (Eds.), *Attention and Orienting: Sensory and Motivational Processes* (pp. 97-136). Hillsdale, NJ: Lawrence Erlbaum, Associates.

Larsen, J. T., Norris, C. J., & Cacioppo, J. T. (2003). Effects of positive and negative affect on electromyographic activity over zygomaticus major and corrugator supercilii. *Psychophysiology, 40*, 776-785. doi:10.1111/1469-8986.00078

Lee, S., & Lang, A. (2009). Discrete emotion and motivation: Relative activation in the appetitive and aversive motivational systems as a function of anger, sadness, fear, and joy during televised information campaigns. *Media Psychology, 12*, 148-170. doi:10.1080/15213260902849927

Leshner, G., Bolls, P., & Wise, K. (2011). Motivated processing of fear appeal and disgust images in televised anti-tobacco ads. *Journal of Media Psychology, 23*, 77-89. doi:10.1027/1864-1105/a000037

Morris, J. D., & Boone, M. A. (1998). The effects of music on emotional response, brand attitude, and purchase intent in an emotional advertising condition. In J. W. A. J. W. Hutchinson (Ed.), *Advances in Consumer Research* (Vol. 25). Provo, UT: Association for Consumer Research.

Öhman, A. (1979). The orienting response, attention, and learning: An information-processing perspective. In H. D. Kimmel, E. H. V. Olst, & J. F. Orlebeke (Eds.), *The orienting reflex in humans* (pp. 443-471). Hillsdale, NJ: Lawrence Erlbaum Associates.

Petty, R. E., Briñol, P., & Priester, J. R. (2009). Mass media attitude change: Implications of the elaboration likelihood model of persuasion. In J. Bryant & M. B. Oliver (Eds.), *Media effects: Advances in theory and research* (3rd ed., pp. 125-164). New York, NY: Routledge.

Phelps, E. A., LaBar, K. S., & Spencer, D. D. (1997). Memory for emotional words following unilateral temporal lobectomy. *Brain and Cognition, 35*, 85-109. doi:10.1006/brcg.1997.0929

Potter, R. F. (2000). The effects of voice changes on orienting and immediate cognitive overload in radio listeners. *Media Psychology, 2*, 147-177. doi:10.1207/S1532785XMEP0202_3

Potter, R. F., & Bolls, P. (2012). *Psychophysiological measurmeent and meaning: Cognitive and emotional processing of media*. New York, NY: Routledge.

Potter, R. F., & Choi, J. (2006). The effects of auditory structural complexity on attitudes, attention, arousal & memory. *Media Psychology, 8*, 395-419. doi:10.1207/s1532785xmep0804_4

Potter, R. F., Lang, A., & Bolls, P. (2008). Identifying structural features of audio: Orienting responses during radio messages and their impact on recognition. *Journal of Media Psychology: Theories, Methods, and Applications, 20*, 168-177. doi:10.1027/1864-1105.20.4.168

Potter, R. F., LaTour, M. S., Braun-LaTour, K. A., & Reichert, T. (2006). The impact of program context on motivational system activation and subsequent effects on processing a fear appeal. *Journal of Advertising, 35*, 67-80. doi:10.2753/JOA0091-3367350305

Ray, M. L., & Batra, R. (1983). Emotion and persuasion in advertising: What we do and don't know about affect. In R. P. Bagozzi & A. M. Tybout (Eds.), *Advances in Consumer Research* (Vol. 10, pp. 543-548). Ann Abor, MI: Association for Consumer Research.

Rossiter, J. R., & Percy, L. (1991). Emotions and motivations in advertising. In R. H. Holman & M. R. Solomon (Eds.), *Advances in Consumer Research* (Vol. 18, pp. 100-110). Rrovo, UT: Association for Consumer Research.

Rovinelli, L., & Whissell, C. (1998). Emotion and style in 30-second television advertisements targeted at men, women, boys, and girls. *Perceptual and Motor Skills, 86*, 1048-1050. doi:10.2466/pms.1998.86.3.1048

Rubin, D. C., & Friendly, M. (1986). Predicting which words get recalled: Measures of free-recall, availability, goodness, emotionality, and pronunciability for 925 nouns. *Memory & Cognition, 14*, 79-94. doi:10.3758/BF03209231

Schacht, A., & Sommer, W. (2009). Time course and task dependece of emotion effects in word processing. *Cognitive, Affective, & Behavioral Neuroscience, 9*, 28-43. doi:10.3758/CABN.9.1.28

Schwab, F., & Schwender, C. (2011). The descent of emotions in media: Darwinian perspectives. In K. Doveling, C. v. Scheve, & E. A. Konijn (Eds.), *The Routledge Handbook of Emotions and Mass Media*. London and New York: Routledge.

Shevy, M., & Hung, K. (Eds.). (2013). *Music in television advertising and other persuasive media*. Oxford, United Kingdom: Oxford University Press.

Sokolov, Y. N. (1963). *Perception and the conditioned reflex*. New York: Pergamon.

Stout, P. A., & Leckenby, J. D. (1988). Let the music play: Music as a nunverbal element in television commercials. In S. Hecker & D. W. Stewart (Eds.), *Nonverbal Communication in Advertising* (pp. 207-233). Lexington, MA: Lexington Books.

Thorson, E., & Lang, A. (1992). The effects of television videographics and lecture familiarity on adult cardiac orienting responses and memory. *Communication Research, 19*, 346-369. doi:10.1177/009365092019003003

Van Boxtel, A., & Jessurun, M. (1993). Amplitude and bilateral coherency of facial and jaw-elevator EMG activity as an index of effort during a two-choice serial reaction task. *Psychophysiology, 30*(6), 589-604. doi:10.1111/j.1469-8986.1993.tb02085.x

Wang, Z., Lang, A., & Busemeyer, J. R. (2011). Motivational processing and choice behavior during television viewing: An integrative dynamic approach. *Journal of communication, 61*, 71-93. doi:10.1111/j.1460-2466.2010.01527.x

Waterink, W., & van Boxtel, A. (1994). Facial and jaw-elevator EMG activity in relation to changes in performance level during a sustained information processing task. *Biological Psychology, 37*(3), 183-198. doi:https://doi.org/10.1016/0301-0511(94)90001-9

Wegener, D. T., Petty, R. E., & Smith, S. M. (1995). Positive mood can increase or decrease message scrutiny: The hedonic contingency view of mood and message processing. *Journal of Personality and Social Psychology, 69*, 5-15. doi:10.1037/0022-3514.69.1.5

Wexler, B. E., Warrenburg, S., Schwartz, G. E., & Janer, L. D. (1992). EEG and EMG Responses to Emotion-Evoking Stimuli Processed without Conscious Awareness. *Neuropsychologia, 30*, 1065-1079. doi:10.1016/0028-3932(92)90099-8

Whissell, C. (1998). Objective analysis of text: II. using an emotional compass to describe the emotional tone of situation comedies. *Psychological Reports, 82*, 643-646. doi:10.2466/pr0.1998.82.2.643

Whissell, C., & McCall, L. (1997). Pleasantness, activation, and sex difference in advertising. *Psychological Reports, 81*, 355-367. doi:10.2466/pr0.1997.81.2.355

Wise, K., Eckler, P., Kononova, A., & Littau, J. (2009). Exploring the hardwired for news hypothesis: How threat proximity affects the cognitive and emotional processing health-related print news. *Communication Studies, 60*, 268-287. doi:10.1080/10510970902956024

Wise, K., Kim, H. J., & Kim, J. (2009). The effect of searching versus surfing on cognitive and emotional responses to online news. *Journal of Media Psychology, 21*, 49-59. doi:10.1027/1864-1105.21.2.49

Xu, J., Kemeny, S., Park, G., Frattali, C., & Braun, A. (2005). Language in context: Emergent features of word, sentence, and narrative comprehension. *NeuroImage, 25*, 1002-1015. doi:10.1016/j.neuroimage.2004.12.013

Yegiyan, N., & Lang, A. (2010). Processing central and peripheral detail: How content arousal and emotional tone influence encoding. *Media Psychology, 13*, 77-99. doi:10.1080/15213260903563014

Neutral	Valence	Arousal	Negative	Valence	Arousal	Positive	Valence	Arousal
alien	4.74	3.12	annoy	2.74	6.49	adorable	7.00	5.12
ankles	5.27	4.16	assaults	2.03	7.51	adventure	7.60	6.98
body	5.55	5.52	crisis	2.74	5.44	affection	8.39	6.21
building	5.29	3.92	dangerous	2.96	7.32	baby	8.22	5.53
chairs	5.08	3.15	death	1.61	4.59	Christmas	7.80	6.27
corner	4.36	3.91	deceitful	2.90	5.68	dancer	7.14	6.00
curtain	4.83	3.67	depressed	1.83	4.72	dazzling	7.29	6.33
dirt	4.67	3.76	despise	2.03	6.28	desire	7.69	7.35
door	5.13	3.92	devil	2.74	5.44	eat	7.47	5.69
eggs	5.29	3.76	disappoint	2.39	4.92	excellent	8.38	5.54
engine	5.20	3.98	disaster	1.73	6.33	excitement	8.38	5.54
feet	5.02	3.27	distressed	1.94	6.40	exercise	7.13	6.84
hand	5.33	3.47	drowning	1.92	6.65	fantasy	7.41	5.14
horse	5.89	3.89	embarrassed	3.03	5.87	fascinate	7.34	5.58
icebox	4.32	3.56	fear	2.76	6.96	food	7.62	5.92
indifferent	4.61	3.18	fight	3.75	7.15	joyful	8.22	5.98
key	5.68	3.70	fire	3.22	7.17	love	8.72	6.44
lazy	4.38	2.65	hate	2.12	6.95	memories	7.48	6.10
modest	5.76	3.98	headache	2.02	5.07	outstanding	7.75	6.24
moment	5.76	3.83	horror	2.76	7.21	passion	8.03	7.26
month	5.15	4.03	lie	2.79	5.96	perfection	7.25	5.95
paper	5.20	2.5	miserable	1.93	5.17	promotion	8.20	6.44
pencil	5.22	3.14	painful	2.13	6.50	safe	7.07	3.86
phases	5.17	3.98	panic	3.12	7.02	spring	7.76	5.67
plain	4.39	3.52	ridicule	3.13	5.83	success	8.19	6.11
plant	5.98	3.62	rude	3.36	6.07	surprised	7.47	7.47
shy	4.64	3.77	scared	2.78	6.82	terrific	8.16	6.23
street	5.22	3.39	stress	2.09	7.45	triumphant	8.82	6.78
table	5.22	2.92	suspicious	3.76	6.25	victory	8.82	6.63
taste	6.66	5.22	tragedy	1.78	6.24	wealthy	7.70	5.80
truck	5.47	4.84	ugly	2.43	5.38	win	8.83	7.72
violin	5.43	3.49	victim	2.18	6.06	wonder	6.03	5.00
M	**5.18**	**3.71**	**M**	**2.52**	**6.22**	**M**	**7.79**	**6.12**
SD	0.52	0.63	SD	0.59	0.83	SD	0.63	0.80

Table 1. Valence and Arousal ratings of Emotional Target Words from ANEW database

Individual Target Words in Positive Messages								
Neutral	**Valence**	**Arousal**	**Negative**	**Valence**	**Arousal**	**Positive**	**Valence**	**Arousal**
alien	4.74	3.12	annoy	2.74	6.49	affection	8.39	6.21
chairs	5.08	3.15	assaults	2.03	7.51	baby	8.22	5.53
corner	4.36	3.91	deceitful	2.9	5.68	Christmas	7.8	6.27
curtain	4.83	3.67	despise	2.03	6.28	dancer	7.14	6.00
eggs	5.29	3.76	distressed	1.94	6.4	dazzling	7.29	6.33
engine	5.2	3.98	drowning	1.92	6.65	desire	7.69	7.35
feet	5.02	3.27	embarrassed	3.03	5.87	food	7.62	5.92
hand	5.33	3.47	fear	2.76	6.96	love	8.72	6.44
horse	5.89	3.89	fight	3.75	7.15	outstanding	7.75	6.24
icebox	4.32	3.56	fire	3.22	7.17	passion	8.03	7.26
lazy	4.38	2.65	hate	2.12	6.95	spring	7.76	5.67
modest	5.76	3.98	panic	3.12	7.02	success	8.19	6.11
paper	5.2	2.5	ridicule	3.13	5.83	surprised	7.47	7.47
pencil	5.22	3.14	rude	3.36	6.07	terrific	8.16	6.23
phases	5.17	3.98	ugly	2.43	5.38	wealthy	7.7	5.8
violin	5.43	3.49	victim	2.18	6.06	win	8.83	7.72
Mean	5.08	3.47	**Mean**	2.67	6.47	**Mean**	7.92	6.41
SD	0.46	0.47	SD	0.58	0.62	SD	0.48	0.67

Table 2: Valence and Arousal ratings of Target Words in Positive Messages

Individual Target Words in Neutral Messages								
Neutral	**Valence**	**Arousal**	**Negative**	**Valence**	**Arousal**	**Positive**	**Valence**	**Arousal**
ankles	5.27	4.16	crisis	2.74	5.44	adorable	7	5.12
body	5.55	5.52	dangerous	2.96	7.32	adventure	7.6	6.98
building	5.29	3.92	death	1.61	4.59	eat	7.47	5.69
dirt	4.67	3.76	depressed	1.83	4.72	excellent	8.38	5.54
door	5.13	3.92	devil	2.74	5.44	excitement	8.38	5.54
indifferent	4.61	3.18	disappoint	2.39	4.92	exercise	7.13	6.84
key	5.68	3.7	disaster	1.73	6.33	fantasy	7.41	5.14
moment	5.76	3.83	headache	2.02	5.07	fascinate	7.34	5.58
month	5.15	4.03	horror	2.76	7.21	joyful	8.22	5.98
plain	4.39	3.52	lie	2.79	5.96	memories	7.48	6.1
plant	5.98	3.62	miserable	1.93	5.17	perfection	7.25	5.95
shy	4.64	3.77	painful	2.13	6.5	promotion	8.2	6.44
street	5.22	3.39	scared	2.78	6.82	safe	7.07	3.86
table	5.22	2.92	stress	2.09	7.45	triumphant	8.82	6.78
taste	6.66	5.22	suspicious	3.76	6.25	victory	8.82	6.63
truck	5.47	4.84	tragedy	1.78	6.24	wonder	6.03	5
Mean	5.29	3.96	**Mean**	2.38	5.96	**Mean**	7.66	5.82
SD	0.58	0.70	SD	0.58	0.95	SD	0.75	0.82

Table 3. Valence and Arousal ratings of Target Words in Neutral Messages

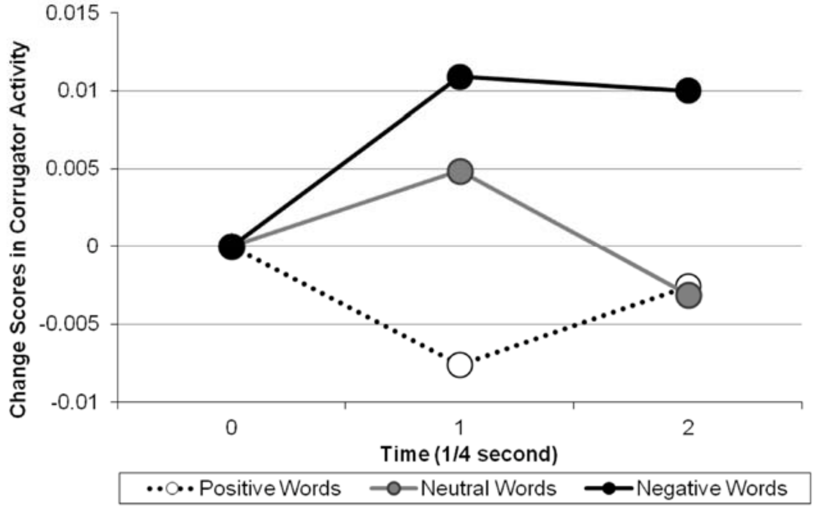

Figure 1. Corrugator muscle activation to positive, negative and neutral words

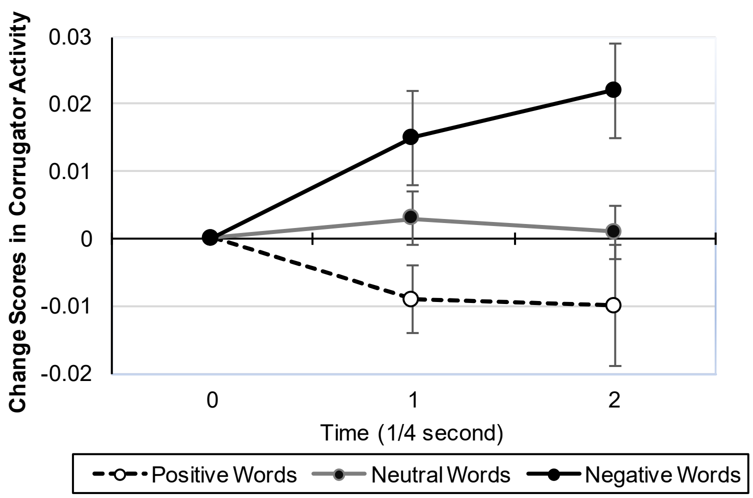

Figure 1. Corrugator muscle activation to positive, negative and neutral words

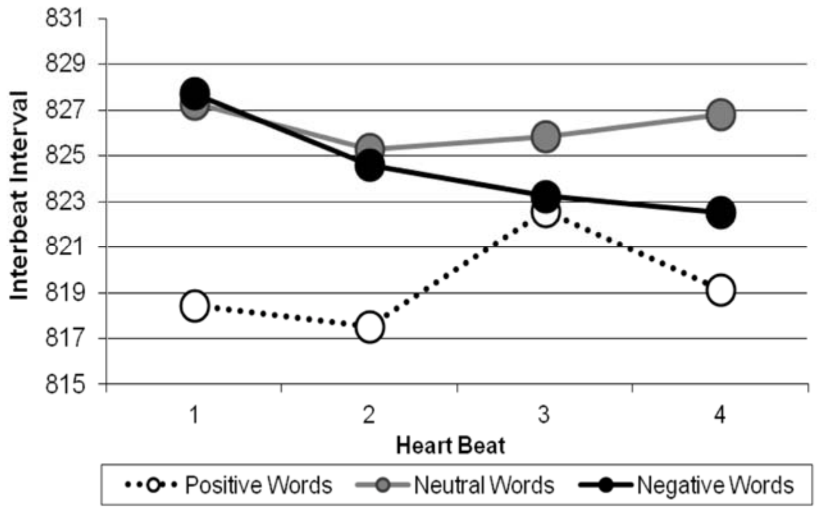

Figure 2. Cardiac IBI response to positive, negative and neutral words

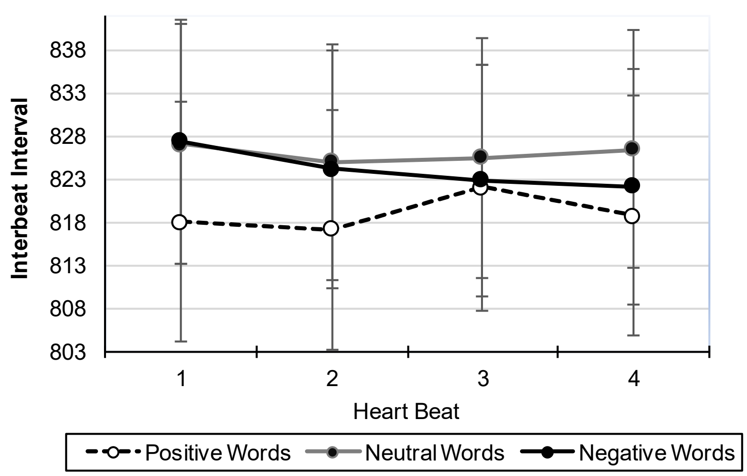

Figure 2. Cardiac IBI response to positive, negative and neutral words

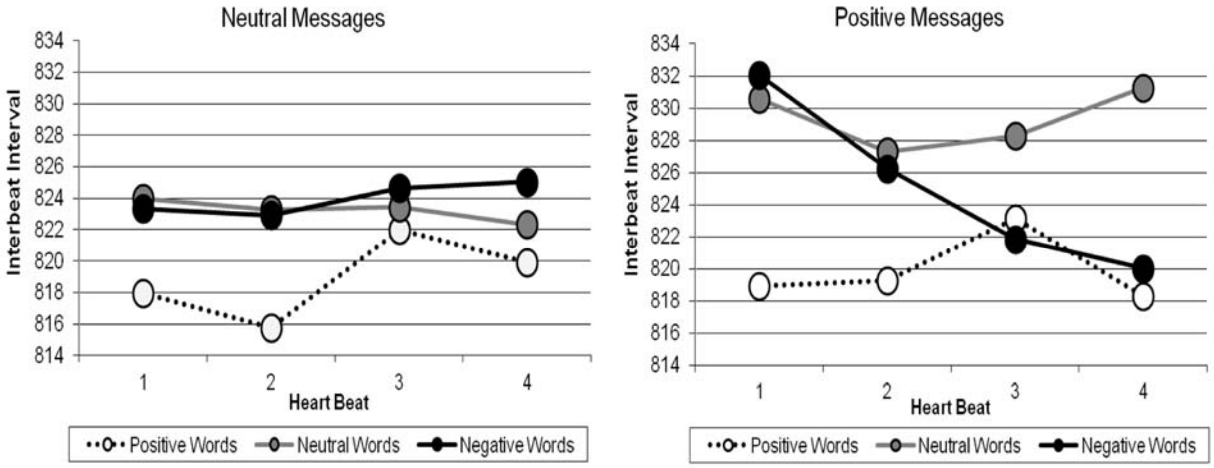

Figure 3. Interaction of word valence and message valence on cardiac IBI response

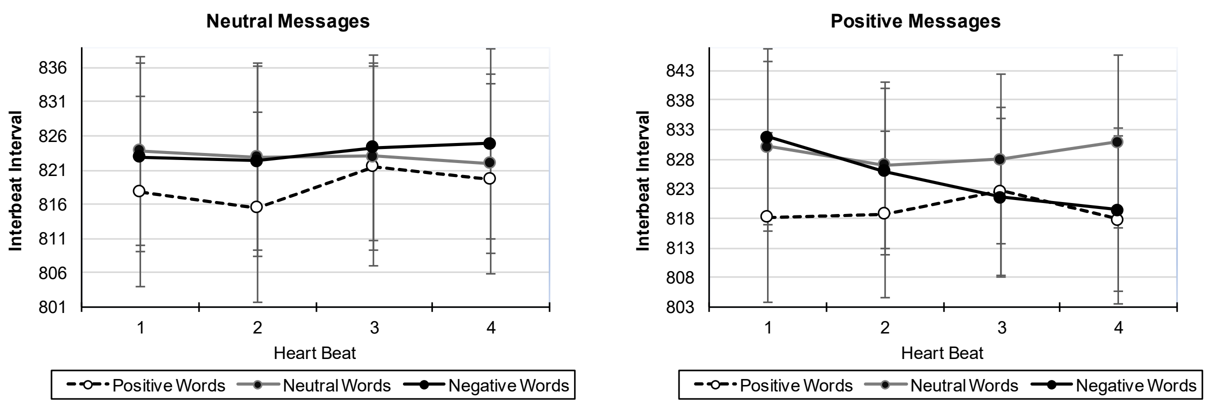

Figure 3. Interaction of word valence and message valence on cardiac IBI response

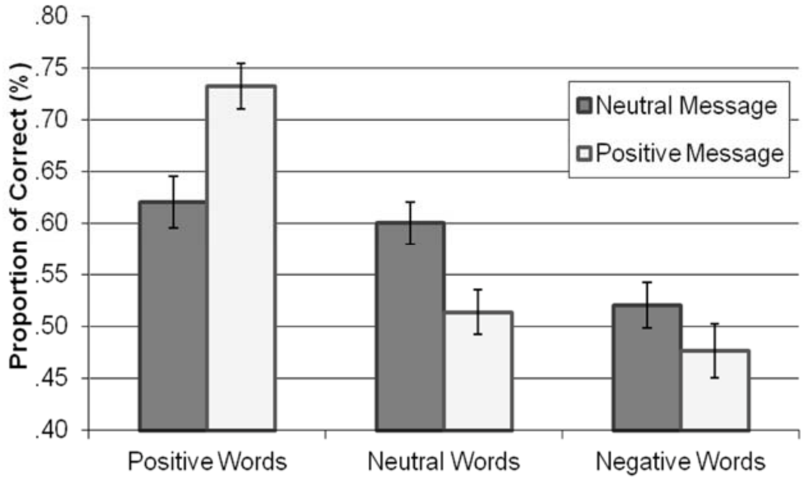

Figure 4. Interaction of word valence and message valence on recognition

Appendix 1:

Sample Neutral Ad Stimuli

Original copy:

The Giant Grandview General Motors autoplex's general manager has overstocked inventory to the max. Again. Now they all must go, or he goes. That's right, the boss once again says, they go or he goes. Before the inventory tax deadline, now any reasonable offer will be accepted and taken directly to management for approval. Choose from hundreds of brand new Chevys, Pontiacs, Buicks, even Chevy trucks, and over 2 million dollars worth of used vehicles. And make an offer because they've all got to go! Don't forget all select new vehicles still have zero percent financing available for sixty months. Plus when we make a deal this week, Grandview General Motors will pay-off your trade-in regardless of how much you owe. Even if it's a lease. Save thousands on brand new GM vehicles and quality preowned vehicles, and help save the general manager's job. "Uh, please?" During the inventory tax reduction sale going on now through Saturday at the Giant Grandview G-M autoplex. On U-S Highway forty. Only fifteen miles west of Highland Park." Call toll free one eight hundred seven seven six forty-eight eleven for details.

Manipulated copy with target words in **bold**:

This just won't be believed. It's a **tragedy** (valence:1.78, arousal: 6.24)! The general manger at the Giant Grandview General Motors autoplex has overstocked inventory to the max. Again. Now they all must go, or he goes. But don't worry, you get to take advantage of this **triumphant** (valence: 8.82, arousal: 6.78) promotion. That's right, the boss once again says, they go or he goes. Before the inventory tax deadline, any reasonable offer will be accepted and taken directly to management for approval. Choose from hundreds of brand new Chevys, Pontiacs, Buicks, even Chevy trucks, and over 2 million dollars worth of used vehicles. All the great GM vehicles you see on the **street** (valence: 5.22, arousal: 3.39). Come and make an offer because they've all got to go! Don't forget all select new and **excellent** (excellence, valence: 8.38, arousal: 5.54) used vehicles still have zero percent financing available for sixty months. Plus, when we make a deal this week, Grandview General Motors will pay-off your trade-in regardless of how much you owe. Even if it's a plain (valence: 4.39, arousal: 3.52) lease. Save thousands on brand new GM vehicles and quality preowned vehicles, and help save the general manager's job. Don't be **suspicious** (valence: 3.76, arousal: 6.25) about this great offer! During the inventory tax reduction sale going on now through Saturday at the Giant Grandview G-M autoplex, on U-S Highway forty, only fifteen miles west of Highland Park." Call toll free one eight hundred seven seven six forty-eight eleven for details.

Sample Positive Ad Stimuli

Original copy:

No two dads are exactly alike, and when you think about it that's kind of nice. For instance, maybe your dad is a talker, maybe he told every boyfriend stories you didn't want anybody to ever hear. Or maybe your dad is a quiet type, the kind that waited up for you in his bathrobe pretending to watch late movies. At Eckerd we know there are thousands of different kinds of dads and that there's one special day each year set aside to tell them thanks. Just for being your dad. That's why it's so important that you pick out the perfect American Greetings card for your type of Dad. And that's why an Eckerd card specialist comes in at least three times a week to make sure you'll always find funny cards, or even mushy ones for those dads who still care about their little girl so much. So come in to Eckerd for the right card, because even if your dad's the kind that says he doesn't read cards, believe me, he reads them every time he misses you. There are thousands of ways to say it and Eckerd has them all.

Manipulated copy with target words in **bold**:

No two dads are exactly alike, and when you think about it that's kind of nice. I am quite **confident** (valence: 7.98, arousal: 6.22) about it. Here is an example. Maybe your dad is a talker, maybe he told every boyfriend stories you would be **afraid** (valence: 2.20, arousal: 6.67) that anybody ever hear. Or maybe your dad is a **quiet** (valence: 5.58, arousal: 2.82) type, the kind that waited up for you in his bathrobe pretending to watch late movies and that was never **mad** (valence: 2.44, arousal: 6.76) at you. At Eckerd we know there are thousands of different kinds of dads and that there's one special day each year set aside to make them **happy** (valence: 8.21, arousal: 6.49). To tell them 'thanks' just for being your dad. That's why it's so important that you pick out the perfect American Greetings card for your type of Dad. And that's why an Eckerd card specialist comes in at least three times a week to make sure you'll always find funny cards, or even mushy ones for those dads who still care about their little girl so much. So come in to Eckerd for the right card, because even if your dad's the **reserved** (valence: 4.88, arousal: 3.27) kind that says he doesn't read cards. . . believe me, he reads them every time he misses you. There are thousands of ways to say it and Eckerd has them all.