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Motivational system approach to understand ad processing following various game outcomes

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ABSTRACT

In this study we test how audience emotions induced by televised sports interact with the emotional tone of advertisements to influence ad processing. Past research exploring this carry-over effect has either neglected the arousal induced by the sporting event or failed to present positive and negative ads to participants. In this study we use a 2 (sports-induced valence: positive/negative) x 2 (sports-induced arousal: calm/arousing), x 2 (ad valence: positive/negative) mixed-design experiment. Participants had psychophysiological measures of cognitive resource allocation and emotional response measured throughout. We found that positive advertisements performed best in cognitive resource allocation in a congruent arousing/positive programming context, whereas negative advertisements worked better following an incongruent calm/positive programming context. Theoretical and practical contributions are discussed.

KEYWORDS

Televised sports; advertisement; placement strategies; dual-motivational system

Introduction

Sports broadcasting is often packed with numerous video advertising (e.g., Lee et al., 2018). During the Super Bowl 2021, there were 65 commercials aired in front of 91.5 million viewers, which took up 18% (46 minutes) of the entire broadcasting time and generated $485 million in revenue (each ad costs $5.6 million; Lapin, 2022). While advertisers utilize various tactics to capture the audience's attention among numerous commercials aired during a sporting event, emotional appeal advertising is one of the common strategies in the field including sports broadcasting (e.g., Kim et al., 2013; Lee et al., 2018). For example, there were various emotional commercials aired during the Super Bowl 2021, utilizing various emotional appeals ranging from positive emotional cues (e.g., humor, excitement, love; Cheetos' "It Wasn't Me", State Farm's "Drake from State Farm") to negative emotional cues (e.g., fear, disgust, sadness; Bud Light's "Last Year's Lemons", Toyota's "Jessica Long's Story").

With emotional advertising, marketers tend to stimulate viewers' emotions (e.g., humor, excitement, love, fear, disgust, sadness) in order to increase viewers' attention and memory and urge audiences to purchase services and products (e.g., Jeon et al., 1999). It is a common

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finding from previous literature that emotional appeals have a substantial impact on effectiveness (e.g., memory and attitude) of the commercials (e.g., Couwenberg et al., 2017; Otamendi & Martín, 2020). It has been found that an emotional message is more likely to capture attention, be remembered, and produces more favorable attitude than an informative/rational message (e.g., Grigaliunaite & Pileliene, 2016; Page et al., 1990). Notably, negative emotional appeals are known to generate a high level of attention and memory (e.g., Biener et al., 2004; Bolls et al., 2001), whereas positive emotional tones are known to elicit an elevated level of positive attitude toward the advertisement and advertised brand (Eckler & Bolls, 2011; Lee et al., 2018).

However, the impact of emotional appeals could be mixed when the emotional commercials are presented at a certain moment of a program because the program context may change viewers' emotional states. For example, exposure to an emotionally negative advertisement following a team's loss may make the team's fans angry whereas an emotionally positive advertisement may soothe or calm their emotions (Lee et al., 2018). While there have been numerous studies that examined the emotional and cognitive information processing of advertisements as a function of program context (e.g., Bellman et al., 2016; Lord et al., 2001), findings of the previous studies have been contradictory. Thus, the current study aims to reinvestigate this specific topic of how emotions induced from programming and subsequent advertising interact to influence the processing of the persuasive message.

Past work has supported one of these two propositions. The first suggests that an advertisement is better processed when its emotional tone is consistent with the programming that precedes it. For example, some research has found that a positive advertisement is more memorable when presented after a happy program than after a sad program, while a negative advertisement is better remembered when played after a sad program than a happy program (e.g., Furnham & Goh, 2014; Lord et al., 2001). The second conclusion is supported by data showing viewers are better at processing a commercial when it is emotionally inconsistent with the program that precedes it (e.g., Feltham & Arnold, 1994; Srull, 1983). The mixed findings in the literature provide marketers with no clear guidance on strategic planning and present researchers with a challenge to determine what theoretical approach will help clarify the cognitive processes consumers employ.

A probable reason for the contradictory findings in previous studies is the limited conceptualization of emotion, which primarily focused on emotional valence and operationalized congruity between a preceding program and commercial contexts accordingly (e.g., Kamins et al., 1991). Emotional valence, however, is only one aspect of a dimensional theory of emotion (e.g., Osgood et al., 1957). The other dimension, emotional arousal, plays an extremely significant role in determining which environmental information gets processed (e.g., Russell & Mehrabian, 1977; Singh & Churchill, 1987). Also, substantial literature based on a dynamic, motivationally driven, limited capacity model of cognition (Lang, 2006a, 2006b) provides empirical evidence that emotional valence *and* arousal induced from messages interact to influence patterns of information processing (e.g., Lang et al., 2013; Wang & Lang, 2012). Thus, the possible effects of emotional arousal contained in messages have not been controlled or tested in previous studies in the area of programming/advertising congruity (cf., Shapiro et al., 2002), leading to the conflicting results mentioned above.

Wang and Lang (2012) used Zillmann's (1971) excitation transfer theory to predict the activation and decay of motivational systems activation as the underlying mechanism producing the arousal effect on the subsequent message. They proposed that motivational system activation in viewers of TV programming content takes time to decay. As a result, the associated activation transfers to the processing of subsequent commercials. Their study tested the effect of the *decaying* motivational systems on the subsequent *neutral* ad processing to capture the pure impact of the motivational system's decay on subsequent message processing. This study extends Wang and Lang's study and argues that the dynamics of motivational systems' activation and decay can explain the message sequence effect not only regarding excitation transfer (Wang & Lang, 2012) but also affective priming and mood congruency. We test how the emotional valence *and* arousal experienced while watching television programming interacts with the positive and negative valence (not neutral) of the subsequent advertisements to impact processing. In this case, the decayed activation pattern elicited by television programming is again predicted to interact with the activation elicited by subsequent advertisements, leading to a new emergent pattern of activation.

In addition to our contributions to testing and extending the existing theories, the current study further adds to the literature in several ways. The first addition concerns the stimuli used in this experiment. Participants watched competitive sports programming, a genre yet to be explored by scholars of programming/advertising congruency. Most experiments have exposed participants to comedy (e.g., Lord et al., 2001; Potter et al., 2006), drama (e.g., Furnham & Goh, 2014; Potter et al., 2006), or reality programming (e.g., Bellman et al., 2016) prior to advertising presentation. While these are popular programming genres and allow for easy manipulation of emotional valence by researchers, sports programming is one of the most globally beloved genres not only for viewers but also for marketers. For example, in the United States alone, televised sports attracted 812 million global TV viewers (sportsmarketanalytics.com) and generated 34.9 billion in ad revenue (Plunkettresearch.com) in 2016. Also, sports programming generates more significant levels of emotional responses, engagement, intrigue, and ritualized behavior in viewers than other genres such as comedy and drama (Gants et al., 2006). The unscripted nature of televised sports has a powerful ability to produce emotional responses such as "thrill in victory" (Gantz, 1981) and a sense of being "pumped up" (Wann, 1995), which may help us reconcile the mixed findings on this topic.

Another contribution of this study is the variety of variables employed. Biometric measures were utilized to capture dynamic cognitive processing during ad exposure. Facial muscle activation known to correlate with experienced emotional valence (e.g., Bolls et al., 2001) was used to confirm manipulations in positive and negative programming and ad valence. Electrodermal activity, which is known to correlate with arousal associated with sympathetic nervous system activation (Bailey, 2017), confirmed programming excitement manipulations. Cardiac activity operationalized attentional resource allocation to the advertisements in real-time (Potter & Bolls, 2012). This was then augmented with traditional self-reported recognition memory measures to best understand the influence of programming context on advertising message processing.

Theoretical Predictions

This study was guided by the theoretical perspectives of Lang's Limited Capacity Model of Motivated, Mediated Messages Processing, or LC4MP (Lang, 2006a, 2006b), which conceptualizes human emotional response as being driven in large part by two different motivational systems, the appetitive system and the aversive system (Lang et al., 2005). Both have evolved to activate in different ways and at different rates depending upon the situation (see, Figure 1). For example, when the environment is comparatively calm, the appetitive system is more activated than the aversive system, a phenomenon known as *positivity offset*. This enhanced approach activation has evolved through survival mechanisms of food foraging and mate pursuit. Similarly, the systems have evolved to have different optimizations in their speed of activation as the environment becomes more intense. Environmental negativity coupled with increased arousal, for example, causes more rapid activation of the aversive system than similar increases in arousal for the appetitive system when the environment is positive. This difference in activation rate is known as the *negativity bias*.

The LC4MP is based upon the thesis that the human brain responds to mediated environmental cues in the same way that it evolved to respond to things that actually happen around us (Reeves & Nass, 1996). Furthermore, the amount of resources allocated to media content varies according to which motivational system is predominantly activated. When positive information activates the appetitive system, more resources are allocated to encoding environmental details, an evolved trait due to the necessity for optimizing specific information about where positive things like food and potential mates can be found. Unlike the appetitive system, however, when the aversive system increases in activation, there is a point at which allocating cognitive resources to encoding specific information ceases because the threshold of a defense cascade has been surpassed

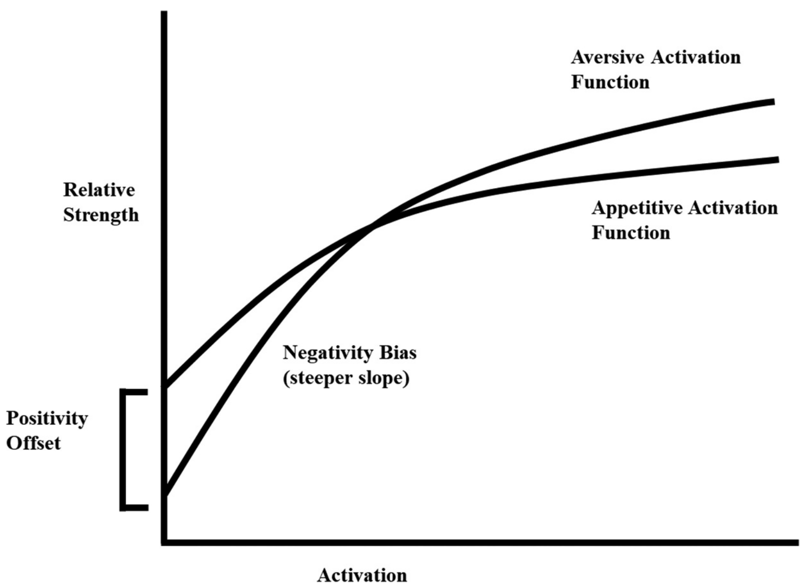

Figure 1. The activation functions of the appetitive motivational system and the aversive motivational system according to LC4MP. (Figure reprinted with permission from Lang et al., 2005).

(Bradley et al., 2001). In other words, the imperative is to escape the situation, not to encode more details about it. Therefore, LC4MP predicts that as arousal increases during pleasant environmental experiences, the appetitive system activates, and more cognitive resources are allocated to encoding details. But when arousal increases in negative environments, the aversive system becomes more activated, leading to decreases in encoding efficiency. At low and moderate levels of environmental arousal, more information is encoded from the negative environment because details are still relevant for assessing threat. In conditions of moderate to high arousal, however, negative environments ramp the drive to escape to a point beyond the threshold of the defense cascade, resulting in fewer resources allocated for encoding detailed information (e.g., Lang & Yegiyan, 2011).

Specific hypotheses based on these theoretical assumptions have been widely supported in studies testing the behavior of the motivational systems when they are immersed within various mediated message contexts such as television news, advertisements, and games (e.g., Baumgartner & Wirth, 2012; Chung & Sparks, 2016; Lang et al., 2013; Sparks & Lang, 2015). However, in the case of *transitions* between programming content and advertising, the predictions become more complicated. Different combinations of emotional valence and arousal between programs and advertisements elicit different sequences of motivational activation, which result in more dynamic patterns of information processing than found in a programming-only context (Keene & Lang, 2016). The LC4MP views motivational system activation as fluctuating rather than binary. In other words, the aversive and appetitive systems do not turn off and on immediately, but instead activation levels vary over time – intensifying and decaying according to dynamic interactions with the environment. Thus, motivational activation caused by a previous message influences information processing of a subsequent message. This notion is empirically supported in past advertising studies (e.g., Wang & Lang, 2012; Yegiyan, 2015). For example, Wang and Lang (2012) found that arousing programming content elicits greater system activation and increased arousal during subsequent neutral ad processing compared to calm programming content. It is expected, therefore, that this difference in activation levels between programming content will spill over to the processing of the subsequent commercials and result in differences in automatic resource allocation to encoding the information they contain.

Specifically, assuming there will be more arousal experienced during the processing of an ad following arousing television content than following calm content, the arousal will transfer to – and interact with – the environmental valence associated with the advertisement to activate the appropriate motivational system. This, in turn, will result in differences in resource allocation to encoding information from the advertisement. For positive advertisements, it is expected that participants will increase cognitive resource allocation to ads following arousing programming content compared to calm programming content because the high arousal state still decaying from the programming will combine with the positive valence of the advertising message to activate the appetitive motivational system. This will also result in better encoding of information for positive ads following arousing programming compared to calm. The opposite pattern is expected for negative advertisements. Residual arousal from the programming content will combine with the negative valence of the ad to activate the aversive motivational system. The greater slope of the activation function for the aversive system (i.e., negativity bias; see,

Figure 1) will increase the likelihood that viewers will surpass the threshold of the defense cascade and stop allocating resources to the task of encoding detailed information from the advertisements.

Based on the assumptions of LC4MP and the results of previous studies (Wang & Lang, 2012; Yegiyan, 2015), the following hypothesis was developed:

Hypothesis 1: There will be an interaction between program-induced arousal and the emotional valence of the subsequent advertisement on cognitive resource allocation to encoding. Positive advertisements following arousing programming will elicit greater cognitive resource allocation to encoding than those advertisements following calm programming. On the other hand, negative advertisements following arousing programming will elicit less cognitive resource allocation to encoding than those advertisements following calm programming.

Another underlying assumption of LC4MP is the appetitive and aversive systems can activate and deactivate independently of each other (e.g., Berntson & Cacioppo, 2008). LC4MP suggests that more cognitive resources are allocated when both systems are activated (i.e., coactivation) than when only a single system is activated (Keene & Lang, 2016; Sparks & Lang, 2015). In other words, evolutionary biological benefits (e.g., reward, threat) from each system result in cognitive resources being made available to process information during coactivation. The coactivation mechanism that two active systems work better than one single system is supported by previous studies that positive and negative messages are co-occurring. In other words, the two systems are activated simultaneously with relatively equal activation strength. However, in this study, the two systems are activated separately, with one system being activated first by preceding messages and then the other system being activated later while the first system's activation is decaying. In this case, it is certain that the two systems are co-active at the beginning stage of the second message, but we are not sure when the decaying system will stop influencing information processing. Another difference in this message sequence case is that the two systems' activation strength is not balanced.

Considering those differences, we want to see whether the co-activation mechanism found in earlier studies applies to this message sequence situation. Specifically, in this study, when the emotional valence of the programming content does not match that of the subsequent advertisement (i.e., positive TV programming/negative ad or negative TV programming/positive ad), the emotional valence of the TV program first activates the corresponding motivational system, resulting in the allocation of the accompanying cognitive resources. This function will then decay as the TV programming ends and the valence-inconsistent advertisement begins, activating the other motivational system. At the beginning of the advertisement, both motivational systems will be coactive. We argue that across viewing time, greater cognitive resources will be allocated to encoding the advertisement following TV programs of incongruent valence compared to when the TV programming and the ad are of the same valence. More specifically, viewers will exhibit on average greater cognitive resource allocation and better encoding for advertisements that are of different valence than the TV programming preceding them than ads that are of congruent valence.

Hypothesis 2: There will be an interaction between program-induced valence and the emotional valence of the subsequent advertisement on cognitive resource allocation to encoding. Incongruent program-ad valence will generate greater cognitive resource allocation to encoding than congruent program-ad valence.

While none of the previous studies have explored the impact of intensity or arousal of the messages when investigating the (mis)match of valence between programming content and subsequent ads, some have reported that the level of content arousal in a single message possibly moderates the coactive messages effect on attention and memory (i.e., Lang et al., 2013; Wang et al., 2012). For example, Lang et al. (2013) found that at low to medium levels of emotional arousal, co-active messages performed better in terms of recall and recognition than messages that activate only a single motivational system (i.e., appetitive or aversive). On the other hand, at medium to high levels of emotional arousal, no such differences in memory were detected, and even positive messages received more resource allocation than coactive messages. Similarly, Wang et al. (2012) found that arousing co-active messages elicit less cognitive resource allocation than calm co-active messages. These conclusions, again, were derived from data when positive and negative content is co-occurring in a sole source of content rather than coactivation resulting from the transition from one source (TV programming) to another (advertising), as is the case in the current study. The authors of previous work suggest that when the two systems are activated simultaneously with equal strength, the aversive system overrides the appetitive system because of different functional roles for survival. Thus, when both systems are spontaneously activated at high levels, the aversive system is more dominant than the appetitive system because of the survival mechanism, leading to information rejection. Therefore, less attentional resources are allocated to process an arousing co-active message than a calm co-active message.

More recently, Keene and Lang (2016) tested the processing of different valence sequences within a single message narrative (e.g., sequentially positive and negative, sequentially negative and positive) and hypothesized that different emotional trajectories would affect cognitive information processing through the mechanism of coactivation. Results showed that sequences that first induce positive valence and then negative valence resulted in better information encoding than when the valence sequence was reversed. This suggests that dynamic changes in emotional tone within messages would be a crucial factor to understand the program/ad (mis)match effect, and that greater resource allocation might be expected when positive programming is followed by a negatively valenced advertisement. However, because Keene and Lang (2016) used messages selected specifically to be moderately arousing, it becomes a question of whether changes in the arousal level would alter the pattern mentioned above. Therefore, the current study asked whether level of arousal induced by the programming moderates the program/ad (mis)match effect. We do not make directional predictions, but based on the studies mentioned above, expect that advertisements will be processed differently depending upon both the valence of their content and the valence and arousal of the preceding TV programming.

Hypothesis 3: There will be a significant three-way interaction between Program-induced valence, Program-induced arousal, and Ad-induced valence on cognitive resource allocation to encoding.

Method

Design

This experiment utilized a 2 (Program-induced valence: positive, negative) × 2 (Program-induced arousal: calm, arousing) × 2 (Ad-induced valence: positive, negative) × 2 (video replication) mixed design. The video replication factor was between subjects, which allowed for two examples of each valence/arousal combination to be identified in different examples of sports competitions. Participants were randomly assigned to one of the two different levels of this factor. This video replication factor also allowed a second set of eight commercials to be tested, increasing the generalizability of findings (Jackson & Jacobs, 1983) as adopted by previous work in this area (e.g., Lord et al., 2001). Thus, in total, 16 commercials were used in this experiment. Each commercial was paired with each TV program clip using a Latin square design. Therefore, across participants, each advertisement was played after each of the four emotional trajectories of TV programming content. Also, the commercials' emotional valence and product categories (e.g., beer, retailer, insurance) were counterbalanced within each Program-induced valence × Program-induced arousal cell. The presentation order of the eight paired programming/advertisement clips was completely randomized by MediaLab software (Jarvis, 2012).

Stimuli

TV programming

Segments of televised collegiate basketball competitions were used as experimental material. Emotional valence was presumed to be induced via sports competitions through a win or loss by the participants' favorite team and the closeness of the score differentials was presumed to regulate levels of experienced emotional arousal (Bee & Madrigal, 2012). For example, watching a favorite team win an extremely close match generates arousing positive feelings in fans whereas witnessing a lopsided loss generates calm negative reactions.

To select possible stimuli, National Collegiate Athletes Association (NCAA) basketball games were reviewed by the first author from the three seasons preceding data collection. All reviewed games featured the team representing the university at which data were collected. This university has a student body known for being engaged in team performance. Based on Gan et al. (1997)'s categorization (e.g., close:1-4 points; lopsided: 15 or more points), a total of 8 games were selected to best represent four-game situations thought to map out arousal/valence conditions: a narrow victory [arousing/positive], a comfortable victory [calm/positive], a loss by a narrow margin [arousing/negative], and a sizeable defeat [calm/negative]. The last four minutes of the games excluding replays and time-outs were tested. Self-report pre-test data of 65 undergraduate students at the university confirmed the representational validity of these stimuli as indicated by self-reported valence (i.e., not at all positive/happy/pleasant [1] to extremely positive/happy/pleasant [7]) and arousal (i.e., not at all arousing/exciting/awake [1] to extremely arousing/exciting/awake [7]). Winning was rated as significantly more positive ($M_{positive}$ = 4.89) than losing ($M_{positive}$ = 2.30), F (1, 255) = 197.84, $p < .001$. Also, the games with a narrow margin of victory were rated as significantly more arousing (M_{arousal} = 5.02) than lopsided games ($M_{arousal}$ = 2.95), $p < .001$. No significant interaction effects were observed in the pretest data.

Advertisements

Potential English-language advertising stimuli were gathered from countries outside the location where the study was conducted (i.e., Canada, United Kingdom, Australia), based on suggestions from previous research (e.g., Bellman et al., 2016). This outside-market approach was taken to control for prior experiences with brands and advertisements. After analyzing pre-test data of 65 undergraduate students at the university, 16 advertisements were identified with a medium level of arousal (M = 3.73; not at all exciting [1] to extremely exciting [7]) and a low level of ad (M = 1.48) and brand (M = 1.34) familiarity (e.g., unfamiliar [1] to familiar [7]). The first half was intended to induce pleasant feelings while the other half was presumed to induce unpleasant feelings. The first half ($M_{positive}$ = 4.40, $M_{negative}$ = 1.71) was evaluated as significantly more positive (e.g., not at all positive [1] to extremely positive [7]) and less negative (e.g., not at all negative [1] to extremely negative [2]) than the other half ($M_{positive}$ = 1.71, $M_{negative}$ = 4.05), $p < .001$. Various product categories were used across both valences. The modal duration for the advertisements was 30 seconds, with the range of duration being 30-74 seconds. The two levels of the ad valence factor did not differ on self-reported pretest values for arousal, brand familiarity, advertisement familiarity, or duration. Descriptive statistics of the selected commercials are reported in Appendix 1.

Measures

Physiological Measures

Emotional responses and cognitive resource allocation during the television programming were operationalized physiologically (Potter & Bolls, 2012). Physiological measures capture participants' immediate reactions to experimental stimuli and thus are more objective than self-reported measures. More importantly, these measures can record human emotions in real time therefore are able to reflect the dynamic responses toward the sport and ad stimuli (e.g., Wang & Lang, 2012).

Emotional valence was measured using facial electromyography (fEMG). Decades of research have demonstrated the close relationship between fEMG patterns and human emotion. Increased fEMG activity in the corrugator muscle region (known as the frowning muscle) is associated with increased aversive motivational activation, reflecting increased negative emotion. Hence in this study, the corrugator (frowning) muscle group, a region above the eyebrow, was measured as an indication of negative emotion (e.g., Wang & Lang, 2012; Yegiyan, 2015). Higher corrugator muscle activation means higher aversive system activation and greater negative emotions (e.g., Neta et al., 2009; Wang & Lang, 2012). Similarly, decreases in corrugator activation can be interpreted as increased activation of appetitive motivational systems (i.e., a positive response; Larsen et al., 2003; Neta et al., 2009)

Emotional arousal – ranging from calm to arousing (e.g., Lang et al., 2005) – was measured using skin conductance level through electrodermal activity (EDA). Operationally, this was collected by placing two sensors on the participant's nondominant palm to capture variations of the electrical conductance of the skin due to the eccrine sweat gland activity. Skin conductance level (SCL) is a good indicator of tonic emotional arousal with higher SCL indicating a more aroused state (Bailey, 2017; Potter & Bolls, 2012; Wang & Lang, 2012).

Deceleration of the heart rate (HR) was used as an indicator of cognitive resource allocation (Potter & Bolls, 2012). Results from previous research have consistently reported that a deceleration in cardiac activity reveals an increase in cognitive resource allocation while an acceleration in cardiac activity indicates a decrease in cognitive effort allocated to encoding information (for a review see, Wise, 2017). For the current study, an electrocardiogram was used to record cardiac activity. The milliseconds between heartbeats were converted to beats per minute (BPM) aggregated each second. Change scores were calculated by subtracting the BPM scores at each of the first 30 seconds of the commercial from the BPM values one second prior to the onset of the advertisement.

The analog physiological signals were sampled at 1000 Hz. Standard physiological data cleaning and preprocessing procedures were followed (see, Potter & Bolls, 2012). fEGM and EDA data were then aggregated per second for the last 30 s of each sporting event and the first 30 seconds of each advertisement. Change scores from the baseline (i.e., value at each second minus the value at the onset of a stimulus) were calculated and used for data analysis.

Brand and Visual Recognition

Encoding performance was measured through visual recognition tasks involving the advertised brands and other visual stimuli appearing in the commercials (e.g., Sparks & Lang, 2015; Wang & Lang, 2012). The recognition tasks asked participants to respond "yes" or "no" to the following questions: "Have you seen the presented brand logo while watching the commercial stimuli?" and "Have you seen the exact same scene while watching the commercial stimuli?" For brand recognition tests, eight brand logos actually seen during the protocol served as targets and another eight logos, which were either the same brand logos made with an altered design or the same logo design associated with a different brand name served as foils. All were randomly presented on the computer screen. Also, eight visual recognition images were taken from scenes of the stimuli advertisements and eight foil images were found which were selected from different commercials with high visual similarity (e.g., same actor/actress, same brand logo). To control for the order and fatigue effect, the recognition probes were randomly presented and remained for 750 milliseconds, as administered by DirectRT (Jarvis, 2012).

Participants were instructed to press the appropriate button as fast as possible. Participants were given a practice session of the visual recognition task. Correct answers were scored "1" and incorrect "0". High scores here revealed greater accuracy in discriminating between targets and foils.

Participants

Invitation letters describing the voluntary and confidential nature of the study were distributed to undergraduate students (~300) attending a large university located in the Midwestern region of the United States. Those receiving an invitation were asked to select a convenient time for their lab participation. Each time slot had only one participant. Sixty-eight participants (21 females) volunteered to participate. The identification level with the university's men's basketball team was measured prior to stimulus presentation using

Robinson and Trail (2005)'s team identification scale. Results of this showed that the participants were highly identified with the team ($M_{\textit{Identification level}}$ = 6.03 out of 7.00 points).

Procedure

Each participant was first greeted by a researcher who briefly explained the study. If the subject agreed to participate, they were seated in a comfortable chair in front of a 42-inch LCD television screen in a simulated dorm room. The room lighting was controlled, with the overhead light turned off, across participants. Similarly, the room temperature was computer controlled to remain constant during each session and across participants. Physiological sensors were attached to the palm of the non-dominant hand to measure skin conductance, to the forearms for ECG measurements, and to the face above the left eyebrow for the EMG measurements. Next, the participant completed a short questionnaire consisting of demographic questions and the team identification scale.

As soon as the participant was comfortable and understood the protocol, they were told they would be shown the final minutes of eight sports broadcasts and that they should watch them in a manner resembling how they would watch in real life. Participants were not told their memory would be tested later in the study session. After the eight programming/advertising sequences were presented randomly, the participant completed a brief unrelated questionnaire intended to clear short-term memory traces of the programming/advertisement sequences. Then the recognition memory test regarding brands and scenes was conducted. Finally, the participants were debriefed and dismissed.

Results

Manipulation checks

Predictions were based on assumptions about the emotional responses that participants would have to outcomes of the sports competitions that they watched. The results of repeated measures ANOVA on physiological data collected during the TV programming indicate that frowning muscle activity was significantly greater when participants watched programs selected to induce negative valence ($M_{negative}$ = .164, SE = .008), compared to those selected to induce positive valence ($M_{positive}$ = .158, SE = .007), $F(1, 66) = 5.96$, $p < .05$, $\eta_p^2 = .083$. Also, programs believed to elicit greater arousal responses due to the narrow point margins resulted in statistically greater mean skin conductance ($M_{arousing}$ = 15.71, SE = 1.08) than programs chosen to lead to calm responses (M_{calm} = 14.44, SE = 1.07), $F(1, 68) = 14.64$, $p < .001$, $\eta_p^2 = .18$.

The hypotheses also relied upon expected emotional responses to advertisements chosen to be positive and negative in overall valence. This manipulation was tested by performing a Program-induced valence (2) × Program-induced arousal (2) × Emotional tone of advertisement (2) repeated-measure ANOVA on Facial EMG and SCL data collected during the first 30 seconds of data collected during commercial processing. Emotional tone of advertisement had a significant main effect on frowning muscle activity, $F(1, 66) = 37.56$, $p < .001$, $\eta_p^2 = .36$. Confirming our manipulation, greater frowning muscle activation occurred as participants processed the negative advertisements (M

$_{negative}$ = .174, SE = .009) compared to the positive advertisements ($M_{positive}$ = .141, SE = .007). Moreover, the level of sympathetic nervous activation as indexed by SCL did not differ during the negative advertisements compared to the positive ones ($p = .99$).

Program carry-over effects were found in both corrugator and SCL data to be consistent with previous studies (Wang & Lang, 2012; Yegiyan, 2015). A main effect of Program valence on corrugator activation during the presentation of advertisements approached significance, $F(1, 66) = 2.85$, $p < .10$, $\eta_p^2 = .04$. Participants exhibited less activation of the frown muscle group suggesting a comparatively positive affective state when they were exposed to advertisements after watching positive programs ($M_{positive}$ = .160, SE = .007) than negative programs ($M_{negative}$ = .166, SE = .008). Also, program arousal had a significant main impact on SCL data, $F(1, 68) = 2.85$, $p < .01$, $\eta_p^2 = .11$. More arousal occurred when participants watched advertisements following arousing TV programming ($M_{arousing}$ = 15.15, SE = 1.05) compared with calm TV programming (M_{calm} = 14.14, SE = 1.06).

In sum, the emotion inductions expected via the experimental stimuli were successful. In addition, as expected, program-induced emotions carried over to influence emotional responses to subsequent advertising. Thus, participants experienced both positive and negative valence when they were exposed to inconsistent emotional combinations between TV program and advertisement. Residual arousal from the TV programming seemed to slowly decay over time. There were no other significant main effects or interactions in the manipulation check analyses. Furthermore, there were no significant main effects or interactions in any of the between-subject analyses involving the two programming induction replication levels. Therefore, these data sources were combined in all tests of hypotheses.

Cognitive resource allocation to encoding

The first hypothesis predicted an interaction between program-induced arousal and the emotional valence of the subsequent advertisements on the amount of cognitive resources allocated to the advertising processing. Cardiac change scores were the dependent variable associated with cognitive resource allocation, therefore a 2 (Program-induced valence) × 2 (Program-induced arousal) × 2 (Ad-induced valence) x 30 (Time) repeated measures ANOVA was performed on cardiac change scores during the first 30 seconds of each advertisement. A significant interaction effect between Program-induced arousal × Ad-induced valence on heart rate change scores was observed, $F(1, 67) = 3.97$, $p < .05$, $\eta_p^2 = .06$. The three-way interaction with Time was not significant ($F < 1$). Figure 2 shows that, as predicted, different patterns of resource allocation were triggered as an interacting function of program-induced arousal and emotional valence of commercial. For positive advertisements, the residual arousal from exciting programming helped to further activate the appetitive motivational system leading to increased resource allocation, indicated by greater cardiac deceleration ($M_{arousing\text{-}positive}$ = − 1.98 SE = .55), compared to positive ads after calm programming ($M_{calm\text{-}positive}$ = − 1.30, SE = .49). Furthermore, as suggested by the concept of negativity bias, when arousing programming content preceded negative ads, participants had significantly less cardiac deceleration ($M_{arousing\text{-}negative}$ = − 1.41, SE = .51) compared to when negative ads following calm programming ($M_{calm\text{-}negative}$ = − 2.72, SE = .50).

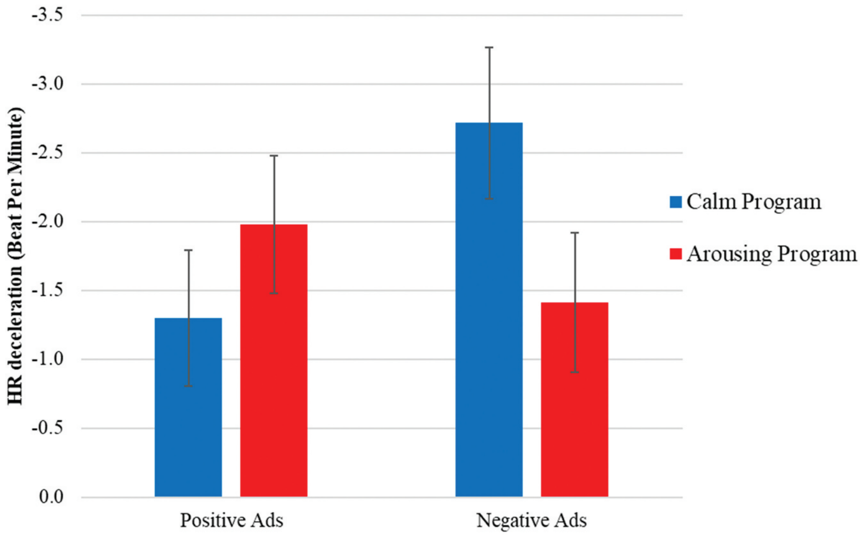

Figure 2. Interaction of program arousal and ad valence on HR deceleration (Error bars indicating SEs).

A repeated measure ANOVA, 2 (Program-induced valence: positive, negative) × 2 (Program-induced arousal: calm, arousing) × 2 (Ad-induced valence: positive, negative) was performed on the visual recognition memory and brand recognition and no statistically significant results were obtained. Therefore, hypothesis 1 was supported for cognitive resource allocation but not for recognition accuracy.

Hypothesis 2 proposed that cognitive resource allocation would be greater for programming/advertisement combinations that were incongruent in valence due to the dual activation of both the appetitive and the aversive motivational systems. A Program-induced valence × Ad-induced valence interaction was significant on cardiac deceleration, $F(1, 67) = 4.53$, $p < .05$, $\eta_p^2 = .06$. Program valence x Ad valence x Time was not significant ($F < 1$). Figure 3 shows greater cognitive resource allocation to the advertisements that were incongruent with the emotional tone of the programming that preceded them ($M_{\text{positive-negative}} = -2.48$, $SE = .49$; $M_{\text{negative-positive}} = 2.22$, $SE = .57$) compared with when they were matched ($M_{\text{positive-positive}} = -1.06$, $SE = .41$; $M_{\text{negative-negative}} = -1.65$, $SE = .48$). Yet, there was no such interaction effect on either visual and brand recognition accuracy. Hence, hypothesis 2 was supported for cognitive resource allocation but not for recognition accuracy.

The third hypothesis predicted a significant three-way interaction between Program-induced valence, Program-induced arousal, and Ad-induced valence on cognitive resource allocation to encoding. There was a marginally significant three-way interaction effect on cardiac deceleration ($F[1, 67] = 3.16$, $p < .08$, $\eta_p^2 = .05$) and a significant interaction on visual recognition accuracy ($F[1, 67] = 4.44$, $p < .05$, $\eta_p^2 = .06$) which can be seen in Figure 4 and Figure 5, respectively. There were no significant results in the brand recognition data. Means, standard errors, and results of planned comparisons are presented in Table 1.

Figure 4 shows that cardiac deceleration occurred during the processing of ads in all viewing situations, suggesting that cognitive resource allocation occurred regardless of the combinations of programming valence, programming arousal, and advertising

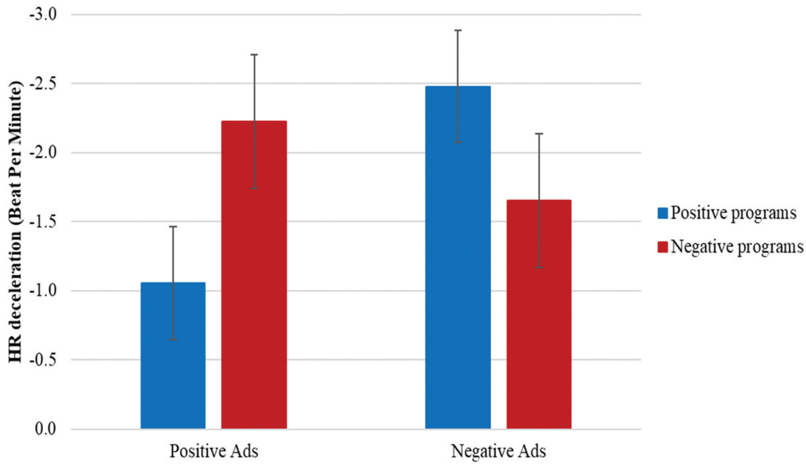

Figure 3. Interaction of program valence and ads valence on HR deceleration (Error bars indicating SEs).

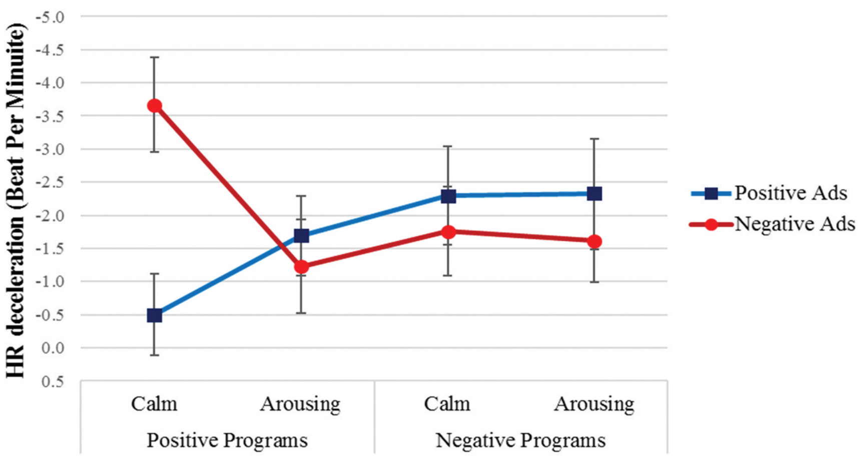

Figure 4. Interaction of program valence and program arousal and ads valence on HR deceleration (Error bars indicating SEs).

valence. The most striking difference between two combinations was that greater resource allocation occurred when calm/positive programming preceded negative advertisements ($M_{\text{calm/positive-negative}} = -3.72$, $SE = .71$) compared to when it preceded positive advertisements ($M_{\text{calm/positive-positive}} = -.41$, $SE = .61$). Planned comparisons tests show this difference was significant ($p < .01$, two-tailed). Less obvious in Figure 4 is that negative advertisements were also allocated significantly more processing resources following calm/positive programming than after arousing/positive programming ($M_{\text{arousing/positive-negative}} = -1.23$, $SE = .70$; $p < .05$, two-tailed), calm/negative programming ($M_{\text{calm/negative-negative}} = -1.71$, $SE = .65$; $p < .05$, two-tailed) and arousing/negative programming ($M_{\text{arousing/negative-negative}} = -1.60$, $SE = .62$; $p < .05$, two-tailed). In addition, positive advertisements received less processing resources following calm/positive programming (M

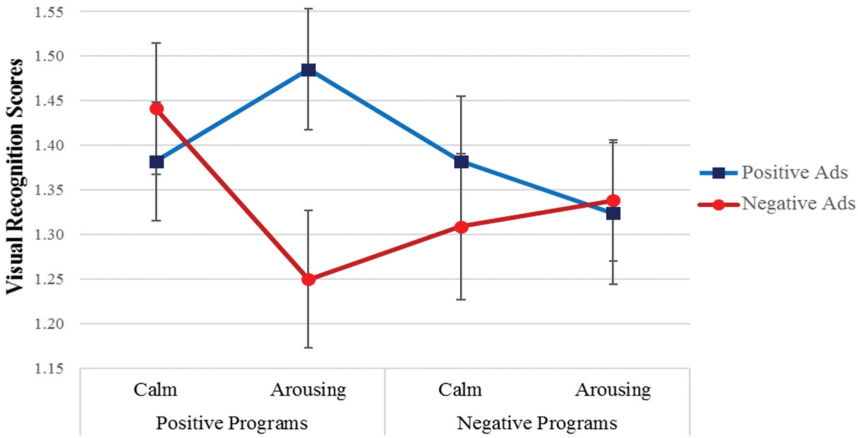

Figure 5. Interaction of program valence and program arousal and ads valence on visual recognition accuracy (Error bars indicating SEs).

Table 1. M (SE) for treatment condition and planned comparison results.

	Positive Program		Negative Program	
	Calm	Arousing	Calm	Arousing
HR deceleration				
Positive Ads	−.413 (.61)$^{b\ 2}$	−1.67 (.60) $^{a\ 12}$	−2.19 (74) $^{a\ 1}$	−2.26 (.82) $^{a\ 1}$
Negative Ads	−3.72 (.70) $^{a\ 1}$	−1.23 (.70$^{)}$ $^{a\ 2}$	−1.71 (.67) $^{a\ 2}$	−1.60 (.62) $^{a\ 2}$
Visual Recognition				
Positive Ads	1.37 (.07) $^{a\ 1}$	1.45 (.07) $^{b\ 1}$	1.40 (.07$^{)}$ $^{a\ 1}$	1.31 (.08) $^{a\ 1}$
Negative Ads	1.43 (.07) $^{a\ 1}$	1.25 (.07) $^{a\ 2}$	1.30(.08) $^{a\ 12}$	1.34 (.07) $^{a\ 12}$
Brand Recognition				
Positive Ads	1.22 (.09) $^{a\ 1}$	1.24 (.08) $^{a\ 1}$	1.21 (.08) $^{a\ 1}$	1.24 (.08) $^{a\ 1}$
Negative Ads	1.10 (.07) $^{a\ 1}$	1.21 (.08) $^{a\ 1}$	1.20 (.08) $^{a\ 1}$	1.16 (.08) $^{a\ 1}$

Note. Within each highlighted measure, means sharing a superscript do not differ significantly from one another ($p < .05$, one-tailed). Letter superscripts are for comparisons between the emotional tone of ads (across columns). Numeral superscripts are for comparisons between programs (across rows).

$_{\text{calm/positive-positive}}$ = − .41, *SE* = .61) than those following calm/negative programming ($M_{\text{calm/negative-positive}}$ = − 2.20, *SE* = .74; $p < .05$, one-tailed) and those following arousing/negative programming ($M_{\text{arousing/negative-positive}}$ = − 2.26, *SE* = 83; $p < .05$, one-tailed).

Figure 5 shows that different patterns of visual information processing occurred as an interacting function of program-induced arousal and emotional valence of commercial. The visual scene recognition data suggests that positive advertisements viewed after arousing/positive programming performed best while negative advertisements presented after calm/positive programming worked best. The most salient difference was detected when positive and negative advertisements were placed after arousing/positive programming. Planned comparisons tests show that visual recognition accuracy was higher when arousing/positive programming preceded positive advertisements ($M_{\text{arousing/positive-positive}}$ = 1.48, *SE* = .07) compared to when it preceded negative advertisement ($M_{\text{arousing/positive-negative}}$ = 1.25, *SE* = .08), $p < .05$, two-tailed. Less obvious in Figure 5 is that negative advertisements were encoded better following calm/positive programing ($M_{\text{calm/positive-negative}} = 1.44$, $SE = .07$) than those following arousing/positive programming ($M_{\text{arousing/positive-negative}} = 1.25$, $SE = .08$), $p < .05$, one-tailed.

Discussion

This study tested the valence and arousal level of sport programming content to explore the interaction between the two on processing of subsequent adverting messages that vary in emotional valence. We found that positive advertisements following arousing sports programs elicited greater cognitive resource allocation (indicated by HR deceleration) when compared with positive ads following calm sports programs. Negative ads, on the other hand, when they were following calm sports programs elicited greater cognitive resource allocation when compared with those following arousing sports programs (hypothesis 1). In addition, when advertisements were placed after TV sports contents of incongruent valence, greater cognitive resources were allocated to process the advertisements (hypothesis 2). Furthermore, the results from physiological and recognition data confirmed that different patterns of information processing occurred as interacting functions of program-induced valence, program-induced arousal, and the emotional valence of the advertisements (hypothesis 3).

The current study extends our understanding of motivated cognition in sequential message processing. We found that the interaction of sport-induced arousal and emotional tones of advertisement lead to different patterns of motivated information processing. As predicted, arousal experienced during sports programs in conjunction with emotional tones of advertisements resulted in different patterns of cognitive resource allocation to process the subsequent advertisement. More attention was given to positive advertisements when they were placed after arousing programs than calm programs. On the other hand, greater cognitive effort on negative advertisement was driven by the preceding calm programs than the arousing programs. With that, the study contributes to the literature from two theoretical perspectives, as discussed below.

The current study demonstrates the advantages of using LC4MP as the unified theoretical framework to explain emotion-related message sequence effects instead of using separate theories to explain different types of message sequence effects. Most major theories of emotion emphasize the importance of considering emotional trajectory, how positive or negative the experience is, and emotional intensity into message sequence effects. Interestingly, much of the literature published in this area focuses only on the valence dimension and examined the effect as a function of (mis)match between preceding message valence and subsequent message valence; or it focuses only on the carryover effect as a function of valence and arousal of the preceding program messages on non-emotionally varying advertising messages (Wang & Lang, 2012; Yegiyan, 2015). We conceptualize the dynamics of the dual-motivational systems, which involve over-time interaction of system decay by previous messages and system activation by subsequent messages, as the underlying mechanism for the emotional sequence effects. This theorization enables us to use LC4MP as a unified theoretical framework to understand message sequence effects better than using separate theories that only addresses one aspect of the effect. For example, the excitation transfer theory only explains the arousal aspect of the sequential effect while affective priming and mood congruency theories only explain the valence aspect of the sequential effect. Indeed, our findings are more supportive of predictions made by LC4MP than the program-ad matching theories (e.g., Lord et al., 2001) and the program-ad incongruence theories (e.g., Srull, 1983).

Second, we demonstrated that the coactivation mechanism that was used to explain the effects of simultaneously activated appetitive and aversive systems (elicited by co-occurring negative and positive content in one single message) can be applied to a context in which one motivational system's activation is decaying over time and the other motivational system is newly activated. For example, in line with the coactivation studies (Keene & Lang, 2016; Lang et al., 2013; Wang et al., 2012), the HR data showed that incongruent messages allocated greater cognitive resources than either continuously pleasant or negative messages when controlling the arousal component. This result suggests that when one motivational system is activated by program contexts and automatically elicits cognitive resources, this function carries over to the next incongruent sequential message, adding additional cognitive resources to process the message. Thus, the message sequence pattern seen here is consistent with findings revealed by earlier studies that examined information processing of co-occurring positive and negative contents (i.e., co-active systems). It shows the power of decaying motivational system on message processing, emphasizing the importance of studying deactivation and sequential dynamics of motivational systems in terms of emotion, cognition, and communication.

Third, we demonstrated how program-induced arousal plays a significant role when viewers process sequentially coactive messages. While this proposition has been rarely tested in previous the program-ad studies or even studies based on the LC4MP. We found that the three-way interaction between programming valence, programming arousal, and advertising valence did reveal differences in recognition performance. Figure 5 shows that memory performance was much higher for positive ads compared to negative ads after arousing and positive programming content. This supports LC4MP's argument that when the appetitive system is highly activated, participants tend to take in as much detail as possible from the environment. When the advertisement begins playing, and it too contains appetitively activating content, the memory for that information is heightened. On the other hand, when the advertisement delivers aversive information (i.e., a negatively valenced message), not only must the appetitive system ramp down, but the aversive system begins ramping up due to the residual arousal from the previous arousing positive content, leading to a point that information rejection occurs.

It should be also noted that both HR and memory performance data revealed a similar pattern concerning negative advertisement processing. Negative advertisements received the greatest cognitive effort (as evidenced by steepest HR deceleration) and highest encoding (as evidenced by highest visual recognition score) when they were preceded by calm positive programs but, elicited the lowest cognitive effort (as evidenced by lowest HR deceleration) and poorest encoding (as evidenced by lowest visual recognition score) when following arousing positive programs. Within the theoretical framework of LC4MP, it can be argued that the remaining appetitive system activated by calm positive programs allocate a certain amount of mental resources. Then, subsequent aversive activation at moderate level during processing a negative advertisement adds extra cognitive resources. Also, the aversive system was generally thought to activate more quickly in response to negative stimuli (e.g., threat) and more slowly decay than the appetitive system as it is more critical for survival (Lang et al., 2013; Wang & Lang, 2012). Therefore, when a negative advertisement is played after a calm positive program, one needs to pay attention to the aversive stimuli (e.g., sudden threat) rather than the disappeared appetitive stimuli (e.g., food, sex). Also, a similar pattern was observed in a case where positive advertisements were preceded by calm negative programs. On the other hand, negative advertisements following arousing positive programs elicited poorest cognitive resource allocation to encoding as has been reported in another research (e.g., Sparks & Lang, 2015; Wang et al., 2012). One possible explanation for this result is that the aversive activation during subsequent negative contents immediately inhibits preceding appetitive activation (Keene & Lang, 2016; Wang et al., 2012), but the residual arousal still functions in the aversive activation and maintains a high level of activation. Similarly, positive advertisements received worst scores for when they were preceded by arousing negative programs among other program contexts – but in this case, high level of aversive activation during the TV programs may slowly decay and override appetitive activation, which lead to memory impairment.

The current study also has important implications for sports programming. In the sport broadcasting context, advertisements are often presented while targets are emotionally stimulated with the major content. Creating effective strategies for the emotionally engaged targets is one of the challenges that sport advertisers face (Lee et al., 2018; Wang & Kaplanidou, 2013). Without a full understanding of program and ad-induced affects, it is difficult to create a successful advertising strategy. Given this, it is unfortunate that so little is known about the dynamic interplay between the cognitive and emotional processing of such an important programming genre and the advertising messages that occur within the programming.

This study provides guidelines to sport marketing professionals and advertisers about how to strategically select the most effective commercials for sporting events. It is a widespread practice that companies produce multiple versions of a commercial (e.g., Nike's Ask our Athletes [Confidence vs. Sasha]) with variations (e.g., stories, characters, duration) to find the best way to target different audience segments (Elliott, 2012). Our results suggest that emotional tone is another important dimension for advertisers to consider varying; different types of emotional appeals produced differences in advertising processing and effectiveness variables. Thus, depending on the game outcomes, companies create media strategies that schedule different versions of a single ad to play to maximize the effectiveness. For example, advertisers would want to air a negative advertisement right after a calm positive situation (e.g., when a viewer's favorite team won by a large margin) and a positive advertisement right after an arousing positive situation (e.g., when a viewer's favorite team won by a small margin). In addition, inserting a negative advertisement after an arousing positive program and a positive advertisement after an arousing negative program should be avoided. Given that sport producers make decisions (e.g., which camera angles to use, when to cut to sponsored breaks, when to switch between different locations such as the stadium and the studio) on the fly all the time, this type of live ad placement strategy should be technically feasible.

Some may argue that the ad placement strategy may not be suited for traditional live broadcasting. However, given that increased viewers watch live sporting events through online streaming services (e.g., YouTube TV, Fubo TV; Kim & Kim, 2020), it is increasingly possible to perform such a programmatic advertising placement strategy. When compared to live sporting events aired through traditional media outlets, it is much easier for advertising practitioners to assess user profile data (e.g., favorite team) through online streaming platforms. Also, sports fans now prefer highlights through online video sharing and social media platforms (e.g., YouTube, Facebook) over live full games (e.g., Baker, 2021). Our implications can be easily applied to highlights/recorded games. As the game outcomes are known at each segment of the game, a valence-appropriate commercial can be inserted ahead of time to the playback for TV programs, or AI programmed to the online video platforms using user-profile data and viewing history.

Nevertheless, there were some limitations. The memory performance data did not support most of the hypotheses that predicted the memory differences at the two-level interaction level. Several reasons might explain the mixed findings. First, there might not be enough trials (i.e., one target and foil) to capture the differences of brand and visual recognition memory across different contexts. Future research should consider using more trials to test recognition memory and/or using auditory memory probes as well. Furthermore, brand logos appeared at the end of advertising in most of stimuli when the program context effect is much less impactful, leading to the no program-ad effect on the memory data. However, given the robustness of visual memory, participants would be able to use other memory recourses to help them to make correct decisions.

Future research should also attempt to address other limitations of the current experiment. Although our results demonstrate the efficacy of using sports competition as a way to manipulate both valence and the intensity with which it is experienced, our design used recorded competitions and thereby eliminated the spontaneous nature of the genre. Thus, future research should replicate the current study in the live sport broadcasting setting. Furthermore, future research in this line should study how the interaction of program-induced emotional content that varies in valence and arousal will interact with the emotional content of subsequent advertisements that not only vary in valence but also in arousal. Also, it would be interesting to investigate how other emotion-evoking situational factors (e.g., injury, time-out) occurring before a commercial break in the middle of a sporting event influence cognitive processing and effectiveness of subsequent commercials. When we know how program-induced emotion varying in valence and arousal interacts with ad-induced emotion also varying in valence arousal, we will have a better understanding of the program-ad effects and provide more accurate guidelines for advertisers.

Disclosure statement

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Appendix 1
Descriptive Statistics of Selected Commercial Stimuli

						Familiarity	
Ads	Product category	Emotional Outcomes	Positivity M(SD)	Negativity M(SD)	Arousal M(SD)	Brand M(SD)	Ads M(SD)
Pos1	Beer	Humor	4.88 (1.11)	1.59 (1.06)	3.94 (1.14)	1.53 (1.57)	1.35 (.86)
Pos2	Daily	Joy	4.63 (1.82)	1.19 (.54)	3.31 (1.54)	1.38 (1.5)	1.00 (.00)
Pos3	Retailer	Humor	3.29 (1.49)	1.71 (1.16)	2.88 (1.65)	1.41 (1.46)	1.24 (.56)
Pos4	Daily	Joy	4.41 (1.62)	2.0 (1.32)	3.71 (1.45)	1.94 (1.89)	1.35 (1.05)
Pos5	Beer	Pride	4.33 (2.09)	1.40 (.50)	3.60 (1.92)	1.93 (1.71)	1.53 (1.40)
Pos6	Daily	Joy	4.45 (1.80)	2.31 (1.43)	3.88 (1.76)	1.18 (.73)	1.12 (.48)
Pos7	Insurance	Humor	4.40 (1.63)	1.94 (1.30)	3.67 (1.71)	1.53 (1.2)	1.93 (1.49)
Pos8	Restaurant	Joy	4.44 (1.15)	1.75 (1.44)	3.75 (.85)	1.62 (1.15)	1.56 (1.20)
Neg1	Beer	Sadness	2.25 (1.65)	4.50 (2.0)	3.19 (1.51)	1.88 (1.78)	1.38 (1.25)
Neg2	Daily	Disgust	1.75 (1.52)	5.31 (1.89)	2.75 (2.17)	1.00 (.00)	1.13 (.5)
Neg3	Retailer	Fear	2.19 (1.17)	3.69 (2.24)	3.88 (2.49)	2.37 (2.09)	1.94 (1.84)
Neg4	Gum	Disgust	2.88 (2.36)	3.38 (2.30)	3.75 (2.10)	1.31 (1.01)	1.06 (.25)
Neg5	Beer	Fear	2.47 (1.80)	3.88 (2.0)	2.88 (1.53)	1.65 (1.54)	1.29 (.85)
Neg6	Restaurant	Disgust	2.29 (1.76)	4.41 (2.6)	3.06 (1.85)	1.12 (.33)	1.18 (.39)
Neg7	Bank	Frustration	2.56 (1.41)	3.50 (1.90)	3.25 (1.73)	1.0 (.00)	1.06 (.25)
Neg8	Theme Park	Fear	2.56 (1.41)	3.69 (1.53)	3.87 (1.54)	1.56 (1.54)	1.69 (4.58)

Note: Pos indicates positive ads while neg indicates negative ads.