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Virtual Advertising in the NBA: How Arousal Level and Visual Attention Alter Brand Recall and Recognition

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ABSTRACT

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During the 2020 season, the NBA implemented, for the first time, the use of virtual advertisements. Virtual advertisements are digitally superimposed ads directly on the court that are visible to anyone viewing the broadcasted version of a game. This study used eye-tracking and galvanic skin response (GSR) in conjunction with the limited capacity model of motivated mediated message processing (LC4MP; Lang, 2006a) to a) determine virtual advertising's effectiveness compared to traditional in-stadium advertising and to b) monitor the effect emotional arousal has on advertising recall and recognition. A sample of 176 fans of the Utah Jazz viewed one of four identical highlight reels of a basketball game that sought to manipulate emotional arousal by altering only the score and were then tested on advertising recall and recognition. Results revealed that virtual advertising receives more visual attention than traditional in-stadium advertisements yet are remembered poorer – indicating that while virtual advertisements are placed in a more central location they are likely still processed peripherally. The attempted manipulation of arousal failed and the results surrounding the LC4MP were insignificant. Implications for the LC4MP and recommendations for advertising practitioners are discussed.

Keywords: virtual advertising, LC4MP, stadium advertising, NBA, eye-tracking

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Introduction

In 2020, due to the COVID-19 pandemic, the National Basketball Association (NBA) had to make adaptations to compensate for the loss of revenue from the restrictions that prohibited fan attendance (Wojnarowski, 2020). One such adaptation was the use of virtual advertising. Virtual advertising is the use of digital technology to superimpose advertisements in the free spaces of a broadcasted program, most often used in sports (Cianfrone et al., 2006). Several studies have analyzed the effectiveness of virtual advertising but have largely produced conflicting results (Cianfrone et al., 2006; Psyma, 1999; Pyun & Kim, 2004; Sander & Altobelli, 2011). Virtual advertisements are customizable, meaning each channel can collect different sponsors and the advertisements can be changed at any time. Often, multiple sponsors choose to advertise via virtual advertising, and, as such, their messages are systematically cycled through, giving screen time to each.

Another common form of sports advertising comes in the way of in-venue or stadium advertisements. These advertisements help promote brand image and brand recognition as they are seen by all those who attend the sports game (Meenaghan, 1991; Pope & Voges, 2015). Some of those advertisements, depending on placement, can also be seen by the viewers of the televised broadcast of the game. One key limitation of stadium advertising is that it is processed as peripheral information, secondary to the main event: the sport (Breuer & Rumpf, 2015; Lee & Faber, 2007). Other sponsored advertising like video commercials or athlete endorsements does not have that limitation, as they are presented as central information.

While virtual advertisements might also be considered peripheral information because they can be digitally imposed in any open space, many are placed directly on the court thus

increasing the centrality and the likelihood of visual attention. Additionally, many virtual advertisements could be considered novel stimuli because they are changing (Tsuji et al., 2009), and can cause an orienting response. According to the limited capacity model of motivated mediated message processing (LC4MP), this response demands more cognition to process, is given more visual attention, and therefore will be easier to remember than other static advertising (Lang, 2006a). Some in-stadium advertisements, for example, a changing virtual banner, would also be considered novel stimuli. The specific implementation of virtual advertisements in the NBA placed brand names directly on the court but did not cycle through different brands. Thus, in this case, the virtual advertisements would not be considered novel stimuli.

The LC4MP provides deep insights into how humans process information, looking at the encoding, storage, and retrieval of information as well as the evolutionary biological motivation systems that dictate the saliency of information (Lang, 2006b). These systems—known as the appetitive and aversive motivational systems—react to positive and negative content respectively (Cacioppo et al., 1997). When looked at through the lens of a sporting event, when one's favored team is winning it will activate the appetitive system and when the team is losing it will activate the aversive system (Lee et al., 2019).

Research shows that the higher the activation of those systems the more cognitive processing may take place; and memory, even for peripheral information, may increase (Cacioppo et al., 2011). In a sporting event, the more exciting a game is, the more arousal a person may experience and the more the systems may activate (Lee et al., 2019).

Due to the lack of consensus provided by previous studies on the effectiveness of virtual advertising (Cianfrone et al., 2006; Sander & Altobelli, 2011), as well as the first-time implementation of virtual advertising in the NBA, the current study seeks to compare recall and

recognition of both virtual and in-stadium advertising while taking visual attention and game intensity into consideration.

Literature Review

Virtual Advertising

Virtual advertising is a digital insertion of an advertisement into a live or pre-recorded television show (Cianfrone et al., 2006; Pyun & Kim, 2004). It offers a seamless superimposition of computer-actuated images into a video or image, making it a clean and versatile way for marketers to advertise their products (Turner & Cusumano, 2000). Virtual advertising is most often employed at sporting events (Cianfrone et al., 2006). The spectators at the sporting event—anyone attending in-person—do not see the virtual advertisements, as they are added onto the broadcasted version of the event. The medium was originally created to allow for advertising revenue for events that couldn't have regular commercial breaks, like the World Cup (Cianfrone et al., 2006).

Virtual advertising has many benefits, often pertaining to revenue; offering more advertising spaces for media companies to sell. It is also favored because it brings in more revenue without infringing on the comfortability of in-person spectators, keeping their experience clean and uncluttered. One major benefit of virtual advertising is that the advertisements can be fluid, allowing for a continual change in message or brand—a significant upgrade from contemporary stadium advertising. "Stadium signage is often static and unchanging, while virtual advertisements can be animated or changed each time a team runs another play or fast breaks down the court after a rebound" (Cianfrone et al., 2006, p. 291). Many of today's stadiums have implemented digital banners that cycle through multiple advertisements. This in-stadium signage also offers the benefit of change and customization in

terms of time and placement of each advertisement, but still exists in the periphery (Lee et al., 2019).

Implementation of virtual advertising isn't standard and can be adapted for whichever event or sport is intended. In soccer games in Europe, for example, virtual advertisements are shown as changing banner advertisements along the border of the field (Kidd, 2021). The current study will examine virtual adverting in the NBA, which most frequently implements up to three unchanging virtual advertisements directly on the field of play.

As for virtual advertising's effectiveness, there is conflicting evidence. A study done by a German marketing firm in 2002, early in virtual advertising's use, showed that while viewers typically indicated they accepted virtual advertising, they were frustrated when it appeared on the field of play (in this case during a soccer game). This study concluded that, in general, advertising should not divert attention from the field of play (Sasse & Ludwig, 2002). Other groups claim it is a very effective communication technology, leading to much higher rates of advertisement recall (Psyma, 1999). Additionally, Pyun, Han, and Ha (2004) found that virtual advertisements were on-screen significantly longer than traditional signage and that increased exposure time correlated to recognition scores nearly twice as high as those of traditional advertising. It seems that the placement of the advertisement and the sport in which the advertisement is used influence perceived effectiveness (Park & Inou, 2018; Sander & Altobelli, 2011).

While virtual advertising has been in use in the United States since the 1990s (Sander & Altobelli, 2011), and is often seen in sports like soccer, baseball, and hockey, the National Basketball Association (NBA) has been slow to incorporate this form of advertising.

Virtual Advertising in the NBA

In 2020, due to the COVID-19 pandemic, the NBA instituted a quarantine style of play referred to as "the bubble" (Golliver, 2020). This period of nearly 100 days allowed the 2019-2020 season to finish without risk of contracting the COVID-19 virus. In order to ensure this was the case, very strict rules were instituted including the restriction of any in-person fans (Davis, 2020). These strict measures, and the loss of fan attendance especially, brought a significant financial hit upon the NBA and each individual team's would-be revenue (Wojnarowski, 2020). In an attempt to recover some of that lost revenue, the NBA implemented virtual advertisements for the first time, superimposing unchanging advertisements just outside either side of the key on both ends of the court and just out of bounds where players and referees frequently cross (Cavanaugh, 2020).

When "the bubble" ended so did the virtual advertisements. The 2021 NBA season did not include virtual advertisements at all during the regular season. They were, however, reimplemented during the NBA Finals (Lombardo, 2021). It is currently unknown whether virtual advertising will be implemented for future seasons.

As virtual advertising is such a new implementation in the NBA, the current study will likely be the first to examine its effectiveness in this particular environment.

Stadium Advertising

Sport-sponsorship is a popular way for companies to reach a vast audience of varying demographics and interests (Kolah, 2003). Sponsorship can be defined as a monetary investment on the part of a company or person in return for "access to the exploitable commercial potential associated with that activity" (Meenaghan, 1991, p. 36). Sport-sponsorship can be categorized into four categories: individual sponsorship, team sponsorship, association sponsorship, and

event sponsorship (Bello, 2016). In 2019, spending on sport-sponsorship in the United States alone totaled $14.7 billion and is expected to grow to over $20 billion by 2024 (Two Circles, 2019). In general, it has been shown to increase brand awareness and improve brand image (Crompton, 2004; Schlesinger & Gungerich, 2011). Sponsorship often comes in the form of advertisements or products associated with the sport (Bello, 2016). These can be seen in many mediums including stadium signage, the name of the stadium itself, branded gear and clothing, etc.

Some researchers have concluded that stadium advertising is limited in terms of memory (e.g., Breuer & Rumpf, 2015; Cianfrone & Zhang, 2009). Many forms of sports advertisements, including athlete endorsement and video commercials, often happen as a central message, meaning it is the main message being presented. Stadium advertising, on the other hand, has the disadvantage of sharing its space with the very content which the audience is there to watch: the sports game (Cianfrone & Zhang, 2006). In the case of stadium advertising, the sport is the central message, which makes the advertising peripheral (Breuer & Rumpf, 2015; Lee & Faber, 2007).

While in-stadium advertising is at a disadvantage as peripheral information, a relatively understudied potential benefit exists in the arousal level induced by the sport (Lee et al., 2019). In conjunction with the LC4MP, a model that investigates how humans process information, heightened arousal is often connected with better recall (Lang, 2006a). The relationship between peripheral information processing and arousal is still understudied, but higher levels of positive arousal and lower levels of negative arousal have been shown to lead to greater memory of peripheral cues (Chung & Sparks, 2016; Yegiyan & Lang, 2010).

The current study seeks to add depth to the LC4MP research by monitoring how differing levels of arousal induced through a basketball game alter advertising recall and recognition. Additionally, this study will compare the overall effectiveness of virtual advertising and all in-stadium advertising visible on the broadcasted version of an NBA basketball game.

LC4MP

The limited capacity model of motivated mediated message processing (LC4MP) was first conceptualized by social scientist Annie Lang in 2000 (Lang, 2000). In its early stages, it was known as the limited capacity model of mediated message processing (LC3MP), but the additional "m" for motivated was added soon after in 2006 (Lang, 2006a, 2006b). It attempts to model how humans process information including the encoding, storage, and retrieval of a message, using information from biological sciences, evolutionary psychology, and cognitive sciences (Fisher et al., 2018). The LC4MP attempts to look at information processing in real-time, conceptualizing how that process works (Detenber & Lang, 2010).

The LC4MP is especially important due to the unique insights it offers into media effects research. Physiological data has been used in media effects research for decades (e.g., Donnerstein & Barrett, 1978; Zillmann, 1971), examining an input (media) and its connected output (effect), but this research overlooks a crucial psychophysiological step in between input and output: the processing of the information. Message processing has been viewed as a 'black box' that researchers would never be able to examine or attempt to understand (Lang & Ewoldsen, 2010; Lang et al., 2009). The LC4MP does just that, using psychophysiological methods to understand how a message is processed, thus giving greater insights into the potential physiological media effects, as well as enriching communications research in general (Lang,

2006a, 2013). For the current application, the LC4MP will be applied to monitor how different advertisements are processed during an NBA basketball game.

Assumptions of the LC4MP

Limited capacity. The LC4MP is built upon five assumptions, each based on research and theory. The first assumption is that a human's capacity to process information is limited and predictable (Fisher et al., 2018; Kahneman, 1973; Lang, 2006a; Shiffrin & Schneider, 1977). This limitation comes into effect due to the limited nature of cognitive resources, a well-researched area of study. For example, only so much of the information a person processes can be stored as a memory (Hasher & Zacks, 1979; Kahneman, 1973; Shiffrin & Schneider, 1977). This processing is predictable in that a cognitive selection process takes place wherein the brain stores the perceived salient information and discards the excess (Handy et al., 2001). This concept relates to peripheral and central messaging already mentioned. Much of in-stadium and related advertising is peripheral information, secondary to the game play. The primary, or central information, the sport, is determined to be salient and therefore processed at a much higher rate.

Determining saliency is a process that often takes place automatically, though research indicates it can be done consciously as well (Lang, 2000). The decision is a reflection of the individual's own conditioning and goals. If, for example, a person knows they'll be tested on advertising recall, they'll consciously allocate more cognitive resources to the processing of the advertising messages, making that information salient and ensuring it gets stored. The LC4MP breaks this process of cognitive allocation into three steps: encoding, storage, and recall (Lang 2000, 2009).

Motivational systems. The second assumption of the LC4MP is that humans have developed two motivational systems throughout evolution that aid in survival (Lang, 2006a).

This assumption is based on a model called the evaluative space model (Cacioppo et al., 1997, 2011), which highlights the appetitive and aversive motivational systems. These systems aid in the determining of salient information.

The appetitive system connects with positive evolutionary information, like finding a reliable and safe source of food. Remembering the source of the food promotes survival, thus cognitive effort is automatically expended to ensure that information is encoded and stored (Lang, 2006a). The aversive system connects with negative evolutionary information, like recognizing a threat. Low levels of aversive motivation, like when a potential threat is detected, lead to greater cognitive effort to encode and store information such as exits or escapes. High levels of aversive motivation led to the near abandonment of encoding and storage and focus instead on the retrieval of the information already stored, as an escape from dangerous situations is crucial for survival (Lang, 2006a). While humans no longer face the same challenges and experiences as their past hunter/gatherer selves, the appetitive and aversive motivational systems still remain active in evaluating positive and negative stimuli respectively (Cacioppo et al., 1997; Mirenowicz & Schultz, 1996).

An example of these motivational systems being used and manipulated with modern stimuli happens in the field of advertising. Marketers can promote self-cancer-screening, for example, by manipulating the arousal level and tone of the message. Cancer is a negative concept, thus linking to the aversive motivational system. Marketers will change the tone and message of an advertisement to attempt to elicit low-level activation of the aversive motivational system, thus maximizing the encoding, storage, and eventually persuasive power (Lang, 2006).

Continuously varying media. The third assumption is that media is made up of continuously varying streams of information that are presented through one or more channels,

like senses and formats. (Fischer et al., 2018; Lang, 1995, 2006b). Connected with this is the idea that all forms of communication can be viewed as mediated, that is, all forms of communication are processed similarly. Therefore, all communication can be assumed to be carried out through the use of various communications technologies (Mangus et al., 2015). This idea comes from Reeves and Nass' (1996) research, which indicates that the human brain still has not developed an automatic mechanism to immediately know the difference between digitally mediated representations of real-life phenomena and actual real-life phenomena. An apple on a computer screen is processed the same as an apple in real life, at least for long enough for the automatic determination of saliency and associated encoding and storage processes to take place (Bailey, 2015; Lang & Bailey, 2015).

Time. Fourth, the LC4MP assumes that both communication and human behavior take place over time (Fischer et al, 2018; Lang, 2006a). One message can evoke different levels of motivational activation and arousal throughout its course, which makes it difficult for certain methodologies such as participant self-report to capture the totality of arousal and cognitive activation (Nabi & Green, 2015). "For this reason, the LC4MP is advantageously situated to utilize dynamic measures of message processing such as continuous response measurement, psychophysiology, and neuroimaging" (Fisher et al., 2018, p. 272). The current study will look at continuous response using Galvanic Skin Response (GSR) supplemented with eye-tracking.

Interactive communication. The last key assumption of the LC4MP is that communication can be defined as "an ongoing interactive exchange of information via a medium that is received by an individual" (Fischer et al., 2018, p. 273). A key term in that definition is *interactive*. Even in seemingly one-way situations like viewing television, the user has the

capability to alter cognitive attention, thus changing how much information is processed. All communication is interactive (Geiger & Reeves, 1991; Lang 2000).

The LC4MP offers many tenets but has proven especially useful in understanding three main domains of research: cognitive capacity, motivated processing, and memory. Each of the aforementioned domains will be explained below as they pertain to the LC4MP.

Cognitive Capacity

Central to the LC4MP is individual cognitive capacity. Put simply, it is assumed that a person can only process so much information (it is the "limited capacity" model after all; Lang, 2000). A commonly used analogy is a "cognitive pie" cut into four pieces (Lang & Basil, 1998). When a person is given information or anything that needs to be processed this pie, representing total cognitive capacity, begins to break into four pieces: resources required to successfully process the message, resources allocated to the message, resources remaining in the system while the task is being performed, and available resources (Fisher et al., 2018; Lang et al., 2006).

Following this analogy, the more cognitive effort a message takes to process, the less available resources will remain to be used for other cognitive tasks; and inversely, the easier a message is to process, the more remaining cognitive power is available to process extraneous information. This has been tested extensively using secondary task reaction time (STRT) methodology (e.g., Basil, 1994; Fox et al., 2007; Lang et al., 2006; Lang & Basil, 1998). STRT research indicates that a person is capable of completing two tasks at once, a primary task and a secondary task. It has been shown that the more cognitive effort expended to complete the first task, the STRT will be higher, meaning that it will take longer to complete the secondary task (Basil, 1994; Lang & Basil; 1998).

The amount of cognitive effort required to process information has been shown to increase with messages that are motivationally relevant and that have a higher ratio of new, or novel, stimuli introduced per minute (Lang et al., 2007, 2013a). As stated, the more cognitive effort required by the primary task, the slower the reaction time will be for the secondary task, to a certain point. If the primary task is too complex, the participant will enter a state called cognitive overload, which leads to poorer attention to the primary task and faster reaction times for the secondary task (Fox et al., 2007; Lang et al., 2006). Cognitive overload occurs when the resources required to process a message exceed the resources allocated for message processing (Fox et al., 2007). The LC4MP offers a unique look at the effect of cognitive overload on message processing but in all the concept is still understudied (Fisher et al., 2018).

In the context of the current study, cognitive capacity relates to the idea of central and peripheral information. The primary task is the processing of the central information: the basketball game. The secondary task is the processing of the peripheral information: the advertisements. This aspect of the LC4MP addresses the difficulty a person might have to process advertisements that share screen space with a sport.

Motivated Processing

Messages that activate one of the motivational processes, appetitive or aversive, require greater cognitive effort and therefore lead to greater encoding and storage (Fisher et al., 2018). Because of this, understanding how the appetitive and aversive systems operate within an individual and how their activation alters cognition has become a central focus of the LC4MP (Fisher et al., 2018; Lang, 2006a, 2006b). As mentioned previously, both the appetitive and the aversive systems are evolutionary biological processes that assist in determining the saliency of information (Cacioppo et al., 1997, 2011). The appetitive system pertains to positive stimuli and

the aversive pertains to negative stimuli (Bradley, 2007; Bradley et al., 2001). This is the case for mediated communication messages as well (Mangus et al., 2015), though because mediated messages often contain both positive and negative stimuli, activation of the motivational systems varies greatly (Chung & Sparks, 2016).

In the LC4MP, a message's valence (positive or negative) and arousal (calming or exciting) determines its emotional tone (Lang, 2006a, 2006b). The emotional tone is what then triggers the reflexive activation of one of the motivational systems (Berntson & Cacioppo, 2000; Lang, 2006a). The intensity of a message leads to varying levels of both arousal and system activation (Berntson & Cacioppo, 2000). An exciting message correlates with higher arousal and higher levels of motivational system activation; conversely, a less exciting message correlates with lower levels of arousal and lower levels of motivational activation (Chung & Sparks, 2016). The emotional tone in a message is central to motivational activation, but the LC4MP views emotion on the part of the person as a byproduct of the motivation, and as such, emotion and motivational activation are often considered together without distinction (Fisher et al., 2018; Lang, 2000, 2017).

While watching a sporting event the valence would indicate whether the preferred team is winning or losing and arousal would indicate how exciting the game is, often determined by the score. A close game with the preferred team losing would induce high aversive motivation and a game where the preferred team is winning by a large margin would induce low appetitive motivation.

In a neutral environment, where there are no perceived threats or opportunities, the appetitive system is more active than the aversive system. This phenomenon is called the positivity offset (Cacioppo & Gardner, 1999). Evolutionarily, the positivity offset plays a role in

helping organisms leave the safety of their shelter to look for new life-sustaining resources and experiences (Lang et al., 2013b). The aversive system, while less activated at rest, activates much more quickly than the appetitive system, meaning response to a negative stimulus occurs much faster and more intense than a response to a positive one. This phenomenon is called negativity bias (Cacioppo & Gardner, 1999). Evolutionarily, the negativity bias helps protect organisms in extreme danger, motivating them to action very quickly. The positivity offset and negativity bias are thought to be functionally adaptive because failure to react to a threat quickly can lead to death, but failure to react to an opportunity quickly will merely lead to a missed opportunity (Cacioppo & Gardner, 1999).

According to the motivated processing segment of the LC4MP, then, when watching a sporting event with the preferred team winning only slightly or one with the preferred team losing by a large margin the information recall should be increased. This is a central concept to the current study; monitoring how different valence and arousal levels in a basketball game will alter the recall and recognition of the advertising messages.

Individualized Activation. Motivational activation happens differently for each individual, making it difficult to manufacture broad claims about thresholds and other parts of the process, outside what has already been mentioned (Lang et al., 2013b). These differences in activation are often measured using the Motivation Activation Measure (MAM; Bradley et al., 2007; Lang et al., 2005). Research into the LC4MP in conjunction with the MAM has shown individual differences in appetitive system activation (ASA) and defensive (or aversive) system activation (DSA) and that those differences affect media choices and cognitive processing (Bailey, 2015; Potter et al., 2011). Lang, Shin, and Lee (2005) categorized people into four groups according to their differing relative levels of ASA and DSA: risk-takers (high ASA, low

DSA), risk-avoiders (low ASA, high DSA), coactives (high ASA, high DSA) and inactives (low ASA, low DSA).

The people in each category often have similar tastes in media and arousal level (Potter et al., 2011). For example, risk-takers often enjoy more arousing media, such as horror movies, sports, and action video games; conversely, risk-avoiders prefer tamer media such as soap operas and puzzle video games (Krcmar et al., 2015; Lang, 2006a; Wang et al., 2015). These individuals experience the highest and lowest levels of motivational activation (Krcmar et al., 2015). Inactives and coactives, on the other hand, often experience much lower levels of motivated activation and their media choices fall somewhere in-between the high intensity of risk-takers and the low intensity of risk-avoiders (Lang et al., 2011; Sparks & Chung, 2016).

Personal conditioning and experiences can also lead to varying levels of motivational activation. Lang (2006b) explained that a public health message about the risks of cancer will almost certainly activate the aversive system because cancer is bad and very few people have experiences that contradict this idea. A message about smoking cigarettes, on the other hand, will likely activate the aversive motivational system in some–those who believe smoking is bad–and the appetitive motivational system in others–those who enjoy smoking.

Measuring motivational activation. There are many ways to measure, or at least estimate, the activation of the aversive and appetitive motivational systems including self-report, continuous response measurement (CRM), and psychophysiological methods (Fisher et al., 2018). As stated previously, activation of the motivational systems is closely related to emotion, thus self-report measures of emotion have proven to be a reliable form of activation estimation. Self-report also offers insight into overall arousal and valence (Alhabash et al., 2015; Chung et al., 2015). A sizable limitation of self-report for LC4MP measures has already been mentioned;

being that because both communication and human functions are ongoing, a brief snapshot of data only tells part of the story, and CRM and psychophysiological methods lend much further insight (Fisher et al., 2018). CRM is often a self-reported measure as well, but it dodges the limitation mentioned due to its continuously reported nature as a message progress (Lang, 1994). In recent research, CRM is more frequently used to pre-test stimuli to verify arousal level or valence (e.g., Rasmussen et al., 2017), but it can be used as an indication of disposition which hints at emotion, and therefore motivational activation (Bailey, 2015; Lee & Lang, 2009; Wang & Bailey, 2018). Various psychophysiological parameters have measured motivational activation, but heart rate (HR), skin conductance, and facial imaging are the primary metrics (Potter & Bolls, 2012).

HR indicates cognitive load. Increased HR is indicative of higher cognitive processing and similarly, decreased baseline HR indicates lower cognitive processing (Keene et al., 2017). Skin conductance and facial imaging are often used to measure emotional state and valence, and LC4MP research is no different. Skin conductance measures arousal level (high or low) and facial imaging measures valence (positive or negative). Facial imaging, sometimes referred to as facial recognition or facial electromyography, closely examines microscopic muscle movements in the face, as the face will automatically manifest the affective emotional valence a person is feeling (Clayton et al., 2020; Dimberg, 1988). LC4MP research looks specifically at two muscle structures in the face, the corrugator supercilia as an indication of aversive activation, and the zygomaticus major as an indicator of appetitive activation (Bolls et al., 2001; Bradley et al., 2007; Leshner et al., 2018; Wang & Lang, 2012). Psychophysiological methods collect continuous data throughout exposure to a message and give a deeper look at cognitive processing and motivational activation.

Memory

At the very heart of the LC4MP, is the search for an understanding of how humans process information, which can be determined by studying three basic cognitive functions: encoding, storage, and retrieval (Lang, 2000, 2009). Encoding is the creation of a mental representation of a physical stimulus. Storage is the assignment of that representation to either short-term or long-term memory. Finally, retrieval is the activation of that representation into a conscious thought (Lang, 2017). Each of these processes happens automatically and unconsciously (Lang, 2000, 2006b). Not everything a person views is encoded, not everything encoded is stored, and not everything stored can be recalled easily (Lang, 2000). Each of these three functions will be discussed in detail below, including how they can be measured.

Encoding. Encoding refers to the autonomic neural process of subconscious acknowledgment of a stimulus followed by the creation of a mental representation. It is important to note that this neural representation is just a recreation of the stimulus, as it is impossible for a person to store the actual stimuli (Lang, 2000). The process of converting a message into a mental representation is simple. First, the message must engage and be processed through sensory receptors, like the eyes or ears (Eysenck, 2001). Once the receptors have been activated, they will create the representation, and that information will be placed in some sort of sensory storage (Poctor, 2018; Zechmeister & Nyberg, 1982). These sensory stores have unlimited space, but the information there is very short-lived, only lasting between 300 milliseconds and three seconds (Crowder, 2014; Gregg, 2014; Holding, 1975). If the information in these sensory stores is not selected to be moved on into short-term or long-term memory (the storage function), it is written over by new information and lost. Only a fraction of what enters the sensory stores are moved on into storage (Lang, 2000).

Encoding is thought to be connected with resource allocation, which is measured by monitoring tonic or phasic HR deceleration (Liu & Bailey, 2019). Resource allocation does not necessarily indicate that a mental representation of the message was encoded. To test which information is encoded, a forced-choice audiovisual recognition task or multichoice question related to the message content is used (Keene & Lang, 2016; Rodero et al., 2017). To monitor the success with which advertisements were encoded, for example, a recognition test of the brand logos would be appropriate (Fox et al., 2007)

Additionally, certain types of stimuli or movements in a message cause an orienting response (Lang, 2006a). An orienting response, sometimes called a "what is it?" response is triggered by new or novel concepts or stimuli (Graham, 1979). Novel stimuli represent a change in the environment. In mediated messaging, an orienting response can be triggered by a myriad of communication tools including camera cuts, pitch changes in audio, pop-up banners, or other tools that alter what a person is viewing (Clayton et al., 2017; Diao & Sundar, 2004; Lang et al., 2006b, 2015; Lee & Lang, 2015; Potter et al., 2019). An orienting response is accompanied by increased cognitive allocation and automatic encoding of the information (Lang, 2006a). There are many cases in which virtual advertisements are changing and therefore considered novel, the NBA's application, however, is unchanging and therefore not novel (Tsuji et al., 2009).

Storage. Memory research is everchanging with the development of new technologies and theories which seek to explain the phenomenon (Lang, 2000). Much of the specifics of the storage process are still unknown. Memory is formed and strengthened by activation or recall. The more a person thinks about newly encoded information the more associations are made between that new information and existing information. Storage takes place when the newly encoded information is linked to other memories. The new memory is then stored in short-term

or long-term memory, linked with the other memory (Lang, 2000). LC4MP research has shown that there is a connection between storage and motivational activation, specifically that activation of the aversive system leads to greater encoding and decrease in storage, especially regarding peripheral information (Yegiyan, 2015). Cued recall tasks test storage (e.g., Bigsby et al., 2017; Rodero et al., 2017).

Retrieval. Retrieval is the last cognitive step in memory that is monitored by the LC4MP. Retrieval occurs when stored memories are reactivated. It is the process of searching through stored and often inactive memory networks for a specific piece of information and reactivating that memory into working memory (Lang, 2000). LC4MP research has demonstrated that emotional or arousing messages are more easily retrieved than calmer messages (Bas & Grabe, 2015). Free recall tasks test retrieval (Fox et al., 2007).

Motivated processing and memory in the peripheral. Messages that activate the appetitive or aversive motivational systems require greater cognitive effort and therefore lead to greater encoding and storage (Fisher et al., 2018). Much of the research in conjunction with the LC4MP, motivational activation, and memory examines a central message (Chung & Sparks, 2016). This view, however, does not allow for predictions of peripheral images within the central message. For example, in a spectator's sporting event, the sport is the central message, and any advertisements seen on screen or in-person are peripheral (Boronczyk et al., 2018; Breuer & Rumpf, 2012, 2015). That information is still processed, just not centrally. Yegiyan and Lang (2010) found a positive linear relationship between appetitive motivation activation and recognition of images from the peripheral. The higher levels of appetitive lead to higher recall of peripheral information. Conversely, a negative linear relationship between aversive activation and recognition of peripheral images was found. The higher levels of aversive activation led to

lower recall of peripheral information (Yegiyan & Lang, 2010). These findings were corroborated by Chung and Sparks (2016) who also found that, in accordance with the LC4MP, moderate to high levels of appetitive activation as well as low to moderate levels of aversive activation both lead to greater recall. Lee and colleagues also confirmed these results by studying recall of stadium advertising (a peripheral message) during a basketball game (Lee et al., 2019).

The implication of this research is that "viewers automatically and unconsciously give different degrees of attention to a mediated event depending on how much the event is pleasant and arousing, which in turn leads to different levels of memory performance toward peripheral information in the event" (Lee et al., 2019, p. 609). Ultimately, the more cognitive resources required for a person to consume a message, the greater the likelihood that he or she will recall more information from that message, even if parts of that message were encoded and stored subconsciously (Lang, 2006a; Lee et al., 2019).

Visual Attention

Visual attention can be monitored using eye-tracking technology, a long-standing research method within the social sciences and communications research (Chu et al., 2009). Eye-tracking measures many eye movements including fixations and saccades using near-infrared light, reflections, and triangulation (Tobii Pro, 2015). Fixations, which occur when a person's eyes pause on an image long enough to process the information presented, can be considered indicators of visual attention (Just & Carpenter, 1976; Liu & Heynderickx, 2011).

Researchers have established many factors that draw a person's visual attention, including movement (Pratt et al., 2010), abrupt onset or change of stimulus (Yantis, 1998), evolutionarily relevant stimulus (like tasty looking food; Motoki et al., 2018), and many others. Jonides (1981) explored the extent to which visual attention relates to both central information

and peripheral information. They found that central information effectively captured and maintained attention so long as it was presenting relevant information. Peripheral information draws visual attention when it abruptly changes (Yantis & Jondies, 1984). Pertaining to the current study, it follows that a sports program, as central information, is relevant to those who are interested in the game and therefore would dominate visual attention. Virtual advertising, however, as an abrupt and changing peripheral stimulus, may draw visual attention away from the game.

Research Overview

The overall guiding research questions for this study are: a) Is virtual advertising recalled more successfully than static stadium advertising? and b) How does the intensity of the game affect the overall recall and recognition of advertisements?

H1: Because the virtual advertisements are more centrally located on the court, they will yield greater visual attention than traditional in-stadium advertisements.

H2: Greater visual attention of virtual advertisements will yield higher recognition scores than traditional in-stadium advertisements.

RQ1: How does fixation time on virtual (RQ1a) and traditional (RQ1b) advertisements differ between high and low activation of the aversive and appetitive motivational systems?

RQ2: Is there any notable difference in recall of advertisements between high and low activation of the aversive and appetitive motivational systems?

RQ3: Is there any notable difference in recognition of virtual (RQ3a) or traditional (RQ3b) advertisements between high and low activation of the aversive and appetitive motivational systems?

In answering these hypotheses and research questions this study will contribute greatly to the body of literature for both LC4MP and advertising research. Pertaining to the LC4MP, it will fill in gaps regarding peripheral information processing and appetitive and aversive motivational activation. For advertising research, it will be a seminal study on virtual advertising in the NBA, building on what has been gathered from other sport's implementation, and provide recommendations for advertising practitioners to maximize effectiveness in future application.

Methods

In accordance with the Brigham Young University Institutional Review Board and grounded in previous LC4MP research, this study monitored eye-tracking and galvanic skin response (GSR) to measure arousal and visual attention to virtual and stadium advertisements shown during an NBA basketball game. It also employed signal detection and free recall tests to monitor advertising recognition and recall.

Participants

This study consisted of a total number of 176 participants. Each participant was randomly assigned to one of the four conditions: condition one, low aversive (n = 43); condition two, low appetitive (n = 46); condition three, high aversive (n = 42); and condition four, high appetitive (n = 45).

The 176 participants ranged between the ages of 18-44, with a mean age of 21.85. 64% of the participants were male and 36% were female. While this sample certainly favors men, it is an accurate indicator of men versus women sports spectatorship in the United States (eMarketer, 2020). The ethnic breakdown of the sample was 86% White or Caucasian, 5% Native Hawaiian or Pacific Islander, 3% Asian, 2% Hispanic or Latino, 2% Multiracial, 1% American Indian or

Native Alaskan, and 1% “Other.” Despite being a non-random sample, this ethnic breakdown matches that of the institution from which the sample was pulled.

Participants were recruited from Brigham Young University and were informed of the study through either classroom announcement, word of mouth, or by reading one of the various flyers that were placed on campus. Those interested in participating in the study were provided a link where they could sign up for a time to be tested. Participants were compensated $10 for approximately 15 minutes of their time.

Stimulus

An NBA broadcast taken from a 2020 game between the local NBA team, the Utah Jazz, and their rivals, the Denver Nuggets, was used as the stimulus for this study. This game originally took place during “the bubble” (Golliver, 2020), the period when each team was required to quarantine, and in-person spectators were banned to mitigate the spread of the COVID-19 virus. This is significant because this was the first time that virtual advertising has been employed in the NBA thus far. The selection of a clip from a game featuring the local team and their rival affords a greater likelihood that the participants would be more emotionally invested in the game and pay more attention (Lee et al., 2019).

The stimulus for the study was a 5-minute highlight reel of the selected game, edited to make four manipulated versions which altered only the score of the game. The score was manipulated to alter arousal level and motivational activation for the clips used in each of the four experimental conditions. The high arousal stimuli featured a close game, with a score within three points throughout the clip, while the low arousal stimuli featured a lopsided game with the score differing by 10-30 points. To alter the motivational activation within each arousal level, two clips were made, one with the local team winning (appetitive) and one with the local team

losing (aversive). Thus, four different stimuli were created which maintained the same advertisements and timing. To be specific, each of the four stimuli featured the same 5 minutes of the same basketball game, only the score was manipulated. The creation of these stimuli closely follows that of Lee et al. (2019), who determined how to manipulate arousal level and motivational activation in a similar setting.

Throughout the 5-minute clip, a total number of 17 stadium advertisements and four virtual advertisements cycled through. Across each stimulus, the exposure to the advertisements was identical, including frequency, location, and total screen time.

A baseline stimulus that featured a blank screen and calming classical music was shown before each condition. This was used to establish a baseline for GSR readings which allowed for a clearer measurement of arousal level during the stimuli of interest.

Biometric Equipment

This study employed both eye-tracking and GSR equipment. The stimuli were presented, and the data was collected using iMotions 9.1, a biometrics software suite that integrates the eye-tracking data with the GSR data. The eye-tracking data was collected by a Tobii Pro Spectrum screen-based, high-speed eye-tracker running at 300Hz. This device utilizes bright pupil illumination tracking methods, illuminating the eye with near-infrared light, which generates highly visible reflections. The device then uses a camera and other sensors to identify the reflection on both the cornea and the pupil. It then calculates the vector formed by the angle of the reflections between both points and extrapolates the location of that vector onto the screen. This information is correlated with a 9-point grid on the screen giving an accurate approximation of where on the screen the person is looking (Tobii Pro, 2015).

Each participant undergoes a calibration process to ensure accurate eye-tracking results. The calibration process is described below, as presented on the Tobii Pro website:

> During this procedure, the eye tracker measures characteristics of the user's eyes and uses them together with an internal, anatomical 3D eye model to calculate the gaze data. This model includes information about shapes, light refraction, and reflection properties of the different parts of the eyes (e.g., cornea, placement of the fovea, etc.). During the calibration, the user is asked to look at specific points on the screen, also known as calibration dots. During this period several images of the eyes are collected and analyzed. The resulting information is then integrated in the eye model and the gaze point for each image sample is calculated. (Tobii Pro, 2015, para. 3)

The GSR data was collected using a Shimmer3 machine. GSR sensors, which are connected to the first and second fingers of the participant's non-dominate hand as well as the earlobe, measure sweat gland activity paired with pulse. The sensors monitor the amount of sweat in the skin, which can be easily measured due to the electrical conductivity of sweat (Tobii Pro, 2015). These measures have been shown to correlate strongly with emotional arousal; the higher the skin conductance, the higher the arousal (e.g., Eyseneck, 1976).

Procedure

In an attempt to increase the likelihood of emotional arousal, participants were recruited to participate only if they self-identified as a moderate to extreme fan of the Utah Jazz. This was assessed via a single self-report item asking, "Do you consider yourself to be a fan of the Utah Jazz?" anchored by Not at all (1) to Extreme (5). Each participant was invited to come to the lab at a predetermined time to complete the study. Upon arrival, they were asked to sign a consent document that informed them they would be viewing clips from a basketball game but were not

informed of the study's intentions to measure advertisement recall and recognition. They were instructed to watch the game as they normally would. Participants were then brought into the lab, at which point researchers connected them to the GSR machine and seated them in front of the eye-tracker for calibration, approximately 20 inches from the screen. Once calibration was satisfactorily complete, they were randomly assigned to and shown one of the four conditions. If calibration was failed, they were adjusted and recalibrated until successful before being exposed to the stimulus.

Upon completion of the stimulus video, they were disconnected from the GSR machine and escorted to a connecting room where they completed a Qualtrics survey that assessed their free recall and recognition of the advertisements shown in the stimulus. The survey was 51 questions in total, including demographic information, and took roughly 6 minutes to complete. A complete copy of the survey is included in Appendix A.

Measures

Visual Attention

Bright pupil eye-tracking monitors fixations, which are key indicators of visual attention (King et al., 2019). Fixation duration is often measured one of two ways, either by calculating the total time for specific fixations or by calculating the total fixation time across all the fixations (Salvucci & Goldberg, 2000). To measure the duration of attention each advertisement received, an area of interest (AOI) was created around each of the advertisements presented in the 5-minute clip. The aggregate fixation time for each of the AOIs was then calculated, providing the total amount of time each participant spent looking at each of the advertisements, thus measuring visual attention. A still image of the AOIs from the stimulus is included in Appendix B.

Emotional Arousal

Emotional arousal was calculated by running the GSR Metrics Analysis through the iMotions software (iMotions, 2020), which produced the number of "total peaks" and "peaks per minute" for each participant. This is referring to peaks in GSR data collection, which is an indicator of high arousal moments (Boucsein, 2012). Because every participant saw the same video stimuli, minus the score, "total peaks" was used instead of "peaks per minute." The more total peaks a participant exhibited, the more emotionally aroused they were and, conversely, the fewer peaks exhibited, the less emotionally aroused.

Recall

Free recall was tested to measure retrieval. Each participant was asked to list any advertisements or brands they remembered seeing during the clip (Wang & Lang, 2012). The free recall scores were calculated by adding up the correct answers, with a maximum score of 21. It is important to note that the recall test was offered before the recognition to assure there was no memory aide in the retrieval process.

Recognition

A recognition task was used to test encoding. To assess brand recognition, participants were asked to select brands that they remembered seeing in the clip. Different logos or messages of the same brand as seen in the stimulus were used to protect against indiscriminately high scores (Lee et al., 2019; Rothschild et al., 1990). The participants were shown 52 logos—21 that were directly represented in the stimulus and 21 that are different brands of the same category. Brands that were represented in the stimulus are considered targets and brands that were not are considered foils. Michelob Ultra, for example, was a brand shown in the stimulus and was used as a hit in the survey; while Budweiser, another beer company, was not shown in the stimulus

but was used as a foil in the survey. A complete list of both the target and foil advertisements is included in Table 1 below.

Table 1

Target and Foil Brand Advertisements for Memory Recognition Test

Target Advertisements	Foil Advertisements
Kia	Toyota
NBA TV	NFL Network
State Farm	Allstate
Spalding	Wilson
Michelob Ultra	Budweiser
Gatorade	Powerade
NBA	MLB
Nike	Underarmour
5 for the Fight	1UP on Cancer
HBO	Netflix
HBO Max	Showtime
Mountain Dew	Coca Cola
Western Union	Mountain America Credit Union
TNT	NBC
AT&T	Verision
Auto Trader	Carvana
FanDuel Sportsbook	Fantasy Pros
Lovecraft Country	The Witcher
Taco Bell	Del Taco
House of Highlights	Barstool Sports
American Express	MasterCard

Results of this survey were calculated per signal detection analysis (Fox, 2004; Macmillan & Creelman, 2004; Shapiro, 2014). According to signal detection theory, when a

participant correctly indicates that a target was shown in the stimulus it's called a hit and when they incorrectly indicate that a foil was shown in the stimulus it's called a false alarm. Memory sensitivity, *d'* (pronounced dee-prime), represents the standardized difference between false alarms and hits. Sensitivity is a measure of memory strength – how easily a person can distinguish between actual memories and false memories. A higher *d'* score correlates with better memory. In memory tests, *d'* is often used as a way to reduce Type 1 error (Green & Swets, 1966).

To calculate *d'*, the standardized z score of the false alarm rate is subtracted by the standardized z score of the hit rate. $d' = Z(FA)-Z(H)$. It is important to note that when calculating the z score of the hit and false alarm rates, a mean of zero and a standard deviation of one should be assumed – hence the standardization. If the specific sample's mean and standard deviation were used the data would be skewed.

Analysis

Statistical analysis was performed using IBM SPSS software version 27. Statistical power calculations were executed using G*Power 3.1.5 (Faul et al., 2009). The analytical approach will utilize one-way ANOVAs. For ANOVA analyses, effect size standards are small (f^2 = .10), medium (f^2 = .25), and large (f^2 = .40). Achieved power was excellent for the detection of large effects (1.00), good for the detection of moderate effects (.85), and poor for the detection of small effects (.20).

Results

The main objective of the current study was to examine how virtual advertising scored compared to traditional in-stadium advertising in terms of visual attention duration and recall and

recognition. The following sections further answer these questions and the other research questions already proposed.

Bivariate Correlation Matrix

A bivariate correlation matrix was created to examine relationships between emotional arousal, visual attention, and advertising recall and recognition. As seen in Tables 2 and 3 below, the results show that there is only one significant correlation among the variables of interest, between total advertising recall scores and recognition scores of virtual advertisements ($r = .403$, $p < .01$). Those who scored well on the free recall task also scored well on the recognition task for virtual advertisements. There is no other significant correlation among the variables of interest.

Table 2

Bivariate Correlation Matrix

	1.	2.	3.	4.	5.	6.
1.		.403**	-.033	-.034	.002	.135
2.			-.088	.004	-.116	.145
3.				.024	-.071	-.015
4.					-.096	.029
5.						.143
6.						

** $p <$ o.o1

Table 3

Variable Key for Table 2

1. Total Advertising Recall Score
2. Recognition Score for Virtual Advertisements
3. Recognition Score for Traditional Advertisements
4. Mean Fixation Duration on Virtual Advertisements
5. Mean Fixation Duration on Traditional Advertisements
6. Emotional Arousal (as indicated by total peaks detected through GSR)

Hypothesis 1

Hypothesis 1 proposed that virtual advertisements would receive greater visual attention than traditional in-stadium advertisements. Visual attention is indicated by the total fixation duration that each area of interest, in this case each advertisement type, received. To test this hypothesis a paired-samples t-test was conducted using fixation duration as the dependent variable and advertising type as the predictor. There was a significant difference in fixation duration between the virtual advertisements (M = 3.64 seconds, SD = 0.9173 seconds) and the traditional in-stadium advertisements (M = 1.2258 seconds, SD = 0.5365 seconds); $t(172) = 28.702$, $p < 0.005$. This hypothesis was supported; virtual advertisements did receive statistically significantly higher visual attention than traditional in-stadium advertisements.

Hypothesis 2

Hypothesis 2 proposed that virtual advertisements would score higher than traditional in-stadium advertisements on the recognition test. Again, recognition was measured using signal detection theory to calculate memory sensitivity, *d'*. Higher *d'* scores indicate higher recognition.

To test this hypothesis a paired-samples t-test was conducted using *d'* as the dependent variable and advertising type as the predictor. There was a significant difference in recognition scores between the virtual advertisements ($M = 0.0774$, $SD = 0.3279$) and the traditional in-stadium advertisements ($M = 0.7869$, $SD = 0.5089$); $t(173) = -14.872$, $p < 0.005$. Virtual advertisements scored statistically significantly worse than traditional in-stadium advertisements on the recognition task. The hypothesis was not supported as it predicted the inverse relationship.

RQ1

The first research question asked about how visual attention varies for virtual advertisements (RQ1a) and traditional advertisements (RQ1b) among each condition (low arousal aversive, low arousal appetitive, high arousal aversive, and high arousal appetitive). To test this question two one-way ANOVAs were run, one with mean fixation duration of virtual advertisements as the dependent variable and one with the mean fixation duration of traditional advertisements as the dependent variable; both ANOVAs used condition as the independent variable. There was a no statistically significant difference between groups as determined by one-way ANOVAs ($F(3,169) = 0.484$, $p = 0.694$ and $F(3,169) = 1.309$, $p = 0.273$ respectively).

RQ2

RQ2 asked about participant free recall scores within each condition. To test this question a one-way ANOVA was run with recall scores as the dependent variable and condition as the predictor. There was no statically significant difference between groups as determined by one-way ANOVA ($F(3,170) = 0.715$, $p = 0.544$).

RQ3

The last set of research questions asked if there was any noticeable difference in recognition scores of virtual advertisements (RQ3a) or traditional advertisements (RQ3b)

between each of the conditions. A single one-way ANOVA was run to test each subset of the research question. RQ3a was tested using the calculated *d'* score for virtual advertisements as the dependent variable and condition as the predictor. There was a statistically significant difference between groups as determined by one-way ANOVA ($F(3,170) = 2.832$, $p = 0.040$). A Bonferroni post hoc test revealed that the recall scores on virtual advertisements were statistically significantly lower in the low arousal aversive condition ($M = 0.0138$, $SD = 0.2711$, $p = 0.06$) compared to the high arousal appetitive condition ($M = 0.1941$, $SD = 0.3588$). There was no statistically significant difference between the other conditions.

RQ3b was tested using the calculated *d'* score for traditional in-stadium advertisements as the dependent variable and condition as the predictor. There was no statistically significant difference between groups as determined by one-way ANOVA ($F(3,170) = 1.945$, $p = 0.124$).

Manipulation Check

The current study relied on the researcher's ability to manipulate participant emotional arousal, per the LC4MP. Emotional arousal is measured by the total peaks each participant exhibited (monitored with GSR) while viewing the stimulus. To test the manipulation a one-way ANOVA was run with peaks per minute as the dependent variable and condition as the predictor. There was no statistically significant difference between groups as determined by one-way ANOVA ($F(3,170) = 0.419$, $p = 0.739$). The manipulation was unsuccessful; there was no significant difference in emotional arousal among the conditions.

Discussion

Virtual advertisements received more visual attention than traditional in-stadium advertisements yet scored lower on the recognition task. This seems to indicate that although virtual advertising in the NBA is placed in a central location, directly on the court where the

game is taking place, it may still be processed peripherally. This interpretation would make sense – the virtual advertisements likely received greater visual attention due to the movement of the players and the ball directly on top and around them. In this case, focus is still not on the advertisements, rather on the gameplay around them. This aligns with research in peripheral attention which states that when adjusting the focus of attention (like following a player dribble down the court), central and peripheral information often coincide. The two, however, are dissociable. In other words, both central and peripheral information receive visual attention, but the brain knows to process the central stimuli rather than the peripheral (Hoffman, 1998; Kean & Lambert, 2003).

This highlights a common limitation in eye-tracking and fixation research – while there is a relationship between looking and thinking, visual attention and cognitive processing, the two occur independently (Deubel, 2008). Attention, and therefore cognitive processing, shifts before the fixation ends; they are not perfectly coupled (Orquin & Holmqvist, 2018). Deubel (2008) found dissociations of fixations and attention of up to 250 milliseconds. For a fast-moving stimulus like a basketball game, it is likely that the fixations recorded lagged behind actual participant attention. This would give the virtual advertisements a greater fixation duration but might not accurately represent attention and cognition.

The lack of additional significant results can be explained by the failed manipulation of participant emotional arousal. Each of the research questions was formed around the tenants of the LC4MP, which uses high and low arousal to predict information processing. Despite this issue, which is addressed further in the limitations, there was a significant difference in recognition of the virtual advertisements between the low aversive and high appetitive conditions. Recognition was used as a way to measure information encoding. In the low aversive

condition, the virtual advertising was encoded at a much lower rate than the high appetitive condition. According to the LC4MP, both the low aversive and high appetitive conditions should receive better encoding than the high aversive and low appetitive conditions (Cacioppo et al., 2011). The results are contrary to what was expected. The low aversive condition received lower recognition scores than all conditions, while only significant compared to high appetitive. The significance of this result is unknown and warrants further study into the LC4MP.

The appetitive and aversive motivation systems are biological evolutionary processes that take place in order to help determine saliency of information (Cacioppo et al., 1997). As humans have evolved and no longer frequently find themselves in life-threatening situations or scavenging for food, the motivational systems have remained remarkably the same. The current study, like various past studies, sought to manipulate motivational activation and arousal level in a sports setting. It has been assumed that a losing situation would activate aversive motivational processing and a winning situation would activate appetitive motivational processing (Breuer et al., 2021; Lee et al., 2019). While winning and losing are certainly connected to emotional valence (positive and negative), more might need to be done in order to more fully activate the aversive and appetitive motivational systems than simply altering the score on a pre-recorded sporting event.

Breuer and colleagues (2021) more fully sought to elicit motivational activation and emotional arousal by exposing participants to a live broadcast. While their study was only a pilot study for future research, their preliminary results showed a much deeper activation of the motivational processes. Thiers is among the first studies to test these factors in a live broadcast environment and the first to employ physiological measures to monitor arousal in a live broadcast setting – a much more accurate measure of arousal (Breuer et al., 2021; Carrillat et al.,

2015). Breuer and group's study suggests that score does play into activation of the different motivational processes, but that an authentic, live spectator experience more potently elicits arousal. Future researchers interesting in testing the LC4MP in a sports setting should consider using a live broadcast or attempt to more closely mimic a live broadcast in a lab setting.

Additionally, the LC4MP states that motivational activation is personal. Each individual will experience a different level of activation and arousal with a myriad of factors contributing. These individual differences are measured using the MAM, which looks at personal media consumption, desensitization, and general arousal level (Lang et al., 2005). It follows that any time a study uses the LC4MP to monitor motivation activation and arousal level the MAM should be employed to adjust individual arousal scores to provide a more accurate representation of arousal. There is some discrepancy, however, as Lang's (2000) foundational LC4MP study has been cited significantly more than her study that introduces MAM (Lang, 2000; Lang et al., 2005). Not every study using the LC4MP will need to use the MAM, but researchers should be more attentive to those measures in future research. The current study did not employ the MAM, which is a limitation.

Application for Professionals

This study highlights many principles that can and should be applied by both advertising professionals and the planning committees of the NBA and various other organizations. Virtual adverting has been available since the 1990s and implemented in many sports arenas including soccer and hockey (Sander & Altobelli, 2011). Despite having a large, clean court that is perfect for virtual advertisements, the NBA only recently adopted the use of virtual advertisements as a last-ditch effort to bolster revenue during the COVID-19 pandemic. During that "bubble" season, three unchanging and unmoving virtual advertisements were used in each game. After the

conclusion of that 2020 season, virtual advertising was put to rest, for a time, in the NBA. The 2021 season did not see a single virtual advertisement until the NBA Finals, in which they were used the same way as in the previous season.

Increased Revenue

The current study showed that virtual advertisements are not remembered better than other, traditional in-stadium signage, but it also showed that virtual advertisements are still seen and remembered by viewers. Virtual advertising is likely process peripherally just like all over in-stadium advertising. While they aren't more effective, they aren't less effective either. This alone is enough data to encourage the NBA to always use virtual advertisements in their games. Virtual advertising provides additional revenue for the NBA and additional opportunity for brands to sponsor teams and games while advertising their product or name. This is a win-win scenario for both the NBA and advertisers.

The recommended use of virtual advertisements extends past just the NBA. As stated, currently only soccer and hockey use virtual advertising. The author recommends the implementation of virtual advertising in all televised sports including football, baseball, and tennis. Each of these sports also features a large and clean field of play that would be perfect for virtual advertisements. Additionally, baseball and tennis have visible borders where virtual advertisements could be shown as banners, as currently used in soccer. The implementation of virtual advertising would greatly increase revenue for the NFL, MLB, and the ATP.

Added revenue does not only apply to professional sports organizations. Popular collegiate sports like football and basketball receive millions of views per game, depending on the teams playing. The 2021 College Football Playoff final between the University of Alabama and the University of Georgia, for example, saw more than 22 million viewers and was cable's

top telecast in two years (Brooks, 2022). Additionally, the Annual NCAA Division I Men's Basketball Tournament, better known as March Madness, has consistently averaged over 10 million views per game since 2013 (Adweek, 2019). That's more than 10 million viewers a game for 63 games. The implementation of virtual advertising in these settings would provide added revenue for the schools and other organizations while also providing valuable and new advertising opportunities for any brand that takes advantage.

Updated Virtual Advertisements

The current and ongoing 2022 NBA season has seen more regular implementation of virtual advertising in much the same manner as before, three unchanging brands using a static advertisement. It is the opinion of the author that the static nature of these advertisements is a lost opportunity. LC4MP research speaks of "novel stimuli" and "orienting responses" (Lang, 2006a; Tsuji et al., 2009). A novel stimulus is when some new visual event takes place, or a general change in the visual or auditory environment (Tsuji et al., 2009). Novel stimuli cause an orienting response, meaning that the brain marks the event as important and thus requires additional cognitive power to process. The more cognitive effort used, the more likely the event will be able to be recalled, or remembered (Lang, 2006a). Additionally, it is widely assumed that an orienting response brings the visual stimulus out of peripheral processing and into central vision (Briand, 1998). Objects seen as central cues are often more readily remembered than objects seen as peripheral cues (e.g., Rijsdijk et al., 1980). A static advertisement is not a novel stimulus and therefore is less likely to be viewed as a central cue and less likely to be remembered.

The very nature of virtual advertisements, being a completely digital superimposition, allows for complete customization including movement. Virtual advertisements can be animated

and moving, thus drawing more attention and increasing recall and recognition. At the very least, virtual advertisements can be cycled through, showing different advertisements every minute for example. The changing of the advertisement will likely cause an orienting response and increase memory as well as provide additional brands space for advertising and increase revenue. Future research should explore different placement and applications of virtual advertising to make more specific recommendations to professionals.

Limitations and Future Research

Emotional Arousal

The current study is not without limitations. First and foremost, as noted in the results section, the study was unsuccessful in its manipulation of participants' emotional arousal. Much of the relevant LC4MP research, including the current study, relies on the manipulation of emotional arousal to monitor motivational activation and its impact on memory. In this case, the failed manipulation meant that the researcher was unable to induce high and low levels of aversive and appetitive motivation. Many of the research questions hinged on the researcher's ability to manipulate arousal, which is likely a key factor behind the nonsignificant results. Future researchers should seek to replicate the current study and employ the appropriate pretest to ensure arousal will be successful.

Additionally, while the use of GSR as a measure of emotional arousal is commonly used in LC4MP research (Fisher et al., 2018), it can only measure arousal level and not valence. That is to say GSR cannot inform whether the arousal is positive or negative. Motivational activation, as explained in the LC4MP, relies on activation level (high or low) as well as valence (appetitive or aversive). Previous studies in the arena of sports messaging and the LC4MP have assumed

winning and losing to be connected to the appetite and aversive motivational systems respectively (Lee et al., 2019), but future research should investigate that assumption.

Stimulus

The stimulus used in the current study was a 5-minute highlight reel of an NBA game during "the bubble" between the Utah Jazz and the Denver Nuggets. The score needed to be manipulated between conditions, which is why a highlight reel was used instead of actual gameplay – there needed to be a lot of scoring. Previous studies have used both highlight reels and actual gameplay (Lee et al., 2019), but it is the opinion of the researcher that actual gameplay would be more effective at manipulating emotional arousal and better simulate the authentic spectator experience. Future researchers should use a longer clip of actual gameplay and/or track participants during more authentic spectatorship (i.e., during the live broadcast) to more fully understand virtual advertising's effectiveness and the role of emotional arousal on advertising recall and recognition.

An additional limitation came because of the specific game that was selected. The game selected took place on August 25, 2020 and was game five in round one of the NBA Playoffs. That game was chosen because both the playoff atmosphere and the rivalry between the Jazz and the Nuggets would likely lead to greater emotional investment and therefore arousal. The Jazz lost that game by 10 points and went on to lose the series despite being up 3-1 coming into that game. For Jazz fans, which was the sample of the study, it was a memorable game. And therein lies the limitation, many participants did in fact remember this game when they were presented the stimulus in October 2021, some even commenting that the score in the clip was different than what they remembered (the change in score was the attempt at manipulation). This unforeseen memory of the game made it difficult to manipulate the participant's motivational activation of

aversive or appetitive arousal. For a person who remembered the game well, because the Jazz lost, they would likely experience aversive activation even if they were in an appetitive condition.

Previous research on motivational activation in sports used events that happened years in the past (e.g., Lee et al., 2019) to minimize the variable of participant memory. The current study was limited in which games it could use as a stimulus because only the 2020 season used virtual advertising. Future research should replicate this study using a less memorable game or consider a way to control for participant memory.

Sampling

The current study was completed using a non-random convenience sample of Utah Jazz fans. As with any non-random sample, the results cannot be generalized to the greater population of sports spectators or even Utah Jazz fans. Future research should seek to replicate this study using a random sample to more accurately predict results.

Fan Opinion

Early research into virtual advertising as used in soccer found that many fans were dissatisfied with the virtual advertisements, saying it cluttered the experience (Sasse & Ludwig, 2002). As a result of that study, soccer has tended to use virtual advertisements in the borders of the field of play. The NBA's current application of virtual advertising is directly on the court, just outside the key where much of the action happens. Future research should seek to understand audience opinions and concerns on virtual advertising as applied in the NBA. This information will give organizations like the NBA and advertising professionals alike more detail into how to optimize both revenue and audience experience.

Lab Setting

Lastly, the current study is limited in ecological validity because of the challenges associated with a laboratory-run experiment. It is difficult to fully apply lab-run experiments into reality. Great steps were taken to ensure maximum comfort of participants and minimize ecological validity concerns, but some items persist. For example, perhaps a participant would react differently on a psychophysiological level if they were watching the stimulus in person or with friends as opposed to in a laboratory. Future research should seek to measure participant reaction in a live broadcasted environment.

Conclusion

The primary goal of this research was to understand the difference between advertising recall and recognition of virtual advertisements compared to traditional in-stadium advertisements as well as replicate previous LC4MP research on emotional arousal's impact on advertising memory. This type of research will become increasingly more valuable as virtual advertising is implemented more frequently. The NBA's experimental use of virtual advertising indicates growth in this area and provides justification for the current study and future research on virtual advertising efficacy.

The LC4MP was used to build a theoretical foundation in regard to information processing and emotional arousal's relation to memory. While this research was unable to replicate the consistent results of the LC4MP, it still brings insight into the role visual attention plays in information processing.

Significant differences were found in both visual attention and recall scores between virtual advertising and traditional in-stadium advertising. Virtual advertisements received more visual attention and scored lower on the recall task. These results show that, while placed in a

more central location, virtual advertising is likely still processed peripherally – just like other in-stadium advertising. It is recommended that extensive future research explore virtual advertising's efficacy in different applications such as placement, animation, changing or cycling advertisements, size, and others.

This study provides specific recommendations for advertising professionals in regard to virtual advertising. First, it is recommended that advertisers and the NBA continue with their implementation of virtual advertising. While it is likely that virtual advertisements are processed peripherally and therefore recall and recognition will always be low, they still receive visual attention and are excellent ways for brands to attach themselves to a team or sport via sponsorship. Second, it is recommended that advertisers seek to innovate the current implementation of the virtual advertisements in the NBA. Because these advertisements are digital superimpositions it would be easy to cycle between brands or even animate the advertisement. These innovations would likely create a novel stimulus and lead to increased recall, not to mention more revenue from additional advertising space. Lastly, it is recommended that advertising professionals seek to implement virtual advertising in other sports such as football, baseball, and tennis. Each of these sports feature a large, clean field of play that would be perfect for the superimposition of virtual advertisements.

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Appendix A

Survey

*Note: The images are not to scale. Each brand image shown to the participant was presented in high definition and each picture was similar in size to the others.

1. Participant # (the lab assistant will give you this information)

2. List all the brands or advertisements you remember seeing during the clip you just watched.

For the following section, consider any advertisements or brands you saw during the clip you just watched. For each question you will see a picture of a brand logo. If you remember seeing the brand or an advertisement for the brand, select "Yes, I do recall seeing this brand advertised." If you do not remember seeing the brand or an advertisement for the brand, select "No, I do not recall seeing this brand advertised." Please answer as quickly as you can for each question.

3. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

4. Yes, I do recall seeing this brand advertised.

   No, I do not recall seeing this brand advertised.

5. Yes, I do recall seeing this brand advertised.

   No, I do not recall seeing this brand advertised.

6. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

7. Yes, I do recall seeing this brand advertised.

   No, I do not recall seeing this brand advertised.

8. Yes, I do recall seeing this brand advertised.

   No, I do not recall seeing this brand advertised.

9. Yes, I do recall seeing this brand advertised.

   No, I do not recall seeing this brand advertised.

10. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

11. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

12. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

13. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

14. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

15. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

16. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

17. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

18. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

HOUSE OF HIGHLIGHTS

19. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

LOVECRAFT COUNTRY

20. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

mastercard

21. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

Michelob ULTRA

22. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

23. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

24. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

25. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

26. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

27. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

28. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

29. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

30. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

31. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

32. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

33. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

34. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

35. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

36. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

37. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

38. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

39. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

40. Yes, I do recall seeing this brand advertised.

    No, I do not recall seeing this brand advertised.

41. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

42. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

43. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

44. Yes, I do recall seeing this brand advertised.

No, I do not recall seeing this brand advertised.

For the following questions, consider your stance as a fan of the Utah Jazz.

45. I consider myself to be…

Not a fan of the Jazz, A mild fan of the Jazz, A moderate fan of the Jazz, a big fan of the Jazz, an extreme fan of the Jazz.

46. Do you participate in online public forums including Facebook groups and Reddit subreddits about the Utah Jazz?

Yes. No.

47. Durring basketball seasion, about how many hours do you spend consuming Utah Jazz content (including watching games, participating in forums, looking at stats and news etc.)

1-100

48. How old are you?

49. Are you Hispanic/ Latino?

50. Which of the following best describes you?

White or Caucasian, Black or African American, American Indian or Alaskan Native, Hispanic or Latino, Multiracial or Biracial, Asian, Native Hawaiian or Pacific Islander, Other, Prefer not to say.

51. What is your biological sex assigned at birth?

Appendix B

AOIs