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Simmonds, Lucy, Bogomolova, Svetlana, Kennedy, Rachel, Nenycz-Thiel, Magda & Bellman, Steven 2020 'A dual-process model of how incorporating audio-visual sensory cues in video advertising promotes active attention', *Psychology & Marketing* online, pp. 1-11

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A Dual-Process Model of How Incorporating Audio-visual Sensory Cues in Video Advertising Promotes Active Attention

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Accepted *Psychology and Marketing*

Capturing consumers' attention to video advertising is a key marketing challenge. Using real video advertising viewed by a sample of consumers matching the US population on age and gender, the authors examined attention to audio-visual and visual sensory cues identifying the brand using a biometric measure, phasic heart rate. The findings show differences in attention type depending on which senses are stimulated by the sensory cue. This research uncovers a mechanism (internal processing) for how consumers process multisensory cues (audio-visual) in video advertising, and confirms visual sensory cues can elicit automatic attention through the orienting response. In addition to the dual-coding explanation for the superiority of audio-visual sensory cues, the present research suggests a second reason: that audio-visual sensory cues can elicit additional internal processing of the brand name, resulting in active attention and better storage of the brand in memory. This has implications for the limited capacity model of motivated mediated message processing, as well as for marketers relating to the type of content recommended to follow an audio-visual or visual sensory cue in video advertising.

Keywords: Attention, Biometrics, Sensory Marketing, Multisensory Cues, Memory, Video Advertising, Audio-visual

Attracting attention from consumers has become an issue of great importance for marketers in an 'attention economy' where consumers are overloaded with information (Teixeira 2015). At least some attention, especially at the start of an advertisement, is a necessary condition for effective advertising (Bellman, Nenycz-Thiel et al. 2017). Yet, advertising is unlikely to be sales-successful unless it is associated with a brand's name (Rossiter and Percy 2017). An established 'brand name' allows a business to earn greater margins on its products (Christodoulides and de Chernatony 2010). Brand names and logos can act as cues to build brand-salience to help consumers quickly recognize the product in physical or online retail settings. A key tool for building and refreshing memories linking the brand name with consumption situations, at scale, is mass advertising, often in the form of video advertising (Romaniuk 2009, Erfgen, Zenker et al. 2015). Aware of the importance of attention (Brasel 2012), marketers are beginning to set objectives around attention for their advertising testing and evaluation. Contributing to both practice and sensory marketing theory, the current work examines consumer attention to multisensory cues in video advertising.

The marketing discipline has traditionally measured both attention to sensory cues and memory of these cues using the same recall measure (Haley and Baldinger 2000, Heath and Feldwick 2008). Such an approach can be potentially misleading because attention is a separate process from those of memory encoding, storage, and later retrieval (Craik and Tulving 1975, Tulving and Craik 2000, Anderson and Bower 2013). Eye-tracking can measure visual attention, but other psychophysiological measures – such as heart rate – can measure attention to both visual and auditory sensory cues. With the historic difficulty in accurately measuring attention separately from memory, there is limited research into how sensory cues attract attention, and whether that attention translates into later recall.

Given the importance of attracting attention, it is crucial for marketers to choose the most effective sensory cues to identify their brand during advertising. Video advertising can appeal to two of consumers' senses, seeing and hearing, allowing marketers three ways of identifying the brand: visually by showing a representation of the brand; aurally by including the brand's name in the sound track; or audio-visually by combining experiences for both the eyes and the ears. Psychologists have identified two mechanisms for attention to external stimuli: the orienting response and internal processing (Graham 1997), which align with the two middle categories of attention – automatic and active attention – conceptualized in Greenwald and Leavitt's (1984) influential four-level model of attention to advertising. To date, a single study has investigated the effect of visual sensory cues on automatic attention to branding elements using phasic heart rate measure (Gangadharbatla, Bradley et al. 2013). They observed that visual sensory cues in the form of brand placements elicit automatic attention in the interactive environment of video games, through the mechanism of the orienting response. However, researchers have not investigated which type of attention is elicited from consumers by audio-visual sensory cues that identify the brand.

This study, therefore, aims to examine how audio-visual sensory cues elicit consumers' (N = 133) attention at the moment of brand identification in real video advertising executions (N = 31), and to assess at what stage in memory audio-visual sensory cues provide superior benefit compared with visual sensory cues. Viewers' heart rate data will be collected as heart rate provides a useful measure of moment-to-moment visual and auditory attention (Ravaja 2004, Potter and Bolls 2012). This study makes four contributions. First, the findings show that the addition of an experience for the ears (audio-visual sensory cues) can elicit active attention. Second, by applying heart rate metrics, this study determined the mechanism through which audio-visual sensory cues elicit active attention (internal processing), providing further

explanation for the superiority of audio-visual over visual sensory cues. Third, this research explores the use of the limited capacity model for motivated mediated processing (Lang 2000, 2006, 2017) to explain findings in sensory marketing. Fourth, this research provides guidance for marketing practitioners about which marketing content would be beneficial to follow audio-visual versus visual sensory cues when developing video advertising.

LITERATURE REVIEW

Sensory Cues at Brand Identification

The importance of sensory experiences in consumer behavior has been recognised over recent years through the field of sensory marketing (e.g., Krishna 2011, Krishna, Lee et al 2017, Krishna and Schwarz 2014). While there has been useful insight into multisensory effects on measures such as consumers' perceptions and memory (e.g., Krishna 2011), little is known about the effect of sensory cues identifying the brand on attention. It is critical for advertisements to attract some attention from consumers in order to achieve their objectives, such as associating the brand name with specific consumption situations. In video advertising, marketers have three main sensory cues to identify the brand. Visual sensory cues engage the consumer's eyes, by visually showing the brand's name, logo, packaging, or the brand's uniquely associated distinctive assets (Romaniuk 2018) (e.g., characters such as Ronald McDonald for the fast food company, McDonald's). Auditory sensory cues engage the consumer's ears by mentioning the brand via the advertisement's audio track (e.g., spoken brand name or tagline, unique sounds, or jingle). In video advertising, however, audio-only sensory cues are likely to be uncommon (Romaniuk 2009), and instead marketers are more likely to use audio-visual sensory cues. Audio-visual sensory cues for brand identification provide experiences for both the eyes and the ears, by showing the brand and its associated

sounds at the same time. In the present study, the authors assumed that visual sensory cues are the default in video advertising, as they are the most common (Romaniuk 2009). It should be noted that automatic attention is known to habituate to repeated exposure to the stimulus (Barry 2009). Therefore, the first sensory cue identifying the brand will be used in this study so that consumers have had no opportunity to habituate to this cue.

Embodied Cognition

The consumer psychology field is moving to acknowledge the significance of bodily experience as a source of information for consumers, and the importance of embodied cognition for sensory marketing (Krishna, Lee et al 2017). Centred around embodied cognition, the theoretical perspective of the limited capacity model of motivated mediated message processing (the LC4MP) (Lang 2000, 2006, 2017) may aid explanation of multisensory marketing effects. The LC4MP argues that the cognitive processing system is embodied within a biological system that has been designed to respond to threats and opportunities in its environment (Lang 2000, 2006, 2017). The LC4MP explains why viewers can pay attention to video content, but not always remember that content later. Viewers' limited cognitive capacity refers to capacity sometimes being entirely consumed by attention rather than memory encoding and storage. Research using the LC4MP has used psychophysiological measures, such as heart rate, to investigate attention to different sensory cues (e.g., Lang 2018), but there is limited research into attention to audio-visual sensory cues identifying the brand.

Automatic and Active Attention

Attention arises when a person selectively perceives, and cognitively processes, some information from the environment to the exclusion of other perceivable information (Eysenck

2012). Greenwald and Leavitt's (1984) influential framework in the marketing literature delineates four levels of attention. In order of increasing attention, they are: preattention (or inattention), automatic (focal or passive) attention, active attention (or comprehension), and lastly elaboration. The middle levels of attention – automatic and active attention – are the most likely to occur in response to video advertising and therefore will be the focus of this research.

Some stimuli can automatically attract attention, such as biologically relevant stimuli (e.g., threatening, sexual, or delicious food-related content) (Lang and Bradley 2010). Structural features in media that suggest changes in the environment, such as cuts in video content, also attract automatic attention (e.g., Lang, Park et al. 2007). The predominant mechanism of automatic attention is the orienting response, which leads to a quietening of the body and an increase in blood flow to the brain enabling the intake of information about the relevant external stimulus (Öhman 1979, Campbell, Wood et al. 1997, Öhman 1997). The orienting response is identifiable via phasic (short-term) heart-rate deceleration in the first few seconds after a consumer is exposed to a response-eliciting stimulus (Graham and Clifton 1966, Lang 2000, Potter and Bolls 2012). In interactive environments, like video games, media psychology scholars have observed the orienting response to visual brand placements (Gangadharbatla, Bradley et al. 2013). Therefore, the authors of the present study expect that the visual sensory cues relating to the depiction of the brand's name in video advertising will elicit automatic attention, through the mechanism of the orienting response.

Active attention reflects a rejection of external stimuli in support of other processes involved in responding and adapting to one's environment, such as processing information (Jennings 1992, Lang 1994, De Pascalis, Barry et al. 1995, Potter and Bolls 2012). The mechanism of

active attention is the internal processing of stimuli, which is identified via heart-rate acceleration in the first few seconds following a response-eliciting stimulus (Graham and Clifton 1966, Lacey 1967, Wise 2017). Active attention has been reported when the storyline made an implication not directly shown or stated in the content (Keene, Rasmussen et al. 2019) and in studies of radio advertising when the advertisements contained more imagery (Bolls 2002). These findings may be clarified by considering multiple resource theory (Wickens 2008) and brain-imaging studies (Keitel, Maess, Schröger, and Müller 2013; Porcu, Keitel, and Müller 2014; Wahn and König 2017), which suggest there are separate pools of cognitive resources for processing visual versus auditory stimuli, and limited capacity will only affect both pools when the auditory channel also uses up visual processing resources (e.g., high-imagery audio [Bolls 2002]). Therefore, a consumer's ability to give active attention may be increased by an audio-visual sensory cue because a consumer's limited capacity may not be as limited for processing audio as opposed to visual stimuli, allowing cognitive processing of internal stimuli as opposed to perceptual processing of external stimuli (as likely elicited by visual sensory cues) (Fisher et al. 2018). That is, the authors of the current study expect that audio-visual sensory cues will stimulate internal processing and active attention. Showing that audio-visual sensory cues elicit heart-rate acceleration, rather than heart-rate deceleration, would be an important extension of the LC4MP (Fisher, Huskey et al. 2018), especially for its application to understanding sensory marketing.

As well as confirming that visual sensory cues can elicit automatic attention (Gangadharbatla, Bradley et al. 2013), the authors propose that audio-visual sensory cues will elicit active attention. For example, when a character associated with the brand appears at the same time as the brand name is spoken, active attention from consumers will be elicited as shown by their heart rates quickening.

H1: The first audio-visual (vs. visual) sensory cue will be associated with active (vs. automatic) attention through the mechanism of internal processing (identified by heart-rate acceleration) (vs. the orienting response identified by heart-rate deceleration).

Memory Storage

Developing associations in memory is important for a brand (Rossiter and Bellman 2005, Romaniuk 2009), as consumers do not necessarily make purchase decisions at the point of advertising exposure (e.g., in front of a screen) (Mehta and Purvis 2006). If the brand is linked to a number of consumption situations already existing in consumers' minds, they will be more likely to think of the brand in these situations. The process of associating recently encoded information (a sensory cue, such as a brand's name) with information from long-term memory (such as a consumption situation) is known as the storage process in the LC4MP (Lang 2000, 2006, 2017). For marketers, this makes the choice of sensory cue at brand identification important. Audio-visual sensory cues identifying brands, also known as dual-code (Paivio 1986) or dual-mode cues, have been reported to be more effective than either modality alone (Romaniuk 2009). The superior effectiveness of audio-visual cues has been explained by messages conveyed visually and verbally engaging the brain's visual and auditory channels, producing multiple traces in memory, and therefore multiple paths for later retrieval (Leigh 1991, Bryce and Yalch 1993). In addition to this dual-coding description, the authors hypothesize that internal processing of audio-visual sensory cues, and therefore more capacity devoted to storage of these cues, would provide further explanation for the superiority of audio-visual sensory cues on recall measures of advertising effectiveness.

H2: Audio-visual sensory cues will be associated with greater memory storage (measured by prompted recall) compared with visual sensory cues.

Insert Figure 1 about here

Subsequently, we hypothesize that active attention acts as a mediator for the effect of audio-visual sensory cues on recall.

H3: Active attention to video advertising mediates the effect of audio-visual sensory cues on recall (as depicted in Figure 1).

METHODS

Participants

A sample of 133 participants was recruited from MediaScience's audience panel in Austin, Texas. The ethnicity, gender and age distributions were matched to the US population (United States Census Bureau 2014) using quota sampling. The average age of participants was 46 years, with ages ranging from 18 to 80 years. Participants' time and travel were compensated with a $30 gift card. Participants were not taking any medications or had any internal electronic devices (e.g., pacemakers) that could interfere with their natural psychophysiological responses.

Stimuli

To increase external validity and the likelihood of observing natural patterns of attention (Heath, Nairn et al. 2009), real stimuli were employed: 10- to 30-second video advertisements for real brands available in the participants' market. The advertising executions were randomly selected from an advertising database for packaged goods, stratified by brand, so that there were three executions for each brand. A number of brands, and several executions for each brand, were used to cancel out any unique effects of brand or creative execution (Potter and Bolls 2012). The database held English-language advertisements designed for the U.S. market and was provided through commercial

agreements and as such specific details about the product categories and executions cannot be disclosed. Specifically, the commercials used were for well-established global brands available in the participants' city in four low-involvement, packaged goods categories. The advertisements were predominantly transformational (positive-ending) advertising (as defined by Rossiter and Percy 2017) for low-involvement categories.

Advertising Execution Coding

Sensory cues: Advertisements were coded for the first visual sensory cue (for example, the brand's name or logo, clearly identifiable packaging, or another of its distinctive branding assets), or first audio-only, or first audio-visual cue (e.g., the brand's name was spoken in the soundtrack at the same time).

Control Variables for Execution-Related Alternative Explanations for Automatic attention

The test advertisements were also coded for Structural Features including changes in camera angle (e.g., Lang, Park et al. 2007) and Content Features including biologically motivating content (e.g., Bushman 2005, Lang, Chung et al. 2005, Lang and Bradley 2010) adjacent to sensory cues.

Research Design and Procedure

This study used a mixed within-between design. To manipulate the specific execution seen and the presentation order of brands, participants were randomly assigned to one of six groups based on a 3 (execution) × 2 (brand order) factorial design. Participants were randomly allocated to one of two presentation-order rotations, to minimize primacy and recency effects (Ambler, Ioannides et al. 2000). In a within-participants design, each participant acts as her or his own control as data are collected on each participant under all conditions (viewing advertising executions for each of 11 test brands for $N = 133$

participants, i.e., 1430 advertising execution viewings in total). The study was conducted in a laboratory to allow advertising exposure to be manipulated and participants' biometrics to be accurately recorded.

The iMotion's® *Attention Tool* software was used to create rotations of stimuli, and present stimuli to participants. A trained research assistant briefed participants and obtained informed written consent and information on an individual's relevant health conditions prior to data collection. To increase external validity, participants were briefed that they were evaluating a program, rather than being instructed to watch advertising (Lloyd and Clancy 1991). Prior to the program starting, participants viewed a relaxing video for two minutes to establish a resting heart rate reading as a baseline. As participants are familiar with seeing a single program with advertising during commercial breaks, participants viewed a 30-minute episode of a popular comedy program professionally edited with 11 test and additional decoy commercials. A popular program was chosen so that content was interesting to as many participants as possible. The program included mid-roll advertising breaks, with test advertisements not shown in the first or last position in these breaks. For two brands, one of the brand's three executions was unusable (due to technical difficulties), resulting in a final $N = 31$ executions across the 11 test brands. Participants appeared to feel comfortable during the viewing session. Among other activities, participants were seen looking around the room during commercial breaks as they would do at home. The post-viewing survey began with evaluative questions about the program to provide believability for the cover story, and to clear short-term memory after viewing, before asking questions about the advertising.

Dependent Variables

Psychophysiological data were collected from participants to measure their attention as they viewed the program and embedded advertising. All psychophysiological data collection was carried out according to standard laboratory operating procedures (based on Berntson and colleagues (2007), and Potter and Bolls (2012)).

Operationalising active and automatic attention using heart rate. Heart rate was measured via pulse photoplethysmography using a transducer on the ring finger of the non-dominant hand to detect the peripheral pulse. Pulse photoplethysmography identifies changes in blood flow by passing light through the finger and detecting it with a photo-sensor. Data were collected at 200 Hz via the PsychLab Peripheral Pulse Amplifier (PsychLab, USA) using the PsychLab Acquire software (PsychLab, USA). In-house scripts were used to filter the photoplethysmography signals and detect heartbeats using a peak detection algorithm in MATLAB (The MathWorks, Inc., Natick, Massachusetts, USA). The processed data were then incorporated in the data structure containing the timestamped stimuli information and heartbeats were converted to inter-heartbeat intervals. It is recommended to use inter-beat interval, rather than heartbeat (beats per minute), because inter-beat interval has a clearer linear relationship with other variables (Berntson, Cacioppo et al. 1993, Berntson, Cacioppo et al. 1995). Each participant's plot of their inter-beat interval was inspected for data quality.

Self-reported measures

Category-prompted brand recall and brand recognition: Participants were asked to recall the brands they had seen advertised in the experiment, using a product category prompt. Next, participants were asked whether they recognized any of the brands advertised during the experiment, from a list of the 11 test brands and 13 unseen decoys (competitors to the test brands).

Control Variables for Individual Responses to Brands:

Advertising familiarity was assessed via a 5-point scale of previous exposure ('never' to '5+ times') for each advertising execution (Crosby and Stephens 1987).

Brand familiarity was assessed on a 7-point Likert scale ('unfamiliar' = 1 to 'familiar' = 7) (Woltman Elpers, Wedel et al. 2003).

Prior brand usage was measured based on frequency of brand usage via a 6-point scale ('never' to '21+ times') (Ludwichowska, Romaniuk et al. 2017).

Brand attachment was assessed via a 7-point Likert scale ('not at all' to 'very well') (Thomson, MacInnis et al. 2005).

Analysis

As in prior tests of the LC4MP using heart rate data (e.g., Lang et al. 2007), heart-rate response over the 10 seconds after the onset of a potential response-eliciting stimulus was compared with its absence in the previous second of video content. The heart rate data (using the inter-beat interval metric) were analysed using repeated-measures analysis of covariance (ANCOVA) with SPSS version 24 (Armonk, NY, USA) (Potter and Bolls 2012). The repeated-measures ANCOVA included the ten change-in-heart rate measures (change from the second prior to sensory cue), with independent factors Time (0 to 9), Ad (dummy coded [30 variables]), and their two-way interaction, with the consumer's resting heart rate as an individual control. The Huynh-Feldt correction was applied due to the natural correlation within biometric data (Potter and Bolls 2012).

To assess the effects of sensory cues identifying the brand on memory, the authors estimated generalized linear mixed-effects regression models assuming a binomial distribution for the dependent variable (correct category-prompted recall = 1 or 0), with a logit link function. The independent variable, audio-visual or visual sensory cue, was included as a fixed effect. Participant ID was included as a random effect to account for the repeated measures from

each participant. To assess heart-rate acceleration (active attention) on the effect of audio-visual sensory cues on recall, mediation analysis was conducted using PROCESS 3.4 (Hayes 2018).

To assess how the fit of the orienting response pattern related to other potential alternative explanations of the automatic attention, Spearman non-parametric rank correlations were calculated, as described by Murray and Häubl (Murray and Häubl 2007). These correlations were between the ad-level R^2 values of the heart rate response (multiplied by -1 if the response indicated acceleration, i.e., the orienting response deceleration was the positive default according to prior LC4MP studies [e.g., Lang 1994]), the presence of audio-visual sensory cues, and the presence of structural or content features or individual-level variables.

RESULTS

Type of Attention to Visual or Audio-visual Sensory Cues

Hypothesis 1, which predicted that the first audio-visual (vs. visual) sensory cue will be associated with active (vs. automatic) attention as indexed by heart-rate acceleration (vs. deceleration), was tested by the effect on inter-beat interval data of the interaction between Time and Ad. This hypothesis was supported by a significant interaction (F[9,13635] = 3.63, $p < .003$, $\eta_p^2 = .002$, Huynh-Feldt corrected). Next, planned polynomial contrast tests of time on heart rate were carried out to identify whether this significant interaction was due to the predicted difference in the shape of the inter-beat interval response depending on whether the brand was identified audio-visually or visually. A monophasic quadratic trend (U-shaped) in inter-beat interval indicated the presence of heart-rate acceleration indexing internal processing, whereas an inverse U-shaped trend indicated deceleration indexing the orienting response (Thorson and Lang 1992, Berntson, Cacioppo et al. 1993). The quadratic trend for

the interaction of Time and Audio-visual (vs. Visual) sensory cues was significant (F[1,1515] = 15.33, $p < .0001$). Superimposed on Figure 2 is the best fitting quadratic curve for the data from video advertising executions featuring audio-visual sensory cues (dashed line). This U-shaped curve shows that audio-visual sensory cues elicited shorter inter-beat intervals (accelerating heart rate), consistent with internal processing of the brand (indicating active attention). In contrast, the dotted line shows the shape of the inter-beat interval response following executions with initial visual sensory cues. The inverse U-shaped curve shows that visual sensory cues elicited longer inter-beat intervals (decelerating heart rate), consistent with the orienting response (indicating automatic attention). Summary statistics for dependent variables is shown in Table 1.

Insert Table 1 about here

Insert Figure 2 about here

Control variables

To rule out alternative explanations (besides audio-visual versus visual sensory cues) for the differences in observed responses, the fit (R^2) of a quadratic function to the data from each execution was coded as either an inverse U-shaped response consistent with automatic orienting (+1), or a U-shaped response consistent with internal processing (−1). Table 2 shows the range of fit for each response, the sensory cue (visual, audio-visual, and audio-only), and the structural and content features (alternative explanations), associated with each range of fit. All executions featuring audio-visual sensory cues (N = 5, 100%) had a U-shaped response curve consistent with internal processing (Figure 1). The majority of executions featuring visual sensory cues (N = 16, 64%) had an inverse U-shaped response, consistent with a decelerating heart rate (Figure 2 shows the data for executions with an $R^2 > .6$ for an inverse-U response). However, a third of the executions with visual sensory cues (N = 8, 32%) elicited a U-shaped response consistent with the pattern for internal processing (Table

2). One visual sensory cue execution (4%) did not fit the pattern for the orienting response or internal processing.

Insert Table 2 about here

Table 2 also shows that there was no consistent pattern to the association of structural or content features with the shape of the heart-rate response pattern. Almost all (N = 30, 97%) executions contain structural features adjacent to the first sensory cue (Table 2), with both negative and positive fit associated with the presence of structural features. However, only audio-visual sensory cues were uniquely associated with high negative fit (Table 2). On the other hand, content features (e.g., biological drivers such as appetizing food shots) were not significantly associated with the fit of the inter-beat interval response. Finally, none of the brand-association control variables – brand attachment, brand familiarity, prior usage, nor advertising familiarity – had significant correlations.

Insert Table 3 about here

Memory

Hypothesis 2 predicted that audio-visual sensory cues, indexed by heart-rate acceleration, will result in greater memory storage, measured by category-prompted brand recall (Lang 2000), compared with visual sensory cues. This hypothesis was supported by the difference in product category-prompted recall between audio-visual and visual sensory cues (t = 2.245, $p < .05$). That is, memory storage, measured by category-prompted recall, was greater following audio-visual sensory cues. This indicates that the internal processing associated with audio-visual sensory cues encouraged more effective storage of memories associated with the brand name, allowing it to be retrieved more readily in a later recall task prompted by product category.

There was no evidence that brand recognition, typically considered as a measure of encoding into long-term memory (Lang 2000), differed between executions using audio-visual versus visual sensory cues ($t = 1.482$, $p > .05$). This may suggest that memory encoding could be similar after exposure to visual and audio-visual sensory cues. However, only audio-visual sensory cues received additional internal processing that strengthened memory storage and made the brand more likely to be recalled later.

Active Attention as a Mediator

To test hypothesis 3, whether active attention (as indexed by heart-rate acceleration) mediates the effect of audio-visual cues on brand recall, the researchers tested the significance of the indirect effect of audio-visual cues on recall via active attention (Hayes 2009, Zhao, Lynch et al. 2010). The confidence interval of the indirect effect was estimated using Model 4 in PROCESS 3.4 (Hayes 2017) and 10,000 bootstrap samples, controlling for familiarity. The indirect effect of audio-visual sensory cues on recall was significantly positive ($b = 0.098$, $SE = .0595$, one-sided 95% CI 0.002 to 0.192), indicating mediation via active attention.

DISCUSSION

This study makes four contributions to the literature and to marketing practitioners. First, the findings indicate that different sensory cues used to identify the brand can elicit different types of attention responses. Audio-visual (multisensory) cues that engage the eyes and ears are more likely to elicit a phasic acceleration of heart rate, consistent with active attention in Greenwald and Leavitt's (1984) four-level attention framework. This finding can be interpreted as the combination of auditory and visual sensory cues prompting consumers to direct their attention inwards to internally process the semantics of the brand's name. This supports previous findings of relevant stimuli encouraging viewers and listeners to internally

process implications of what they have seen and heard (Bolls 2002, Wise 2017, Keene, Rasmussen et al. 2019).

Our findings confirm that engaging only the eyes through visual sensory cues can elicit the classic orienting response, representing automatic attention to video advertising. This finding supports previous research on visual brand placements eliciting the orienting response in video games (Gangadharbatla, Bradley et al. 2013). That is, even though consumers may have been watching with low attention (e.g., Heath 2009), visual sensory cues can automatically capture their attention. However, a number of advertising executions with visual sensory cues for brand identification evoked heart-rate acceleration, indicating internal processing and active attention. The recent literature may help explain why some visual sensory cues can elicit active attention. A video-based study observed internal processing and active attention, characterized by heart-rate acceleration, when the content implied something not directly shown or stated, and thus additional internal processing was required to understand this implication (Keene, Rasmussen et al. 2019). It would be worthwhile, therefore, for future research to specifically investigate whether active attention was triggered by visual sensory cues that were immersed in unshown or unstated plot implications during the advertisement.

Second, by applying heart rate metrics as used in media psychology, this study determined the mechanism (internal processing) by which active attention mediates the effect of audio-visual sensory cues on recall. This finding may provide further explanation beyond the dual-coding explanation (allowing alternative or back-up memory traces to be created [Bryce & Yalch, 1993; Paivio 1986]) for the superiority of audio-visual sensory cues over visual sensory cues in recall tasks. This research suggests that audio-visual sensory cues are useful

when viewers are looking at the screen, in addition to previous findings suggesting audio-visual cues are an effective way to advertise to viewers when their eyes are off the screen (Bellman, Schweda et al. 2010). The use of heart rate data in this study addresses a call for measures in advertising research with greater temporal resolution (Venkatraman, Dimoka et al. 2015) to allow the moment-by-moment dynamics of ad-processing (e.g., responses following sensory cues) to be examined.

Third, this research uses the limited capacity model of motivated mediated processing (the LC4MP: Lang 2000, 2006, 2017) to make sense of findings in sensory marketing. By demonstrating greater memory storage following heart-rate acceleration (an index of active attention) in response to audio-visual stimuli, the results are consistent with multiple resource theory's contention that there is not one pool of limited cognitive resources, but at least two: one for visual processing and one for auditory processing, and possibly separate pools for perceptual and cognitive processing (Fisher et al. 2018; Wickens 2008). Limited capacity constraints only apply to more than one pool when processing requires high levels from both pools (e.g., high-imagery audio [Bolls 2002]). Showing that sensory cues incorporating both sight and sound are more likely to elicit heart-rate acceleration, rather than heart-rate deceleration, helps to clarify previous unexpected findings (Fisher, Keene et al. 2018) in the LC4MP (Lang 2000, Lang 2006, Lang 2017). This extension of the LC4MP makes it useful for investigating the use of visual and auditory sensory cues in sensory marketing. In future research, it would be worthwhile investigating if extending the theory to encompass multiple pools of resources can aid the use of other senses in sensory marketing, such as haptics, smell, and taste.

The present study's findings support the LC4MP's perspective that watching video content is predominantly a stimulus-driven activity (Lang, Park et al. 2007, Sparks and Lang 2015). This stream of research suggests that where attention is directed in video advertising largely depends on the creative execution. This makes sense as people are usually watching television to relax, rather than to actively seek information about brands (Chowdhury, Finn et al. 2007). These results highlight the importance of creative execution and mode of sensory cue, rather than specifically targeting brand users or brand loyalists. In this study, there was no evidence of association between emotional attachment to the brand and the presence of active attention (internal processing) or automatic attention (orienting response). There were no associations with cognitive knowledge of the brand (brand familiarity), nor behavioural brand usage, nor advertising familiarity. That is, an advertisement in which the brand is clearly identified will attract from all consumers some automatic or active attention to the sensory cues identifying the brand.

Fourth, this study has important implications for marketing practitioners and creatives. This research provides recommendations to guide the use of marketing content following visual versus audio-visual sensory cues for development, and in-market testing evaluation, of advertising executions. As more firms incorporate some biometric assessment of their marketing communications, by using heart rate data to objectively explore the underpinning mechanisms (the orienting response and internal processing) that visual and audio-visual sensory cues can evoke, the results of this study provide practitioners with three quantitative benchmarks for future observations:

- If no change in heart rate is observed in response to sensory cues identifying the brand, it is likely the sensory cue is not capturing attention. This is potentially because the brand is not clearly identified, in terms of size, contrast, loudness (for audio

identification), or frequency. Alternatively, the creative quality of the advertisement prior to the sensory cue may be so low that consumers have disengaged their attention and even automatic attention responses are no longer possible.

- If an automatic attention (heart-rate deceleration) response occurs after a visual sensory cue, it is likely consumers' attention has been automatically attracted by that cue (e.g., the brand's logo or distinctive brand asset). Potentially, following the brand's identification with interesting creative will encourage consumers to continue paying attention to the advertisement, instead of withdrawing attention.
- If the heart rate accelerates to audio-visual sensory cues, it is likely that consumers are engaging in internally processing the brand's name. The active attention following audio-visual sensory cues opens up the possibility of including important brand-related or consumption situation-related details after the sensory cue, helping consumers to internally process the important subsequent information, and associate that information with the brand. The inclusion of both visual and auditory sensory cues to engage the eyes and the ears is important for contemporary marketers, considering many consumers using mobile devices may be multi-screening, where an auditory sensory cue becomes critical (viewers may not be looking at the advertising).

Finally, in the present study, active attention was seen in response to the first audio-visual sensory cues; future research should test whether later sensory cues may elicit some level of active attention.

Limitations and Possible Future Directions

By comparing visual versus audio-visual sensory cues, we cannot rule out the possibility that the effects of audio-visual sensory cues may be due solely to the auditory component. While the authors were limited by the low prevalence of audio-only sensory cues in the random

sample of real video advertisements, future research using manipulated stimuli could test audio-only video advertising executions.

A limitation of the measurement of heart rate is that participants cannot move their hands completely freely so that electrodes stay in place on the non-dominant hand. A restriction in natural movement, and being in a laboratory setting, can remind participants that they are taking part in a study. However, steps were taken to ensure the study was as externally applicable as it could be. For example, real brands in real advertisements were seen in a competitive context, as multiple brands were seen in each ad break, as a viewer would see at home. There were up to three brands per product category shown across the ad breaks and multiple product categories represented.

We encourage replications across diverse samples of commercials and respondents to further generalize these findings. Future studies should test informational as well as transformational advertising in different markets, for less mature and less well-known brands in a variety of product categories.

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TABLES AND FIGURES

Table 1. Summary statistics by visual or audio-visual sensory cues.

	Sensory cue Mean (SD)	
	Visual	Audio-visual
Attention[1]	0.22 (0.67)	-0.85 (0.11) **
Familiarity	5.26 (1.11)	5.49 (0.87)
Prompted-recall	0.45 (0.19)	0.55 (0.31) *
Recognition	0.74 (0.15)	0.80 (0.17)

* $p < .05$; ** $p < .01$.

[1] Fit (R^2) of a quadratic function to the data, coded as positive if the response was automatic attention (heart-rate deceleration indicating the orienting response), or as negative if the response was active attention (heart rate acceleration indicating internal processing).

Table 2. Number of advertising executions per range of cardiac response curve fit for sensory cues, and structural and content features.

Fit of quadratic or cubic pattern (R^2)	Sensory cues			Structural features[1]	Content features[2]
	Visual	Audio-visual	Audio-only		
Active attention (heart-rate acceleration)[3]					
-0.80–1.00	3	4	-	7	2
-0.50–0.79	3	1	-	3	1
-0.20–0.49	2	-	1	3	1
< -0.2	-	-	-	-	-
Automatic attention (heart-rate deceleration)					
0.80–1.00	6	-	-	6	2
0.50–0.79	7	-	-	7	0
0.20–0.49	3	-	-	3	0
< 0.2	1	-	-	1	1
Total	25	5	1	30	6

[1] Structural features refer to camera changes, including camera cuts.

[2] Content features refer to biological features, such as close-up images of food.

[3] A significant positive correlation coefficient represents that the independent variable is associated with a cardiac response curve that fits the automatic attention pattern; whereas, a significant negative correlation coefficient represents association with a cardiac response curve that fits the pattern for active attention.

Table 3. Associations between automatic attention or active attention fit, and control variables.

Fit of attention response (R^2)	Correlation coefficient (r) [1]
Control variables	
Structural features (e.g., camera change)	0.19
Content features (e.g., appetizing food)	-0.06
Brand attachment	-0.01
Brand familiarity	-0.18
Brand usage	-0.26
Advertising familiarity	0.06

* $p < .05$; ** $p < .01$.

[1] A significant positive correlation coefficient represents that the independent variable is associated with a cardiac response curve that fits for automatic attention (the orienting response pattern); whereas, a significant negative correlation coefficient represents association with a cardiac response curve that fits the pattern for active attention (internal processing).

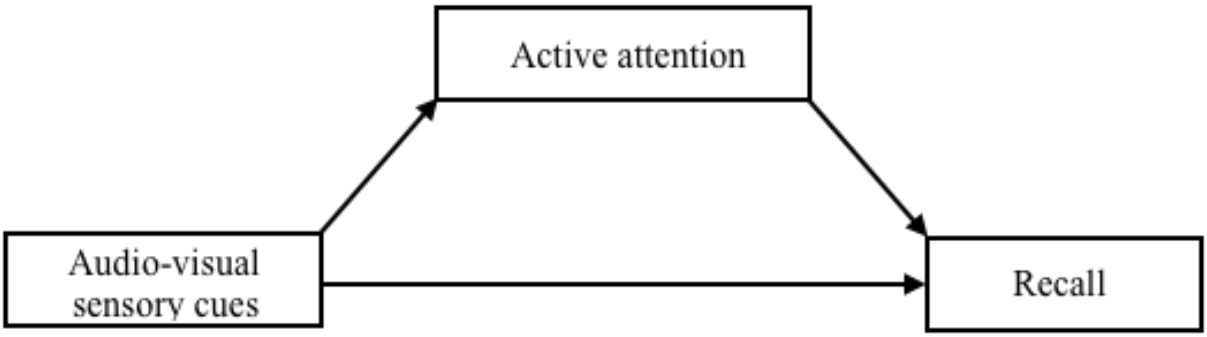


Figure 1. Conceptual model depicting active attention mediating the effect of audio-visual sensory cues on recall (H3).

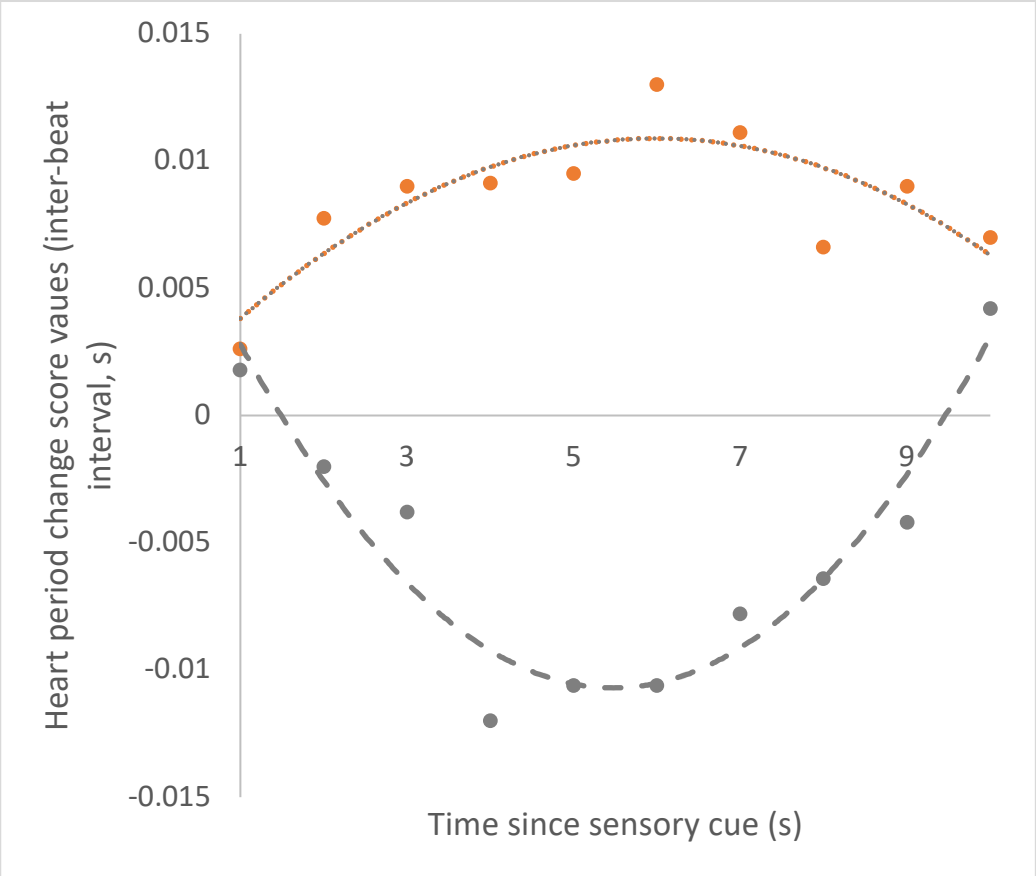


Figure 2: Cardiac response curves following audio-visual or visual sensory cues.

[1] Heart-rate acceleration (a decrease in inter-beat intervals), indexing internal processing and active attention, was evoked following audio-visual sensory cues (dashed U-shaped curve).

[2] Heart-rate deceleration (an increase in inter-beat intervals), indexing the orienting response and automatic attention, was evoked following visual sensory cues in N = 13 executions (dotted inverse U-shaped curve).