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Continuous Emotional Responding to Audio, Video, and Audiovisual Sensory Channels during Television Viewing

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Abstract

An experiment was conducted to examine the independent and interactive influence of the audio and visual channels of information in television on viewers' emotional experience. Audio-only, video-only, and audiovisual television content was presented as psychological stimuli, while participants completed continuous-response measures (CRMs) to index over-time changes in emotional experience of positive valence, negative valence, and arousal. Positive valence and arousal means were significantly influenced by channel over time. Participants reported the most positive emotional experience during audiovisual exposure. The channel and time interaction did not significantly affect negative valence ratings. However, positive valence, negative valence, and arousal ratings were significantly influenced by the interaction of channel and specific message content.

Within the information-processing perspective guiding this study, television represents a psychological stimulus comprising two variably redundant streams or channels of audio and visual information (A. Lang, 1995). The audio and visual channels each convey information through both its structure and content. In both the structure and content of the audio and visual channels, television content communicates motivational significance in the forms of emotional valence and arousal (A. Lang, 2006). Theorists contend that human motivational activation occurs automatically in response to the continuously varying emotional tone of television messages and elicits resulting in continuously varying emotional experience (A. Lang, 2006; Lee & Lang, 2009; Sparks & Lang, 2010; Sparks, Matthews, & Chung, 2011; Wang, Lang, & Busemeyer, 2011). Human emotional experience is conceived of as a conscious affective state that is thought to stem from unconscious motivational activation (Cacioppo & Gardner, 1999). Although individuals cannot report their motivational activation level, individuals are capable of reporting their ongoing emotional experience or feelings emerging from motivational activation (Barrett, Mesquita, Ochsner, & Gross, 2007).

The human motivational and cognitive systems each independently and interactively process audio and visual information (Baddeley, 2006; Sternberg, 2003). Thus, emotional experience and cognitive processes (A. Lang, 2006) differ according to information presentation channel, channel structure, channel content, and their collective interaction. Previous television research from this perspective (A. Lang, 2006) has examined the collective influence of audiovisual content on cognition without parsing out the independent influences of each channel. The present study utilized continuous-response measures (CRMs) to examine the over-time influence of the audio, video, and audiovisual channels of television messages on motivational activation and, thus, the emotional experience of the viewers during television viewing.

Literature Review

Dual Motivational Systems

The Limited Capacity Model of Motivated Mediated Message Processing (LC4MP, A. Lang, 2006) assumes that human motivation, emotion, cognition, and behavior are embodied and interactive phenomena. The LC4MP assumes that human motivation is regulated by the appetitive and aversive motivational systems (Berntson & Cacioppo, 2000; Cacioppo & Berntson, 1994; Cacioppo & Gardner, 1999; A. Lang, 2000, 2006). The appetitive system regulates approach, while the aversive system regulates avoidance responses (Cacioppo & Gardner, 1999; A. Lang, 2006). The systems independently and automatically activate, without conscious thought in response to motivationally relevant stimuli in the environment. Activation is theorized to occur in order to promote human survival. The appetitive system activates to sustain life by promoting human approach tendencies toward opportunities for sustenance in the environment. The aversive system functions to protect human life from harm by removing the person from potential dangers, such as predators and threats to life, associated with environmental threat. Opportunity and threat are regarded as pleasant and unpleasant stimuli, respectively (A. Lang, 2006).

When the environment is pleasant and low arousing, the appetitive system's resting activation is greater than the aversive system's resting activation. The higher resting activation level of the appetitive system, when compared with the aversive system, promotes approach to survival opportunities and is called positivity offset. However, as the arousal level of an unpleasant stimulus increases, the aversive system responds more vigorously than the appetitive system responding to increasing arousal in a pleasant stimulus. The more vigorous activation

function of the aversive system in response to increasingly arousing unpleasant stimuli, when compared with the activation function of the appetitive system in response to increasingly arousing pleasant stimuli, is called negativity bias. Differing levels of motivational activation result in survival appropriate allocation of cognitive resources to encoding, storing, and retrieving survival relevant information from the environment, including mediated messages (A. Lang, 2006).

Motivational relevance of a stimulus including mediated information is determined by the survival significance of information for the human organism (Detenber & Lang, 2010; A. Lang, 2006). The human motivational system has adapted to quickly respond to motivationally relevant stimuli of varying intensity in the environment. Adaptively responding to pleasant and unpleasant stimuli helps keep humans alive. Thus, arousal, pleasantness, and unpleasantness represent the fundamental dimensions of motivational relevance or the common denominators of human emotion (Detenber & Lang, 2010; A. Lang, 2006).

Based on this notion, researchers have conceived of motivationally relevant stimuli in terms of arousal and valence dimensions. The arousal dimension ranges from *very calm* to *very excited*. The pleasant valence dimension ranges from *not-at-all pleasant* to *very pleasant*. Likewise, the unpleasant valence dimension ranges from *not-at-all unpleasant* to *very unpleasant*. Conceptualizing valence in terms of separate dimensions relates to the independent and dual nature of the human motivational systems (M. M. Bradley, Codispoti, Cuthbert, & Lang, 2001; Cuthbert, Bradley, & Lang, 1996; A. Lang, Shin, & Lee, 2005; Yegiyan & Lang, 2010).

The motivational systems are independent and dual, and may be individually activated or co-activated (Cacioppo & Gardner, 1999; A. Lang et al., 2005; Yegiyan & Lang, 2010). In environmental stimuli, pleasant valence activates the appetitive system, and unpleasant valence

activates the aversive system. However, a stimulus may be pleasant only, unpleasant only, or both pleasant and unpleasant in valence. Thus, a stimulus may activate the appetitive, aversive, or both the appetitive and aversive systems. The level of activation in each system depends on the intensity of the environmental stimulus. In other words, the level of arousal in a stimulus determines the level of activation in the relevant motivational system (Cacioppo & Gardner, 1999; P. J. Lang, 1995; P. J. Lang, Bradley, & Cuthbert, 1997).

The type and level of activation therefore vary depending on the valence and intensity of the stimulus, respectively (Ito, Cacioppo, & Lang, 1998; A. Lang, 2006; A. Lang, Bradley, Sparks, & Lee, 2007; A. Lang et al., 2005; P. J. Lang, Bradley, & Cuthbert, 1990; Yegiyan & Lang, 2010). Thus, the more arousing a pleasant stimulus, the greater the appetitive activation will be. On the other hand, an unpleasant stimulus automatically activates the aversive system with greater levels of unpleasant arousal associated with greater aversive system activation.

Emotional Experience: Self-Reported Continuous-Response Measures (CRM)

The emotional tone of a stimulus conveys motivational relevance and elicits activation in the human motivational systems (Cacioppo & Gardner, 1999). Emotional experience follows motivational activation and also serves a biological function (Detenber & Lang, 2010; A. Lang, 2006). Appetitive activation elicits positive emotional feelings, and aversive activation elicits negative emotional feelings. Intensity of the activation determines how weak or strong the emotional feelings are. Thus, the human emotional experience is induced by consciousness of a stimulus (Damasio, 1999) and regarded as emerging from motivational system activation (A. Lang, 2006).

That is, emotional tone of a stimulus automatically activates the appetitive and/or aversive system in response to the motivational relevance (A. Lang, 2006). The system disposes the organism for appropriate action. Action dispositions are expressed, in part, as survival appropriate feelings toward the stimulus. Subsequently, emotional feelings will be positively or negatively directed toward the stimulus with appropriate intensity (e.g., Tsuchiya & Adolphs, 2007). Individuals are consciously aware of their emotional feelings emerging from motivational activation although the motivational systems unconsciously activate (e.g., Fahr & Fahr, 2009; Barrett et al., 2007).

Moreover, motivational relevance continuously varies with constantly changing mediated television environments and stimulates continuously varying motivational system activation. Emotional experience of valence and arousal dynamically change over time during television viewing (A. Lang et al., 2007; Sparks & Lang, 2010). As emotional experience is a conscious affective state, researchers have recognized CRM as an effective tool to observe how media users affectively process sequential or fluctuating variations of mediated information in the form of audio, visual, and audiovisual content (Baumgartner, Sujan, & Padgett, 1997; Biocca, Prabu, & West, 1994; Lee & Lang, 2009; Weaver, Huck, & Brosius, 2009). CRM records patterns and degree of participants' continuous responses over a time period. The measurement can provide immediate and unobtrusive feedback while allowing comparisons of the patterns with other time series (Biocca et al., 1994). Thus, the current study utilized a CRM to examine the moment-to-moment fluctuations of continuous emotional experience in response to television messages conveyed through audio, video, and audiovisual transmission channels.

Channels of Television-Message Processing

Television comprises two continuous and simultaneous streams of mediated information. Television transmits auditory and visual information respectively through audio and video channels (A. Lang, 1995, 2000). Numerous studies have addressed uniqueness in audio and video channel cognition (e.g., Leahy & Sweller, 2011; Mayer, 2009; Mayer & Johnson, 2008; Moreno & Mayer, 2002; Tabbers, Martens, & Van Merriënboer, 2004). Dual processing models with interdependent auditory and visual processors and pools have been proposed (Baddeley, 2006; A. Lang, 1995) with integration in the prefrontal cortex (LeDoux, 2002). Additionally, processing advantages have been observed for audiovisual redundancy, when compared with audio-only or video-only channels (e.g., Leahy & Sweller, 2011; Moreno & Mayer, 2002). Multiple channels of information presentation increases cognitive efficiency and reduces the threat of cognitive overload (Moreno & Mayer, 2002).

Moreover, auditory processing is thought to be more complex than visual processing during television viewing (A. Lang, 1995; A. Lang, Potter, & Bolls, 1999). To understand auditory information previously heard, viewers likely use contextual information to infer the representations of the words and retrieve related information from long-term memory (Hampson & Morris, 1996). Further, auditory processing may evoke imagery to engage visual processing of the brain (Bolls, 2002). Thus, auditory processing is viewed as a controlled task requiring a significant amount of cognitive resources; however, visual processing would require relatively less cognitive effort (A. Lang, 1995; A. Lang et al., 1999).

The existing evidence related to television message processing demonstrates that viewers uniquely cognitively process the audio and video channels of television messages. The channels of information are dynamically and continuously delivered with varying degrees of audio-video redundancy, which influence cognition (Lee & Lang, 2009). Past research has further

demonstrated that various media (Bolls, Lang, & Potter, 2001; Poels & Dewitte, 2008; Potter & Choi, 2006; Yegiyan & Lang, 2010) including television (A. Lang, 2000, 2006; Lee & Lang, 2009; Sparks & Lang, 2010) convey motivational relevance through emotional tone that elicits motivational activation, induces emotional experience, and influences cognitive processing of messages.

However, past studies have not compared the unique influences the structure and content of the audio, video, and audiovisual channels within the same message on motivational activation and emotional experience. Such a study represents a first step toward bridging the explanatory gap between findings demonstrating that audio and video channels are uniquely cognitively processed and evidence that cognition is a motivated phenomenon. Valence and arousal conveyed through audio, video, or audiovisual channels unfold uniquely over time and are expected to influence the viewers' motivational systems activations, emotional experience, and ultimately cognitive processes (e.g., A. Lang, 1995, 2000, 2006; A. Lang et al., 1999). Examining motivational activation in response to the audio, video, and audiovisual channels is a first step toward explaining how motivational activation induced by audio-only, video-only, and audiovisual television channels influences motivated processing individual channels and audiovisual television messages. In order to better understand the interaction of channel structure and content with the human motivational and cognitive systems, the current study poses the following research questions:

> **RQ1:** Does television message channel (audio, video, and audiovisual) significantly influence over-time emotional experience of positive valence? If so, which channel has the greatest effect?
>
> **RQ2:** Does television message channel (audio, video, and audiovisual) significantly influence over-time emotional experience of negative valence? If so, which channel has the greatest effect?

> **RQ3:** Does the television message channel (audio, video, and audiovisual) significantly influence over-time emotional experience of arousal? If so, which channel has the greatest effect?

Differences in Television Messages

Unique messages may elicit different emotional experience (e.g., A. Lang, 2000). Moreover, the congruence between audio and video channels presenting the same information may vary moment-to-moment across messages or stories (A. Lang, 1995). Finally, emotional experience in response to mediated messages may differ according to the specific message contents. Accordingly, the following research question is proposed:

> **RQ4:** How do specific message contents influence over-time self-reported emotional experience of positive valence, negative valence, and arousal? Do message and channel interact?

Methods

Stimulus Materials

Television message clips were selected through a three-step process. In the first phase, 150 2-minute (i.e., 120 seconds) television clips were randomly selected from 16,128,000 minutes of programs televised on 400 AT&T U-Verse Channels during the February 2011 Sweeps rating period. In the second phase, 98 television clips without advertisements were selected from the sampling frame and sorted by genre (Creeber, 2008). In the third phase, the experimenter selected clips from the four most representative genres from the sampling frame: drama, educational programming, movie, and reality (Creeber, 2008). For the experiment, nine television clips were randomly chosen from each of the four genres. The 36 television clips used in the audiovisual condition of the experiment are presented in Appendix 1. The 36 television

clips were edited with video removed for the audio-only condition and with audio removed for the video-only condition of the experiment.

Design

This study used an experimental design with two between-subjects factors (Channel: audio, video, and audiovisual; and Message: 36 television clips) and one within-subjects factor (Time: 120 seconds). Undergraduate students ($N = 230$) participated in exchange for course credit. The participants listened to audio-only, watched video-only, or listened to and watched the audiovisual condition. Participants did not rate the same message in more than one channel condition.

Presentation orders were controlled to alleviate potential participant fatigue. There were a total of 18 presentation orders (see Appendix 2), each order had 18 different television messages taken in approximately equal numbers of audio-only, video-only, and audiovisual channel conditions. Half of the participants were presented with half (18) of the 36 television messages. The other half was presented with the other 18 television messages. Each order had four channels, each of which contained four different messages presented continuously within the same channel, and one channel with two different messages. The duration of each television clip was 120 seconds. CRM ratings for emotional experience (i.e., positive valence, negative valence, and arousal) were sampled 120 times per message, averaged over one second, and then stored using MediaLab software (Jarvis, 2004).

Measure

There are two ways of measuring emotional experience: physiological and self-reported measurements. Physiological measurements, such as facial EMG and skin conductance, provide direct indicators of motivational system activation without the influence of social desirability or cognitive bias (Tran et al., 2007). However, physiological measurements require much time, money, and potentially reduce external validity (Tran et al., 2007). On the other hand, self-reported measures have been widely used as relatively convenient, valid, and reliable indicators of continuously and dynamically changing emotional experience (e.g., Baumgartner et al., 1997; Biocca et al., 1994; Fahr & Fahr, 2009; Poels & Dewitte, 2008). Empirical evidence has shown that self-reported responses to emotional experience were consistent with concurrently collected physiological data (Ivory & Kalyanaraman, 2007; P. J. Lang, Greenwald, Bradley, & Hamm, 1993; Schneider, Lang, Shin, & Bradley, 2004). Therefore, self-reported measurements were used for this study.

CRMs were used to indicate the strength of the perceived magnitude of emotional experience dimensions: pleasantness, unpleasantness, and arousal in real-time. Thus, participants were asked to continuously rate on-going emotional response during each of 18 2-minute television messages. Each participant continuously rated his or her emotional experience according to either *(a) how good, (b) how bad, or (c) how calm versus excited* he or she felt during each clip on a 0-to-100 sliding scale (positive valence: 0 = *not at all good*, 100 = *very good*; negative valence: 0 = *not at all bad*, 100 = *very bad*; and arousal: 0 = *very calm*, 100 = *very excited*) located below the viewing window on the computer screen.

Procedure

The experiment was conducted in a university computer lab on 19 individual desktop computers. Each experiment session lasted approximately 40 minutes. Television clips and CRM questions were presented on the computer screen using MediaLab software (Jarvis, 2004) in pre-determined random orders. Participants were instructed to continuously report CRM ratings for a total of 18 clips (See Appendix 2). Before each block of clips representing a channel condition, participants were informed what channel type (i.e., audio-only, video-only, or audiovisual) would be presented in the block. Messages within each channel were presented randomly in block. In the audio-only condition, participants did not see the corresponding video clips. Instead, participants saw a black screen in the viewing box. In the video-only condition, participants did not hear the audio associated with the video clips. In the audiovisual condition, participants both heard and saw the television clips' content. Participants rated each television message on one of three sliding scales by moving the cursor along the 0-to-100 continuous rating scales located beneath the message-viewing window. The CRMs measured ongoing emotional experience of positive valence, negative valence, and arousal. The CRM scale had a default starting point of 50 on the 100-point scale. Thus, participants were instructed for 6 seconds prior to each message as follows: "Please wait for the clip to begin. When the clip begins, immediately move the cursor to 0. Then, immediately begin rating."

Results

Repeated-measures ANOVA analyses were performed to examine the influence of time (within subjects), channel and message (between-subjects) on continuous emotional experience of positive valence, negative valence, and arousal. Regarding research question 1, the analyses showed no significant main effect of Channel on CRM rating means of positive valence, $F(2,$

1278) = 2.57, p = .08. A post-hoc Bonferroni analysis was carried out for comparisons among channels. The results showed no significant difference between the audiovisual (M = 3.28, SE = .09) and audio-only channels (M = 3.07, SE = .09), p = .325, between the audiovisual and video-only channels (M = 2.99, SE = .09), p = .09, and between the audio-only and video-only channels, p = 1.00. Further, the results showed that the CRM positive rating means were significantly influenced by the Channel × Time interaction, F(238, 152082) = 4.01, p < .001, η^2 = .01. The results are displayed in Figure 1.

Regarding research question 2, the analyses showed no significant main effect of Channel on CRM rating means of negative valence, F(2, 1278) = 1.59, = .21. Specifically, there were no significant differences between the audiovisual (M = 2.57, SE = .10) and audio-only channels (M = 2.77, SE = .10), p > .05, between the audiovisual and video-only channels (M = 2.56, SE = .10), p > .05, and between the audio-only and video-only channels, p > .05. Additionally, the analyses found no significant Channel × Time interaction, F(238, 152082) = 1.33, p = .22. See Figure 2 for details.

Regarding research question 3, the analyses indicated the significant main effect of Channel on CRM rating means of arousal, F(2, 1294) = 9.70, p < .01, η^2 = .02. A post-hoc Bonferroni analysis found that CRM arousal mean ratings were greater for the audiovisual channel (M = 2.87, SE = .09) than the video-only channel (M = 2.30, SE = .09), p < .001. However, the audiovisual channel did not differ significantly from the audio-only channel (M = 2.67, SE = .09), p = .37. There was no significant difference between audio-only and video-only channels, p > .05. The CRM rating means of arousal were significantly influenced by the Channel × Time interaction, F(238, 153986) = 8.05, p < .001, η^2 = .01. The results are shown in Figure 3.

In relation to research question 4, the ANOVA analyses examined the Channel × Message interaction effect on CRM positive, negative, and arousal rating means. First, the analyses revealed the significant main effect of Message on CRM positive valence rating means, $F(35, 1278) = 10.05$, $p < .001$, $\eta^2 = .22$. Significance was also found for the Channel × Message interaction, $F(70, 1278) = .1.51$, $p < .05$, $\eta^2 = .08$. Second, the results showed the significant main effect of Channel on CRM rating means of negative valence, $F(35, 1278) = 12.30$, $p < .001$, $\eta^2 = .25$. However, no significant interaction effect was found between Channel and Message, $F(70, 1278) = 1.20$, $p = .13$. Third, Message had the significant main effect on CRM rating means of arousal, $F(35, 1294) = 7.09$, $p < .001$, $\eta^2 = .16$. The Channel × Message interaction was also significant, $F(70, 1294) = 1.32$, $p < .05$, $\eta^2 = .07$.

Discussion

This study investigated how audio, video, and audiovisual channels of television differently influence viewers' continuous emotional responses of positive valence, negative valence, and arousal. Over time, channels significantly influenced positive valence and arousal; however, channel did not have a significant influence on negative valence. The results of the study may be attributed to the different functions of the forebrain and midbrain in distinctive processing of each emotional dimension (e.g., Murphy, Nimmo-Smith, & Lawrence, 2003).

According to literature on the brain's structure and function (Breedlove, Watson, & Rosenzweig, 2010; Davidson, 2000; Davidson & Fox, 1988), the forebrain consisting of the left and right hemispheres, which are interconnected by the corpus callosum, deals with emotion, memory, and language. The left hemisphere predominantly processes positive emotion while the right hemisphere primarily processes negative emotion. In addition, the left hemisphere is more

effective for verbal memory while the right hemisphere better remembers visual-spatial information (A. Lang, 1991; A. Lang & Friestad, 1993). Meanwhile, the midbrain including the reticular activating system takes charge of attention and arousal (Breedlove et al., 2010; Morgane, Galler, & Mokler, 2005). Areas within the midbrain are interrelated with vision and hearing (Breedlove et al., 2010). Therefore, auditory and visual information as well as each emotional dimension are processed in the different parts of the brain. As shown in our findings, television sensory channels have different degrees of influence on the emotional processing.

Specifically, the current study did not show a significant effect of channel solely on CRM positive rating means. However, over time, channel significantly influenced the positive ratings (see Figure 1). Processing auditory information requires more cognitive effort and resources, when compared to visual information (A. Lang et al., 1999). Thereby, the auditory processing and resulting conscious positive feelings would require greater time for processing. Thus, during the initial time of exposure to the message, the CRM positive ratings may not differ significantly between video-only and the audio or audiovisual channel. However, as time passed, the audio and audiovisual channels using the left hemisphere of the brain resulted in higher positive ratings than the video-only channel. The video-only channel played a less significant role in activating the appetitive system and resulting in positive feelings. Furthermore, the audiovisual channel demanded fewer cognitive resources than the audio-only channel because the audiovisual channel stimulated multimodalities of the viewers in the processing of the corresponding message (Moreno & Mayer, 2002). The simultaneous use of audio and video modalities performed the complementary function of understanding the message and successively elicited the greatest magnitude of appetitive activation and resulting positive emotional experience ratings.

On the other hand, the right hemisphere mostly handles negative emotion and visual information (A. Lang & Friestad, 1993). The results of this study showed no significant main effect of channels on CRM negative rating means. Perhaps, unlike in the left hemisphere, the effects of the audio-only channel may be diminished in processing negative valence. However, it was interesting that the video-only and audiovisual channels, even by the interaction with the time, did not have the greater influence on CRM negative ratings than the audio-only. During television viewing, the audio channel seemed to play a more important role in shaping various emotional tones of television messages. Further, these findings demonstrate that the right hemisphere versus the left hemisphere is asymmetrical in processing negative versus positive valence (e.g., Murphy et al., 2003). That is, the negative processing may be regarded as more complex than the positive processing.

Furthermore, the results of this study showed that CRM arousal rating means were significantly influenced by sensory channels solely as well as the interaction of channel and message. Specifically, since the initial time of exposure to the message, the audio-only and audiovisual channels resulted in greater CRM arousal ratings than the video-only. Therefore, the findings suggest that the audio channel may have the dominant role in eliciting greater motivational relevance with the messages. Besides, as the time had passed, the audiovisual channel led to the greatest rate of increase in CRM arousal ratings. The finding was consistent with previous studies suggesting that structural complexity in television messages increases arousal levels of the viewers (e.g., A. Lang, Bolls, Potter, & Kawahara, 1999; A. Lang, Zhou, Schwartz, Bolls, & Potter, 2000).

Last, this study showed that channels in interaction with messages significantly influence all dimensions of emotional experiences. Message content may primarily convey motivational

relevance (A. Lang, 2006). Moreover, each message may differ in the degrees of audio-video redundancy (A. Lang, 1995; Moreno & Mayer, 2002). Thus, the effects of audio and/or video modalities may differ across the messages. Accordingly, channels should be considered as a platform (i.e., to maximize or suppress emotional responses) to effectively deliver such emotional messages.

This study provides implication for practitioners (e.g., television programming producers, editors, or operators). The practitioners may consider the utilization of appropriate sensory channels of television to elicit specific emotional experiences of the viewers during television viewing. To elicit greater positive or arousal feelings, audio or audiovisual channels can be utilized. However, to enhance negative feelings, the practitioners may place greater weight on message design but less attention to the use of sensory channels. Collectively, these findings represent an initial step toward the future explanation of the influence of motivational relevance in the audio and video channels on observed differences in audio and visual processing.

Limitations and Future Research

There were several limitations in the experiment of this study. Self-reported measures are subjective and may over- or under-state subjects' responses (e.g., Fahr & Fahr, 2009). Future studies should employ direct measures, such as functional magnetic resonance imaging (fMRI), for observation of brain activity. Moreover, modality studies (e.g., Moreno & Mayer, 2002) argued that cognitive overload is more likely to occur with auditory information than visual information. As the conscious expression of emotions may require processing resources, future studies may explore that the influence of the audio channel on the emotional processing may differ with the occurrence of cognitive overload. In addition, this study used various television

messages for the experiment. Considering significant interaction effects between channel and message, future studies may be examined within a specific message context (i.e., holding the similar degree of motivational relevance or of audio-video redundancy). Also, to reduce the message effects, other studies may further explore the effects of channels and/or times on the corresponding message, or under the similar levels of subjects' prior knowledge about the message content.

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Figure 1. Continue-response measurement (CRM) positive valence ratings.

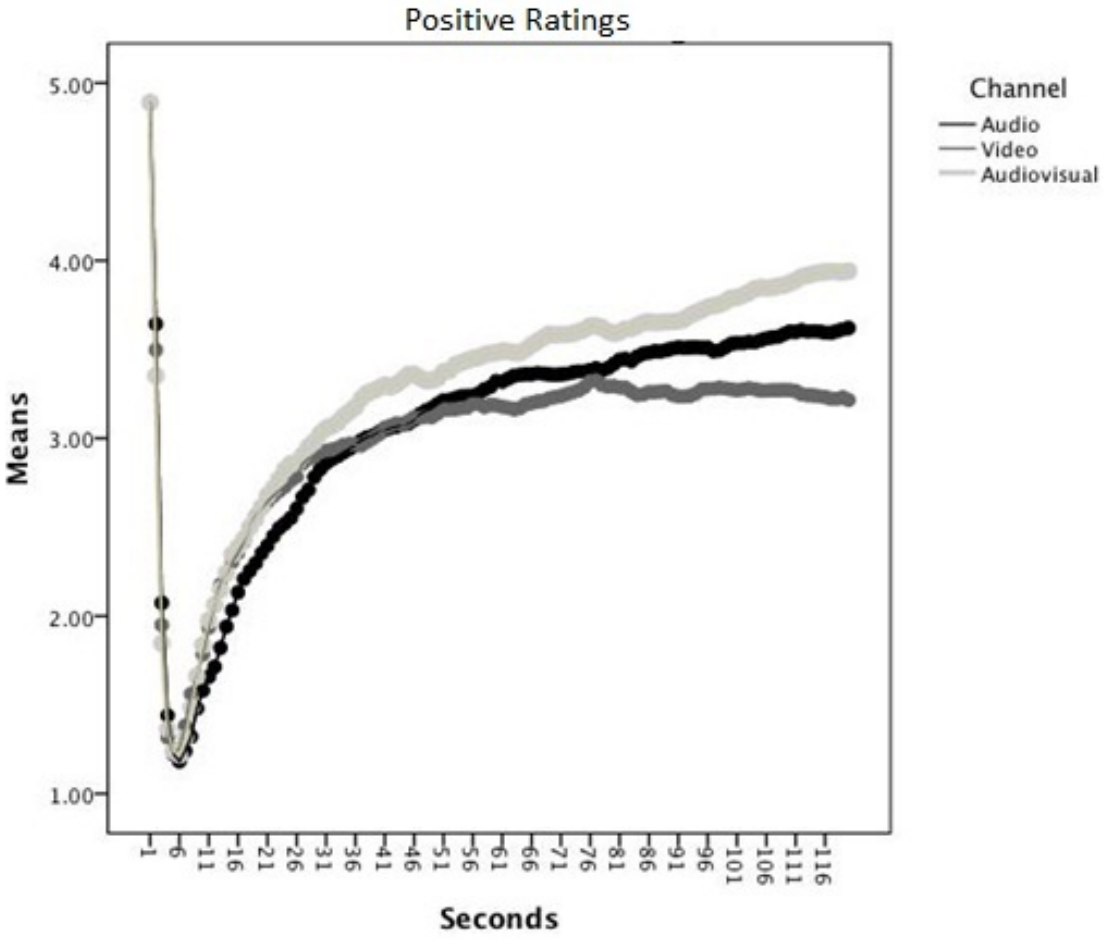


Figure 2. Continue-response measurement (CRM) negative valence ratings.

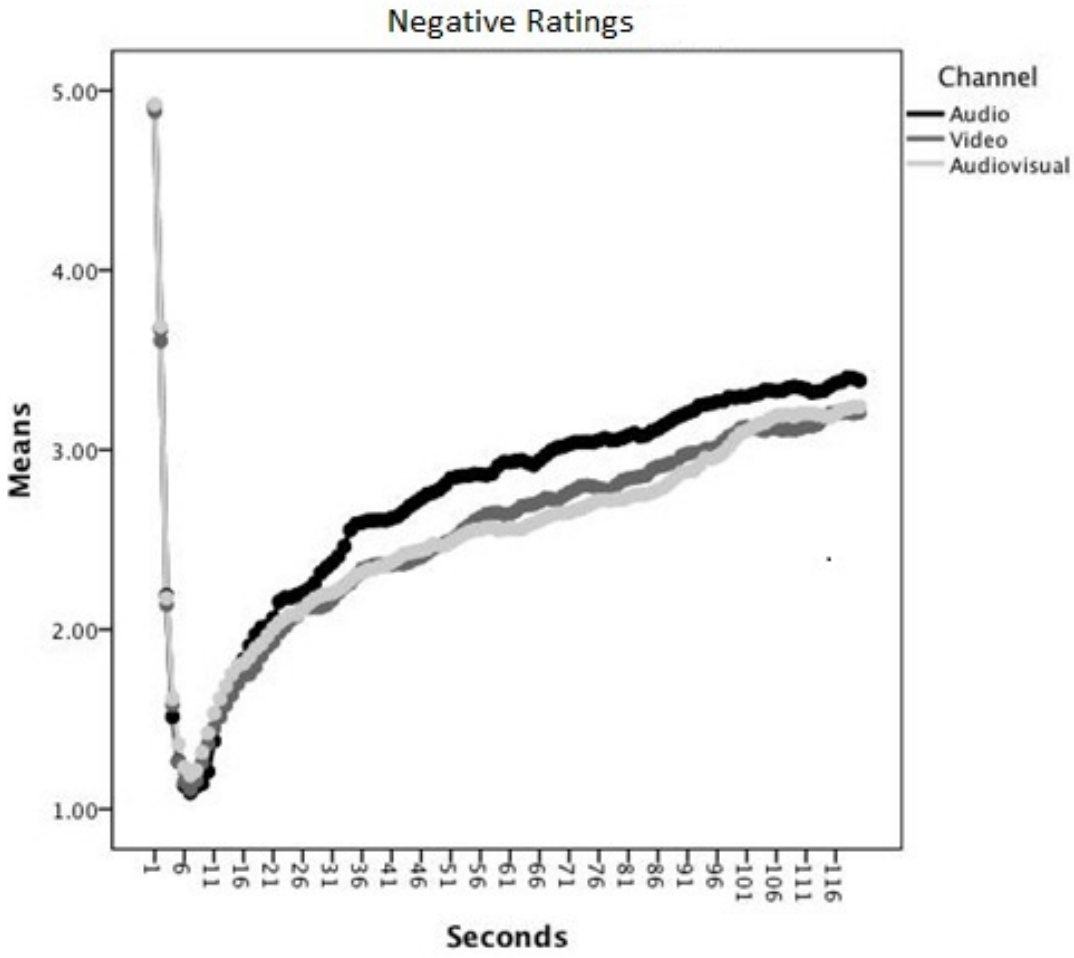
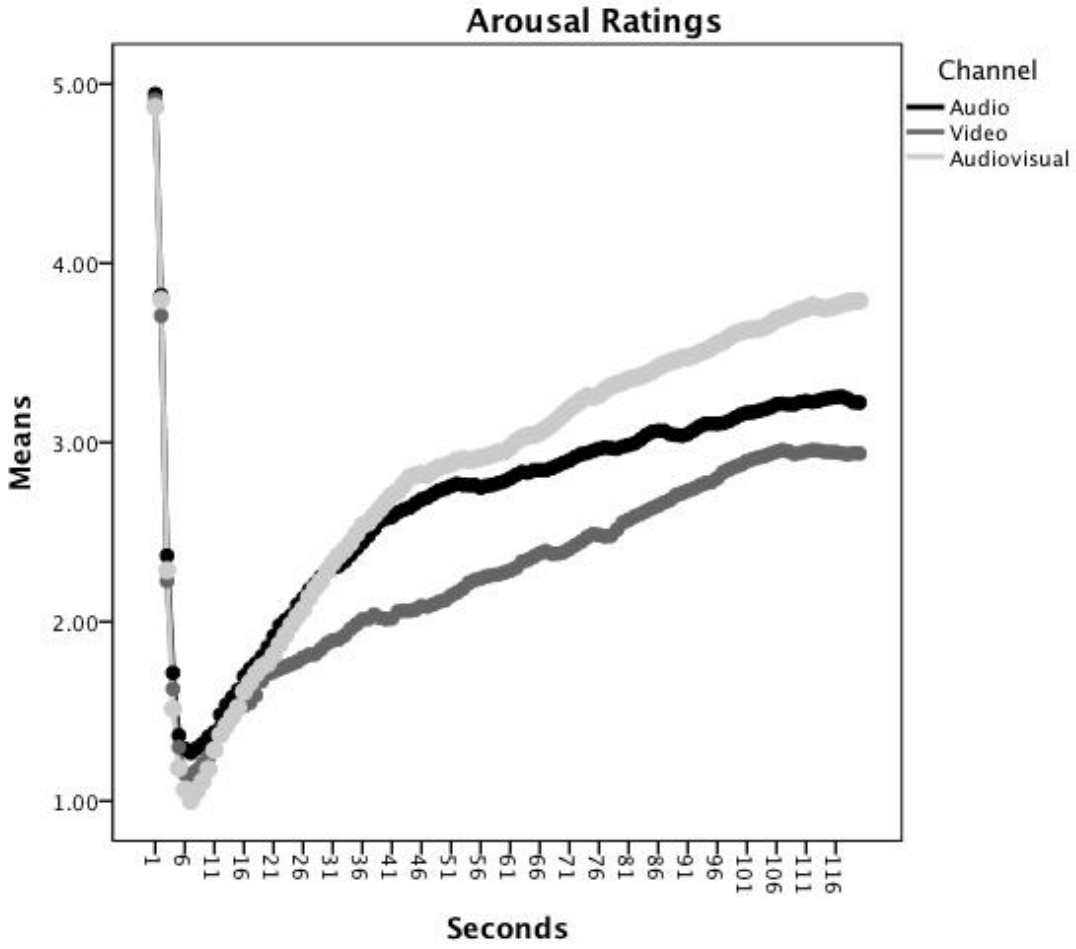


Figure 3. Continue-response measurement (CRM) arousal ratings.



Appendix 1

List of selected television message clips

Clip	Program	Genre
1	Bar Karma	Drama
2	Blood Ties	Drama
3	Criminal Minds	Drama
4	House	Drama
5	Leverage	Drama
6	NCIS	Drama
7	Star Trek	Drama
8	Supernatural 1	Drama
9	Supernatural 2	Drama
10	Caught in the Act	Educational Programming
11	Egypt: Engineering	Educational Programming
12	Factory Made	Educational Programming
13	Hooked	Educational Programming
14	Merlin: The Legend	Educational Programming
15	Operation Reunion	Educational Programming
16	Snake Wranglers	Educational Programming
17	The woman with 15 personalities	Educational Programming
18	Aftermath	Educational Programming
19	Invictus	Movie
20	John Q	Movie
21	Mr. Deeds	Movie
22	The Scorpion King	Movie
23	Starsky & Hutch	Movie
24	The Cake Eaters	Movie
25	The Old Man and the Sea	Movie
26	The Scout	Movie
27	Two Lovers	Movie
28	American Chopper	Reality
29	Carnivore Chronicles	Reality
30	Hardcore Pawn	Reality
31	Hording: Buried Alive	Reality
32	Las Vegas Jailhouse	Reality
33	My Fair Wedding with David Tutera	Reality
34	My First Place	Reality
35	America's Next Top Model	Reality
36	What's Eating You	Reality

Appendix 2

Presentation Order

	Order 1	Order 2	Order 3	Order 4	Order 5	Order 6	Order 7	Order 8	Order 9
	Arousal	**Pleasant**	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**
Clip 1	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 2	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 3	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 4	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 5	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 6	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 7	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 8	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 9	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 10	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 11	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 12	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
	Pleasant	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**
Clip 13	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 14	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 15	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 16	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 17	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 18	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio

	Order 10	Order 11	Order 12	Order 13	Order 14	Order 15	Order 16	Order 17	Order 18
	Pleasant	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**
Clip 19	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 20	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 21	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 22	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 23	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 24	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
	Unpleasant	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**	**Pleasant**	**Unpleasant**	**Arousal**	**Pleasant**
Clip 25	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 26	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 27	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 28	Audio	Audio	Audio	Video	Video	Video	AV	AV	AV
Clip 29	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 30	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 31	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 32	Video	Video	Video	AV	AV	AV	Audio	Audio	Audio
Clip 33	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 34	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 35	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video
Clip 36	AV	AV	AV	Audio	Audio	Audio	Video	Video	Video