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# Examining Minor League Baseball Spectator Nostalgia: A Neuroscience Perspective

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## ABSTRACT

The purpose of this study was to explore nostalgia's effect on MiLB spectators' psychological, emotional, and behavioral responses. Mobile encephalography (EEG) headsets were used to monitor attendees' neurological responses that may be indicative of nostalgia, while an ecological momentary assessment (EMA) permitted the capturing of spectators' self-reported nostalgic levels. This approach allowed participants' mental scores to be analyzed in relationship to their nostalgic occurrences. Brainwave frequencies emblematic of inward attention and arousal were significantly related with the number of instances spectators reported feeling nostalgic, which denote mental dispositions prevalent among attendees more prone to nostalgia. Moreover, PROCESS macro regression highlighted nostalgia's ability to influence spectators' behavioral intentions. Results also revealed environmental stimuli originating from sight, sound, and sociability to be especially prominent in triggering nostalgia. Overall, the study's findings reveal unique characteristics present in baseball that render both immediate and enduring effects.

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## 1. Introduction

Rooted in experiential marketing, the concept of nostalgia marketing is designed to initiate stimulation which provokes senses and feelings (Ju et al., 2016), two components highly related to consumer behavior (Cui, 2015). Sensory interactions, although not a tangible commodity, can activate deep and powerful feelings, whereby the consumer longs to reenact a favorable experience. These psychological experiences elicited by organizations increase consumers' connection to brands because nostalgic feelings are directly tied to the individual (Holak et al., 2007). When feelings, derived from memory, bond a consumer to an organization, favorable attitudes tend to grow, eventually boosting brand trust (Valta, 2013), positive word-of-mouth communications (Youn & Jin, 2017), brand loyalty (Palmatier et al., 2006), and purchase behavior (Hwang & Hyun, 2013).

Baseball is one service industry that has long benefited from its inimitable ability to invoke nostalgia. The clean-cut grass, the epochal organ interwoven into the action, food only befitting of a ballpark, and proverbial heckling of umpires represent experiences fans have grown to cherish. Each of these pastime familiarities remind baseball enthusiasts of the sights, smells,

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sounds, feelings, and social interactions which consistently accompany America's favorite past time. Consequently, memories emanating from baseball become sentimental outcomes worth commodifying in attempts to improve patronage.

In addition to the traditional marketing implications, research also demonstrates nostalgia's ability to produce social and emotional health benefits. Albeit in disciplines outside of sport, studies have demonstrated nostalgia's ability to enrich one's self-esteem, optimism (Baldwin & Landau, 2014), social connectedness (Wildschut et al., 2010), and future well-being (Davis, 1979; Zauberman et al., 2009). This is because nostalgia is highly correlated with interpersonal characteristics such as warmth, joy, gratitude, affection, innocence, and even possibly sadness or a sense of loss (Holak & Havlena, 1998). Thus, the benefits of studying baseball nostalgia are not limited to increased attendance. Instead, it is plausible that by attending baseball games, individuals' social well-being may be enhanced, too.

Nostalgia's ability to serve favorable social, emotional, and behavioral outcomes underscores its relevance to consumer behavior research. However, the methods required to investigate it present a number of methodological challenges ranging from retrospective, self-reporting response bias to treating lab-generated stimuli as a natural demonstration of neural activity. Concerning the latter, nostalgia research conducted in controlled experimental environments relies on the presentation of intentionally-occurring events so that stimuli and behavioral data can be synchronized with neural recordings (Mavros et al., 2016). This could be considered best practice as it allows the research to confidently link variations in neural activity to external events being artificially engineered. Unfortunately, this type of experimental manipulation may limit the type and frequency of exposure propagating a psychological state, such as nostalgia. It also prevents cognitive processes occurring in natural, real-world settings (see Hölscher et al., 2011), whereby a participant would have agency over choices such as seat location, social interaction, food and beverages, and movement around the ballpark. Thus, one could conclude that there is a need to adapt neurological protocols for conditions which should not be controlled – for instance, a professional baseball game.

Recent technological advancements in mobile Electroencephalography (EEG) now permit the monitoring of brain wave activity in real time, aiding in the detection process of mental states such as nostalgia. EEG data are recorded using electrodes placed at specific locations across the scalp (e.g., frontal, temporal, parietal). Although portable devices possess limitations due to limited spatial resolution, high temporal resolution permits spectral analysis for optimal inference of sensory, cognitive, and motor processes inherent within sport consumption (Park et al., 2015). Further, mobile EEG devices, like Emotiv, utilize sophisticated modeling to optimize the measurement of neuronal activity associated with trait and state nostalgia (i.e., arousal, withdrawal motivation, and reflection/inward attention). These tools now afford researchers the ability to analyze a sport spectator's cognitive process while spectating in an actual stadium environment.

Based upon these recent advances, the current study had three objectives: (a) determine the prevalence of nostalgia being experienced by spectators through the examination of brainwave frequencies suggestive of nostalgia; (b) identify what interactive elements within a ballpark may be triggering spectator nostalgia; and (c) determine the emotional and behavioral impact of nostalgia. Methodologically, we are attempting to provide a novel approach to analyzing sport nostalgia. In addition to the use of mobile EEG devices, Ecological Momentary Assessment (EMA) was used to elicit real-time responses. This method served as an extension and stronger form of data collection compared to retrospective, self-reported data. By amending previous methods, ballpark managers may better understand which environmental stimuli are best cultivating both short-term and lasting positive affects in attendees.

## 2. Literature review

Our focus on nostalgia in the sport experience is grounded in literature on the topic of sensory marketing as well as two theoretical frameworks: Mehrabian and Russell's (1974) Sensory – Organism – Response (SOR) framework and Boym's (2001) two variants of nostalgia – restorative and reflective nostalgia. These frameworks not only inform cognitive indexes to be used to identify nostalgia, but also provide added context when studying the manifestation of nostalgia. In addition to examination of these frameworks, the following sections provide review of sensory marketing and other relevant literature that guided the study's research hypotheses.

### 2.1. Sensory marketing

Mehrabian and Russell (1974) SOR framework was used to convey the environment's role in evoking a psychological response suggestive of nostalgia. As stated by Gobé (2001), sensory experiences are immediate, powerful, and capable of changing our lives profoundly. In capturing this, the SOR theoretical model highlights the ways in which environmental stimuli (S) induce emotional responses from organisms (O), resulting in behavioral responses (R). Previous research in contexts ranging from retail (Donovan et al., 1994) to theme parks (Bigne et al., 2005) have used Mehrabian and Russell's framework to demonstrate stimuli's ability to positively impact consumer arousal, pleasure, as well as behavioral intentions.

From this research, one can conclude that a general level of environmental stimulation emanating from sight, smell, sound, touch, taste, and social interaction exists in all service settings. However, sport, which prides itself on multisensory engagement, may be inherently superior in comparison to other service contexts with regards to its ability to invoke arousal and pleasure. To quote Lee, Lee, Seo, and Green (2012), "spectators can appreciate the visual beauty of a stadium's architecture and grounds, hear stimulating music at the stadium, feel comfortable seats, experience the stadium's unique smell, and enjoy the taste of the food available at the concession stands" (p. 492). Each of these sensory elements

demonstrates ways in which environmental interactions can impact consumers' emotions to a level greater than the cognitive component involved in decision making (Lindstrom, 2005). Moreover, it emphasizes marketing tools to be used by sport organizations as a way to trigger affectual outcomes bonding consumers to sport-related brands.

Despite this potential, the multi-sensory nature of the sport experience went long unexplored from a sensory marketing perspective until Lee et al.' (2012) development of the Sensoryscape. Designed to measure the sensual, social, and psychological elements with the sport stadium experience, the Sensoryscape allowed future research to examine the impact of senses within sports. Utilizing the instrument within both Minor (MiLB) and Major League Baseball (MLB), the authors found that spectators' sensory experiences positively impacted satisfaction and behavioral intentions. Furthermore, Lee et al. (2012) suggested that the smells, sounds, and tastes experienced in a stadium can trigger nostalgic memories of previous visits.

## 2.2. Nostalgia

The work by Lee et al. (2012) prompted Slavich, Dwyer, and Hungenberg (2019) to explore the impact of senses on fans' nostalgia. Nostalgia is defined as "a preference toward objects that were more common when one was younger" (Holbrook & Schindler, 1991, p. 330). Put simply, it is a cognitive-affective experience comprising a memory, which triggers an emotional response (Cavanaugh, 1989). Many of the memories that are recalled as part of nostalgia often comprise sensory and social components. For example, the smell of chocolate chip cookies baking in the oven or hearing a song from one's adolescence can evoke memories from that time and place (Chou & Lien, 2014). Further, social experiences including birthdays, graduations, class reunions, weddings, as well as traditional holidays are shown to trigger nostalgia (Holak & Havlena, 1992).

Based upon the sensory experience present within ballparks, Slavich et al. (2019) analyzed spectators' nostalgic occurrences via their senses and social interaction and identified nostalgic sights, tastes, and social interactions to be psycho-sensory factors pervasive in spectators' pleasurable emotions. Interestingly, though, the two ballparks examined by Slavich et al. (2019) differed based upon the two senses, raising questions about the cause and impact of spectators' nostalgic experiences. Despite limited foundation for hypothesis prediction, we expected that initial exposure to sensory and social stimuli would create early nostalgic experiences, which would dissipate over the course of the experience. Based upon this supposition, we assessed the temporal aspect of such stimuli, and hypothesized an initial high level of nostalgic instances during baseball spectators' ballpark experience, slowly decreasing over the course of the ballgame.

**Hypothesis 1a.** Spectators will experience their highest level of nostalgia via social interaction, sight, and taste.

**Hypothesis 1b.** Spectators will experience their highest level of nostalgia at the beginning of their experience, which will slowly decline over the course of the experience.

## 2.3. Psychological states linked to nostalgia

While each suggest sensory environments conducive for eliciting a process of meaningful engagement with, and reflection with days gone by, it is important to note that they may be representing fundamentally different attitudes and emotions toward the past. In fact, nostalgia has long been considered a bittersweet experience (Kaplan, 1987), comprised of pleasure and sometimes sadness. Its association with the latter began in nostalgia's earliest studies and emanates from one's realization that a previous time cannot ever be returned to (Batcho, 2013).

This sense of homesickness was observed in men fighting in wars, marginalized populations in the era of colonialism, and among prisoned criminals (Naqvi, 2007). Based upon these contextual findings, nostalgia became a neurological condition synonymous with sadness, anxiety and psychic pain (Sedikides et al., 2008). In recent years, however, Boym (2001) challenged its absoluteness by stating that not all memories pertaining to the past facilitate sadness. As evidenced in her discussion of the variance in *restorative and reflective* nostalgia, the mind's journey to the past is not solely motivated in recreating a pivotal moment, but can also involve an attempt to delight in the emotions spurred on by moments of reminiscence. Thus, the distinctions present in Boym's restorative vs. reflective nostalgia framework lie mostly in a memory's relationship with *experience* (i.e., the importance of the past and the present), and *expectations* (i.e., to what purpose our memories serve; Muller, 2006). It is this difference that causes memories to conjure feelings of joy (i.e., reflective) or of sadness (i.e., restorative; McDonald, 2016).

Restorative nostalgia is that which "puts emphasis on *nostos* and proposes to rebuild the lost home and patch up the memory gaps" (Boy, 2001, p. 404). As Boym illustrated, restorative nostalgia's similarities to homesickness place it in line with psychologists' original portrayal (see Volkan, 1999); one that is analogous to melancholia (i.e., withdrawal and sadness). In desiring to reconstruct a time and place that is lost, an emphasis is placed on an attempt to relive the way things were (McDonald, 2016). An example of such restorative nostalgia in the sport context includes Yankee Stadium's limestone exterior, which is designed to mimic the old Yankee Stadium built in 1923. Many ballparks throughout MLB and MiLB display classical architectural features such as statues outside their gates, brick facades, manual scoreboards, and visible steel beams, all of which serve as restorative nostalgic stimuli (Stride et al., 2015) intended to allow the attendee to "return home."

Reflective nostalgia, meanwhile, "dwells in the *algia*, in longing and loss, the imperfect process of remembrance (Boy, 2001, p. 404). The focus, according to Boym (2001), is not on the recovery of what is lost, but on the meditation and reflection

upon history. In this form, one acknowledges that what is in the past will stay in the past, and thus, chooses to exhibit emotions more consistent with recollection, allowing for the enjoyment of a memory (McDonald, 2016). An example in the sport context is the song “Take me out to the ballgame,” a time-honored tradition experienced and shared by spectators every 7th inning.

Ultimately, Boym's (2001) categorization suggests there to be two attitudes toward the past, one comprised of reflection, and the other comprised of withdrawal. These delineations prove useful in the discussion of nostalgia's manifestations and modes of operation in the context of baseball fandom. Similarly, Mehrabian and Russell's (1974) demonstration of the environment's role in cultivating an aroused and pleasurable experience yields insight into what proceeds a response, such as nostalgia. Taken together, these theoretical frameworks inform a set of cognitive indexes to be used to identify and measure nostalgia.

#### 2.4. Using EEG to detect nostalgia

Under the frameworks of Mehrabian and Russell (1974) and Boym (2001), mobile EEG technology was utilized as a means to link spectators' neurological activity to their nostalgic reporting. It should be noted that a concrete, direct measurement of cognitive-emotional states is not possible, even with the use of EEG. Rather, the indices presented below represent formulaic indicators of neuronal activity associated with various mental states, as supported by previous research. The following sections provide a contextual illustration of EEG-detectable mental indices that may be induced from environmental stimuli within an MLB ballpark. It will also detail how these states assist in the recognition of both state and trait nostalgia.

##### 2.4.1. Withdrawal motivation

Past works have illustrated that episodes of nostalgia are often triggered by unpleasant or withdrawal-related motivational states (Pierro et al., 2013; Stephan et al., 2014). Withdrawal motivation is conceptualized in opposition to approach motivation, and is associated with levels of valence and arousal (Kelley et al., 2017). Those who present higher levels of approach motivation report higher levels of enjoyment and engagement in the current situation, indicated by asymmetric cortical power, with higher relative brain activity on the left frontal lobe than the right (Navea & Dadios, 2015). Conversely, withdrawal motivation reflects an aversive state of mind consistent with feelings of sadness, empathy, and loneliness (Barrett et al., 2010; Stephan et al., 2014; Wildschut et al., 2006). The relationship to nostalgia is made because those who are more susceptible to feeling sad or distressed are also more inclined to engage in self-reflection, explaining why homesickness and nostalgic tendencies have been closely linked (McCann, 1941).

Although recent literature has shifted from conjoining homesickness with nostalgia, and have even begun to claim it to be an emotion that is largely positive, the melancholia nature of nostalgia was still supported by Peters (1985) and Volkan (1999). To their point, nostalgia is one going back in time, which involves a realization of the past which is insuppressibly lost (Hertz, 1990). Thus, sadness is very much a part of the nostalgic process. This relationship suggests that time spent in a withdrawn state should parallel with an individual's propensity to engage in nostalgic reverie.

**Hypothesis 2.** Greater levels of withdrawal motivation, denoted by a negative motivation value, will have a significant impact on number of nostalgic instances reported throughout the game.

##### 2.4.2. Inward attention

Extant research supports the role of inward attention inducing a psychological mindset reflective of state nostalgia (see Pierro et al., 2013; Routledge et al., 2011). Conceptually related to mindfulness, inward attention is associated with a relaxed, unattached reflection on one's inner experiences, which may include nostalgic memories. Cortical indicators could include evidence of inhibited directed attention (i.e., high frontal theta) and reduced sensory processing (i.e., high parietal alpha). Wildschut et al.'s (2006) content analysis of written nostalgic experiences assists in an explanation of why inward attention is closely linked to nostalgia. The authors point out that nostalgic episodes often reference momentous life events, such as cultural rituals, family traditions, or cherished memories (Sedikides et al., 2008). Events which encapsulate deep, wholesome, and consequential life experiences will regularly elicit acts of reflection (Routledge et al., 2011). Moreover, occurrences which possess great symbolic value are incessantly ruminated over, due to the meanings they impart in us. Thus, state nostalgia is often preceded by inward attention (e.g., self-reflection), suggesting a strong correlation exists between the two.

**Hypothesis 3.** Greater levels of inward attention will positively influence spectators' number of nostalgic instances reported throughout the game.

##### 2.4.3. Arousal

The relationship between nostalgia and arousal has been demonstrated in multiple research settings. For instance, Barrett et al. (2010) found that participants' music-evoked nostalgia was positively associated with the level of arousal experienced by hearing the song. Similarly, other literature found that nostalgic scents were positively associated with the attributes arousal, familiarity, and autobiographically relevant (Reid et al., 2015). Evidence of increased activity in the sensorimotor strip of the cortex (i.e., parietal gamma) could indicate higher levels of sensory processing (Maffei et al., 2019). With the

arousing capacity of sensory elements within the baseball environment including the sight, smell, and taste of food and beverages, the sound of music, and the sensory-captivating nature of the crowd, spectators' nostalgia may be positively associated with arousal.

**Hypothesis 4.** Greater levels of arousal will positively influence spectators' number of nostalgic instances reported throughout the game.

### 2.5. Nostalgia's effect on social and behavioral outcomes

Nostalgia contributes to overall social well-being by aiding psychological health. Social well-being can be defined as "the appraisal of one's circumstance and functioning in society" (Keyes, 1998, p. 123). Engaging with one's personal nostalgia can greatly increase an individual's ability to look optimistically during hard times and see themselves with a greater sense of self-worth. Davis (1979) proposed that nostalgia is a way to filter out ordinary memories and reflect on those that contain positive narratives, such as achievements or pleasurable happenings. Recounting these memories can be used as a guidance tool for future well-being (Zauberman et al., 2009). For example, when optimism is derived from a state of nostalgia it can be used as a coping mechanism because it reminds individuals of moments in which they overcame tough situations, or times they perceived themselves as capable (Carver et al., 2010). Time spent reflecting on these moments increases the accessibility of positive self-characteristics, while also decreasing the likelihood of defensive responses when self-esteem is threatened (Vess et al., 2012).

Further, social experiences are one of the key components of nostalgia (Hepper et al., 2012). Recalling memories of past social interactions allows one to create a perception of social connections and support (Wildschut et al., 2006). These feelings of social support and competent social skills are what allow for increases in self-esteem, which consequently helps individuals maintain an optimistic outlook on the future (Symister & Friend, 2003). This increased optimism will in turn, drive an individual to better cope with stressful situations and produce better outcomes. This navigation is guided by the value individuals perceived themselves of having in past nostalgic events (Davis, 1979). Overall, sport has shown over time to produce a myriad of hedonic and social benefits to those consuming it (Wann, 2006). This study intends to further perpetuate such empiricism by illustrating nostalgia as a contributing antecedent to well-being.

**Hypothesis 5.** Spectators' nostalgic experiences will lead to enhanced social well-being.

In addition to nostalgia's social impact, minimal research has demonstrated how these positive outcomes materializing from nostalgia may directly benefit sport organizations. As discussed previously, Mehrabian and Russell (1974) constructed a theoretical framework that explained environmental stimuli's effect on emotional and behavioral impacts. Among responses most pertinent to sport operators is re-patronage and positive word-of-mouth, two elements representative of one's behavioral intentions. In general marketing literature, nostalgia has been shown to positively impact consumers' attitudes toward brands (Merchant & Rose, 2013), enhance brand attachment (Fournier, 1998), and increase purchase intentions (Loveland et al., 2010). Thus, if the positive affect materializing from nostalgia is believed to be facilitated by the sport organization, an attendee is likely to form a connection with the brand due to the reminiscent feelings they provide.

**Hypothesis 6.** Spectators' nostalgic occurrences will positively impact their behavioral intentions.

The review of literature described presents a contextual framework for exploring a nostalgic process that begins with stimuli being produced from MiLB environments and concluding with favorable social and behavioral responses. The ensuing section will provide a detailed description of the methods employed to operationalize the hypotheses outlined above.

## 3. Methods

### 3.1. Sample

Participants in this study included individuals ( $n = 46$ ) attending Double-A MiLB baseball games in the Southern region of the United States. The ballparks selected for involvement in the study were chosen in an attempt to capture both modern and conventional ballpark environments. Both facilities were centrally located in their respective city's downtown area; however, each offered their own distinctive characteristics. For instance, the contemporary ballpark features site lines of modernly-constructed buildings, including new apartments and commercial structures. In contrast, the more established ballpark presents a natural backdrop, including views of the region's mountainous landscape.

While each offers traditional ballpark food and beverage offerings, the modern ballpark offers a greater variety of food and beverages, including selections unique to the local region. Further, both ballparks played music that could be described as traditional baseball music as well as a variety of modern and other musical genres. Finally, each of the games in which data were collected featured crowds of at least half-capacity, according to the ballparks' information guides. Therefore, each setting provided sensory and social stimuli common among nostalgic experiences.

The final sample was comprised of 32 individuals in attendance at MiLB games in Chattanooga, Tennessee, and 14 in Birmingham, Alabama. Respondents from Chattanooga were, on average, slightly under 32 years old ( $M = 3.71$ ),

predominately male (78%), had lived in Chattanooga just under 10 years, and were attending roughly 3 games per year ( $M = 3.19$ ). In slight contrast, Birmingham respondents were slightly older ( $M = 46.71$ ), included more female representation (43%), had lived in the area for just under 11 years, and attended, on average, 2.21 games per year. To ensure a sample representative of the team's fan base, sample demographic data were compared with the team's 2018 league attendance data and was found to be similar.

### 3.2. Data collection

Data collection was achieved through the cooperation and assistance of the two MiLB organizations. Game dates were selected by the participating organizations to aid in capturing a sample that would be representative of their fan bases. Spectators were recruited for participation through a systematic random sampling method. Specifically, research members were placed at several entrances and informed to intercept every 15th fan who entered the ballpark. When introducing the study's purpose and method to the prospective participant, members accompanying the attendee were also asked if they would like to participate, thus creating a secondary, non-probability sampling effect to participant recruitment. The multi-method sampling procedure rendered a participant response of 50. However, incomplete data required the dismissal of four subjects, resulting in a useable sample size of 46.

Data were collected through multiple instrument tools disseminated at seven MiLB games played during the 2018 season. Measurements intended to capture spectators' self-reported nostalgia were collected real-time through Ecological Momentary Assessment (EMA). These data were utilized to address the specific senses contributing to nostalgic responses as well as the temporal aspect of nostalgic responses. Mobile EEG headsets, produced by Emotiv, were used to examine neural correlates consistent with withdrawal motivation, inward attention, and arousal. Overall, the study's EMA and EEG tools aided in examining relationships between spectators' mental states and their nostalgic dispositions. Additional responses describing spectators' social well-being, behavioral intentions, demographics, and previous attendance history were acquired by self-administering surveys following the completion of each participant's mental state data collection period. Data collection began for participants prior to the game's start time (6:45 p.m. – 7 p.m.) and concluded after 9:15 p.m. or following the completion of the 5<sup>th</sup> inning. The following subsections describe the use of EEG and EMA and other employed instruments.

#### 3.2.1. Electroencephalography (EEG)

Electroencephalography has been utilized routinely in laboratory settings for over six decades (Soutar & Longo, 2011). Utilizing highly-sensitive nodes placed in strategic locations on the scalp, researchers can observe and record electrical activity inferred from the cortex. Provided adequate signal quality, research commonly proceeds with translating raw electrical signals via Fast Fourier Transformation (FFT) into discrete frequency bands based on oscillations per second (Hz). Lower frequency brainwaves (Delta, Theta) generally indicate lower intensity brain activity (i.e., sleep, daydreaming, etc.), while higher frequencies (i.e., Beta, Gamma) reflect higher mental loads (i.e., attention, anxiety). The central bandwidth (Alpha) represents a relaxed state of mind, prepared for action (Purves, 2012).

Neuronal activity is recorded simultaneously from multiple sensors located over strategic areas of cortical functionality. Sensors on the forehead (i.e., F3, F4) measure activity in the frontal lobe, an area associated with higher-order thinking, problem-solving, and the interpretation of emotions. The parietal lobe (Pz), located just posterior to central peak of the cranium, is involved with the immediate sensory processing and attentional shifting (Soutar & Longo, 2011). Direct neuronal connections from the parietal lobe to subcortical regions (i.e., limbic system) and the frontal lobes explain correlated activity in various regions, as information is sensed, interpreted, and translated into action. Thus, oscillatory data from relevant cortical locations can provide insight into general mental status, as compared across conditions.

#### 3.2.2. Emotiv Insight

This study utilized Emotiv Insight portable EEG headsets to collect electrical signals from five cortical locations. Emotiv headsets have been verified as comparable to commonly used laboratory equipment in signal quality and reliability (Badcock et al., 2013). The five sensor locations adhere to the international 10-20 system, with two sensors on the frontal lobe (af3, af4), two on the temporal lobes (t7, t8), and one on the parietal lobe (pz), as well as a ground and reference node on the left mastoid process. The Insight employs passive, semi-dry polymer sensors, activated with a diluted saline solution applied to the scalp.

Participants were fitted outside of the ballpark prior to each game. Baseline measures were not utilized in this study, as nostalgia likely incurs before arriving at the gate of the ballpark. Additionally, multiple repeated measures for all participants, and comparisons to self-reported nostalgia, would account for intra and inter-individual differences. EEG data were collected at a rate of 128 Hz, filtered and transformed into brainwave frequency data for analysis. To minimize noise from muscle movements and ambient electrical signals, Emotiv devices incorporate low and high pass filters, thus limiting the range of data analysis to frequencies between .5– 43 Hz, with digital notch filters at 50 Hz and 60 Hz and a built-in digital 5<sup>th</sup> order Sinc filter. When utilizing the software development kit (SDK) for data collection on a portable device, the Emotiv system employs standard, proprietary preprocessing before performing FFT. This procedure includes the removal of sharp spikes in the data, removing DC offset and slow drift with a high-pass filter, and the application of a Hanning filter on all data across two-second epochs. Though proprietary, the filtration process employed by the Emotiv system, as well as an

intentionally non-peripheral sensor montage, have demonstrated reliable data for previous studies (Aspinall et al., 2013; Bailey et al., 2017). Factory settings were used for spectral boundaries including theta (3.5–7 Hz), alpha (7–13 Hz), beta (13–30 Hz), and gamma (30–43 Hz). The data were transmitted via Bluetooth, using a custom iPhone application and stored with timestamps on a local device.

Additional data preparation proceeded with an iterative process. First, remaining noisy segments of data were identified and removed through visual inspection. This process was aided by the inspection of related heart rate (HR) and heart rate interval (HRI) data collected with fitness trackers (Microsoft Band 2). Areas with significant variation ( $>2$  standard deviations) or with obvious signal instability were marked with a custom data visualization package. If no corresponding changes were evident in biomarkers collected from independent armband sensors, the data were eliminated from the analyses. Other indicators validating decisions for data exclusion included GPS data (i.e., a walk to the bathroom or concessions), flat-lines (indicating a momentary loss of sensor contact), and clear visual patterns common across multiple sensors (indicating external interference). Secondary filtering revealed few unusable segments, resulting in the loss of  $< 8\%$  of the data.

FFT data were then manually transformed through Python coding into three affective states: motivation, inward attention (i.e., reflection), and arousal. Guided by recent research utilizing similar devices, this study utilized frontal beta/alpha asymmetry as an indicator of withdrawal motivation (Navea & Dadios, 2015; Shestyuk et al., 2019). Accordingly, a negative relationship in subsequent analyses will reflect withdrawal motivation whereas a positive relationship would be suggestive of approach motivation (Approach/Withdrawal motivation =  $\beta/\alpha \text{ af3} - \beta/\alpha \text{ af4}$ ). Higher theta power in the frontal and temporal lobes, combined with higher alpha in the posterior ( $1A = \theta \text{ af3} + \theta \text{ af4} + \theta \text{ t7} + \theta \text{ t8} + \alpha \text{ pz}$ ) were indicative of inward attention (Lagopoulos et al., 2009). Finally, arousal was measured using gamma activity in the parietal lobe (arousal =  $\gamma \text{ pz}$ ), as supported by previous research (Bailey et al., 2017; Maffei et al., 2019).

### 3.2.3. Ecological Momentary Assessment (EMA)

Using software designed by Illumiv, participants were provided cell phones by the research team equipped with a mobile EMA application. EMA, a form of signal-contingent protocol sampling, is considered a best approach for targeting behaviors that are ongoing and are therefore likely to be occurring in moments briefly leading up to a prompt (Christensen et al., 2003). This makes EMA well-suited for researching cognitive states susceptible to retrospective memory bias. However, identifying the duration of time between observations is often subjective, rendering very little consistency in sampling practice.

To determine the appropriate time interval, several factors were considered. First, the average inning of an MiLB game lies just under 20 minutes, and it was requested by each participating organization that participants in the study not be interrupted with questions more than once per inning, if possible. This, in conjunction with Delespaul's (1992) advice to avoid sampling more than six times over a data collection period, helped establish initial parameters for determining the amount of time between sampling prompts. Further, retrospective memory bias was also taken into consideration. It was agreed upon by the research team, and MiLB team executives, that fans be given 20 minutes in between prompts, allowing attendees an opportunity to experience a sensory interaction and reflect upon the mental response (if any) without too much time lapsing.

With the 20-minute interval selected, the EMA device was set to administer survey questions beginning at 7 p.m. and continue every 20 minutes, with the final question coming at 9 p.m. At each 20-minute epoch, participants were prompted with two items relating to whether or not they had experienced nostalgia. For example, one item stated, "What I am currently experiencing is causing me to recall pleasant memories." Another inquired if recent events that occurred within the past 20 minutes were making them reminisce about a previous time. These items were assessed on a seven-point Likert-type scale (1 = Strongly disagree, 7 = Strongly agree). In the event the average response among these two items exceeded five (indicating an inclination of nostalgia), the mobile application would follow up with additional sensory questions relating to smell, taste, visual cues, sounds, and social interactions. Each of these questions were adapted from previous works implemented in the contexts of MLB and MiLB (see Lee et al., 2012 and Slavich et al., 2019) and were intended to gauge what environmental stimuli were contributing to nostalgia, and based upon times of responses, when they experienced such nostalgia. The one-item statements pertaining to the five senses were each measured on a Likert-type scale from 1 (*No nostalgia experienced at all*) to 7 (*Nostalgia experienced very much*). Examples of sensory items include "The smells in the air at the ballpark" and "The taste of the stadium's food I am eating at this game."

### 3.2.4. Social well-being

Examining the enduring effects of increased nostalgic experiences prompted an exploration into participants' social well-being. Eleven items were adapted from Hepper et al. (2012) instrument, which focused on the constructs positive affect, self-regard, social-connectedness, and meaning in life. The items maintained sufficient reliability in Hepper et al.'s (2012) study and similarly met the reliability threshold in the current study ( $\alpha = .82$ ). Each of the items requested that spectators consider how the baseball event influenced state functions, such as happiness, mood, social relationships, and personal value. An average score was derived among spectators' social well-being responses to create a composite score.

### 3.2.5. Behavioral intentions

We sought to discover participants' behavioral intentions in order to determine the behavioral impact of nostalgia. Two items from Yoshida and James (2010) were utilized, assessing spectators' intention to attend a future game and recommend a game to a friend. Both items maintained sufficient reliability and validity in previous use as well as the current study.

#### 4. Results

To first ascertain a reliable means of analyzing variations in mental states experienced by spectators throughout the game, a repeated measures analysis was conducted. This test rendered no significant changes in Motivation (Wilk's Lambda .641,  $F(5, 25) p = .671$ ), Inward Attention (Wilk's Lambda .938,  $F(5, 25) p = .889$ ), or Arousal (Wilk's Lambda .878,  $F(5, 25) p = .634$ ) across the 20-minute time increments. Non-significant differences across time points supported taking an overall average score of spectators' motivation, inward attention, and arousal from the time they entered the ballpark, shortly before 7 p.m., until after the final nostalgic question was prompted at 9 p.m. This procedure, which illustrated participants' mental dispositions indicative of traits, was consistent with previous studies using EEG when examining mental states over an extended period of time (Bailey et al., 2017). Each of the three mental state composite scores were then used to analyze whether mental state characteristics reflecting withdrawal motivation, heightened levels of arousal, and inward attention would explain the frequency by which spectators identified feeling nostalgic.

Examining the frequency of nostalgic occurrences warranted converting participants' ordinal data into a dichotomous outcome. Consequently, the 1–7 Likert-item scales were merely used as a means to create nostalgia/non-nostalgia categories, which were used to operationalize spectators' nostalgic episodes. This method permitted the research to identify traits consistent with those experiencing nostalgia more frequently than others, which would not have been possible utilizing scaled responses.

The practice of converting ordinal response data into dichotomous variables has received support in literature. The justifications begin by illustrating that real data is rarely normal, an assumption of parametric testing (Micceri, 1989). One approach to remedying non-normality is dichotomization, a tactic that can be achieved, for instance, by defining cut points (i.e., median) where above and below lie an equal number of values (Donoho & Huber, 1983). To this end, a clear delineation of bimodal distribution of the survey responses was revealed during an analysis of response frequencies. Examinations of histograms at each time point also indicated that less than 23% of responses lied within the neutral ranges of 3.5–4.5 on the 7-point scale, suggesting that most participants either clearly experienced nostalgia or did not. Moreover, average response values over all time points revealed 4.75 to be a median, which supported responses exceeding or equal to five being representative of nostalgia, and those below five as being non-nostalgic.

After establishing a pragmatic method for identifying a nostalgic occurrence through EMA, the testing of Hypothesis 1–6 became possible. To begin, responses collected through EMA were utilized to initially analyze the sensory and temporal components of spectators' nostalgic responses. These data were placed in a frequency table seen below. Only sensory stimuli inciting a five or higher score on the 1–7 scale were reported in Table 1. To analyze Hypothesis 1a and 1b, chi-square analyses were conducted to ascertain potential differences between nostalgia evoked via senses and time epochs. Regarding Hypothesis 1a, results of the chi-square analysis exhibited that nostalgic responses differed according to sense ( $\chi^2_{(4)} = 22.51$ ,  $p < 0.05$ ). Table 1 illustrates that nostalgia was most experienced via Sight, Social, and Sound, with Taste and Smell contributing to fewer nostalgic occurrences. Thus, results provided partial support for Hypothesis 1a.

In examination of Hypothesis 1b, chi-square analysis exhibited that nostalgic responses differed according to time period ( $\chi^2_{(6)} = 23.148$ ,  $p < 0.05$ ), providing evidence for nostalgia varying by time epoch. Exploration of results displayed in Table 1 exhibits the 8 p.m. period serving as the peak for each sense and social interaction. Also, with the exception of Taste, data for each sense and social interaction followed an inverted U pattern, increasing through the first hour of the experience and decreasing the second hour. These results provide support for Hypothesis 1b and suggest that nostalgia is most experienced during the early stages of the experience. Overall, these results demonstrate that nostalgic occurrences vary throughout the course of the experience based upon both sense and time. Complete results of nostalgia experienced via each sense at each time epoch can be seen in Table 1.

Identifying nostalgic instances reported by attendees then enabled subsequent analyses that allowed to first test the relationships between mental states and nostalgic frequency, and secondly, how nostalgic occurrences may influence spectators' social well-being and behavioral responses. The proposed causal model which reflects Hypotheses 2 through 6 can be seen below.

To evaluate the sequential effects outlined in Fig. 1, a PROCESS macro regression approach developed by Hayes (2013) was used. The PROCESS macro is based on Ordinary Least Squares (OLS) path analysis, and can be a preferred approach to other

**Table 1**  
Frequency Analysis of sensory variables' impact on spectator nostalgia across time epochs.

| Variables | 7:00 | 7:20 | 7:40 | 8:00 | 8:20 | 8:40 | 9:00 | Total |
|-----------|------|------|------|------|------|------|------|-------|
| Sight     | 14   | 16   | 16   | 19   | 11   | 11   | 6    | 93    |
| Smell     | 7    | 11   | 8    | 11   | 4    | 5    | 3    | 49    |
| Sound     | 11   | 13   | 13   | 20   | 11   | 14   | 7    | 89    |
| Taste     | 6    | 7    | 8    | 10   | 12   | 12   | 5    | 60    |
| Social    | 12   | 12   | 16   | 20   | 11   | 11   | 11   | 93    |
| Total     | 50   | 59   | 61   | 80   | 49   | 53   | 32   |       |

Note: Frequencies represent the amount of times respondents evaluated the sensory impact at a 5 or above on a scale of 1–7 (1=No nostalgia experienced at all, 7=Nostalgia experienced very much).

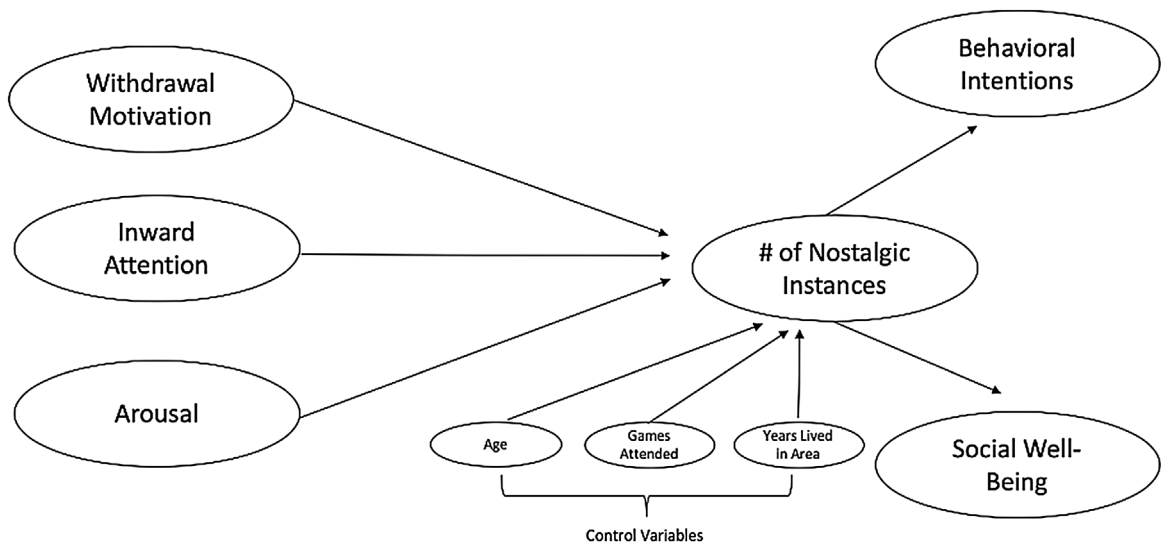


Fig. 1. Hypothesized model.

path modeling methods (i.e., SEM) when limited by sample size (Hayes et al., 2017). But while PROCESS macro provides advantages to alternative path modeling methods, it does not estimate the components of the model simultaneously. For instance, the model in Fig. 1 includes two dependent variables (i.e., behavioral intentions and social well-being), which requires PROCESS (Model 4) to estimate the regression equations separately.

In evaluating Models 1 and 2, attempts were made to minimize confounding effects by controlling for (a) the amount of time an attendee had lived in the area, (b) the amount of games attended the previous year, and (c) age. Results from path analysis, summarized in Table 2, revealed that the neural correlates representing the three mental states accounted for 44% of the variance in the number of nostalgic instances reported. Direct effects of inward attention and arousal on attendees' number of nostalgic instances support Hypotheses 3 and 4, and indicate that events which prompt increased arousal and meditative reflection (i.e., inward attention) may heighten one's propensity to nostalgic episodes. However, Hypothesis 2, which posited that those who are prone to withdrawal motivation may possess a greater disposition to nostalgic happenings, could not be concluded.

PROCESS macro also permitted the testing of the model's hypothesized causal relationships. Increased nostalgic episodes significantly impacted attendees' behavioral intentions ( $b = .36, p < .05$ ) while controlling for each of the mental states, thus supporting Hypothesis 6. Hypothesis 5, which attempted to illustrate a relationship between an attendee's nostalgic happenings and social well-being, was not satisfied. As referenced in Table 2, a non-significant model failed to demonstrate sport's resonant ability to yield hedonic affects that are residual in value.

As a last step, testing the function of nostalgia as a mediator was done using bootstrapping (see Hayes, 2013). This method helped inform nostalgia's role in establishing any underlying relationship between arousal, inward attention, and attendees' behavioral intentions. A bootstrap confidence interval for the indirect effect of inward attention (.0244) based on 5,000 bootstrap samples was entirely above zero (0.0021 to 0.0614). Note that because the percentile confidence interval does not include zero, we can conclude that the indirect effect is statistically significant (Mallinckrodt et al., 2006). Inward attention, then, may indirectly influence attendees' desire to return and engage in positive word-of-mouth through its effect on nostalgia. However, arousal's indirect effect (.0791) included confidence intervals ranging from -.2423 to .1785, denying conclusive evidence that nostalgia mediates the effect of arousal on attendees' behavioral intentions. There was no evidence that inward attention, nor arousal, had an independent effect on attendees' behavioral intentions based upon their non-significant direct effects outlined in Table 2, thus supporting the hypothesized causal model. Overall, Model 1 provides affirmation of brain wave frequencies' ability to serve as indicators of nostalgic dispositions, which in turn, impacts fans' behavioral intentions.

While the path analysis painted a picture of spectators' propensity to feel nostalgic according to their mental state tendencies, a closer examination of EEG descriptive data within each 20-minute epoch would provide inferential support of mental indices consistent with nostalgic feelings. For instance, motivation for nostalgic respondents was lower in each of the six time epochs, reinforcing literature evidencing withdrawal motivation as a state of mind associated with nostalgia. Further, arousal and inward attention were larger among nostalgic respondents than non-nostalgic attendees in all six time periods. Although the data in isolation of one another fails to provide unequivocal evidence linking specific cortical activity patterns with state nostalgia, the directional associations bear proof that mental indices can have a relationship with traits emblematic of nostalgia. Results of these findings are exhibited in Table 3, with data for inward withdrawal motivation, inward attention, and arousal provided.

**Table 2**

Model coefficients reflecting nostalgic instances' effect on behavioral intentions and social well-being.

| Antecedent          | Consequent                |           |          |                                 |           |          |                             |           |          |
|---------------------|---------------------------|-----------|----------|---------------------------------|-----------|----------|-----------------------------|-----------|----------|
|                     | Nostalgic Instances       |           |          | Model 1 - Behavioral Intentions |           |          | Model 2 – Social Well-Being |           |          |
|                     | <i>b</i>                  | <i>SE</i> | <i>p</i> | <i>b</i>                        | <i>SE</i> | <i>p</i> | <i>b</i>                    | <i>SE</i> | <i>p</i> |
| Inward Attention    | .4767                     | .0457     | <.01     | .0802                           | .0298     | = .6740  | -.1448                      | .0291     | = .49    |
| Motivation          | -.2345                    | .7574     | .09      | -.2300                          | .4598     | =.1245   | .0281                       | .4477     | = .17    |
| Arousal             | .4084                     | .1478     | <.05     | .1724                           | .0945     | =.3319   | .0878                       | .0931     | = .45    |
| Nostalgic Instances | —                         | —         | —        | .3585                           | .099      | <.05     | .2516                       | .0985     | = .27    |
|                     | $R^2 = .44$               |           |          | $R^2 = .40$                     |           |          | $R^2 = .16$                 |           |          |
|                     | $F(7,37) = 3.71, p < .01$ |           |          | $F(8,36) = 2.80, p < .05$       |           |          | $F(8,36) = 0.88, p = .542$  |           |          |

**Table 3**

Descriptives reflecting spectral power mean responses among Nostalgic and Non-nostalgic spectators for each 20-minute time epoch.

| Time      | Variable          | Nostalgic Respondents<br>( <i>M</i> ) | Not Nostalgic Respondents<br>( <i>M</i> ) |
|-----------|-------------------|---------------------------------------|-------------------------------------------|
| 7:20 p.m. | Inward Attention* | 16.209                                | 12.263                                    |
|           | Motivation        | −0.066                                | −0.038                                    |
|           | Arousal           | 1.272                                 | 0.842                                     |
| 7:40 p.m. | Inward Attention  | 13.745                                | 11.966                                    |
|           | Motivation        | −0.052                                | −0.011                                    |
|           | Arousal           | 0.627                                 | 0.927                                     |
| 8 p.m.    | Inward Attention  | 12.530                                | 11.851                                    |
|           | Motivation        | −0.059                                | −0.034                                    |
|           | Arousal           | 1.150                                 | 0.749                                     |
| 8:20 p.m. | Inward Attention  | 14.598                                | 11.349                                    |
|           | Motivation        | 0.064                                 | 0.144                                     |
|           | Arousal           | 1.495                                 | 1.199                                     |
| 8:40 p.m. | Inward Attention  | 14.559                                | 13.274                                    |
|           | Motivation        | 0.049                                 | 0.132                                     |
|           | Arousal           | 2.103                                 | 0.581                                     |
| 9 p.m.    | Inward Attention  | 14.322                                | 9.773                                     |
|           | Motivation        | −0.096                                | 0.262                                     |
|           | Arousal           | 0.492                                 | 0.981                                     |

Note: The table reflects EEG spectral power based on values emanating from the frequency band equations noted in section 3.2.2.

\* Significance at the  $p < .05$  level.

## 5. Discussion

With its deep roots in American culture, baseball has managed to utilize emotional experiences to spur sentimental feelings of days gone by. Wachhorst (2013) encapsulates this well by describing the game as being symbolic of “youth and summer, of fathers and sons, of a simpler rural past.” Simply put, baseball is considered tantamount to American stock, and the nostalgia it engenders has long triggered an affinity for the game. However, baseball attendance at various levels including MiLB has seen declines in recent years (Norris, 2018). Equally alarming, baseball demographic data shows 18–34 year-olds to be the least engaged, leaving baseball organizations searching for ways to reignite younger and future generations' enthusiasm for the game.

Fortunately, the presence of nostalgia is shown to influence consumer demand, which makes it a powerful commodity to be exercised by MiLB to combat the trends outlined above. Yet this proposition is operating under the assumption that the baseball experience is continuing to incite a reminiscent sensation amongst 21 st century fans. Also, commodifying nostalgia requires attendees to attribute their positive emotional and social responses to the MiLB environment, thereby creating a desire to return. Each of these suppositions informed the study's fundamental questions: (a) are spectators still experiencing nostalgic sensations while in attendance at MiLB games, and (b) are nostalgic instances contributing to favorable outcomes that are enduring for the fan and aiding the monetization of the game? The empirical results of this study indicate that the answers to these inquiries are undeniably yes. To demonstrate, the ensuing section will illustrate the relationships between the cognitive indices and nostalgia (Hypotheses 2–4), with particular attention being paid to their associations with the study's theoretical frameworks. Conclusions are also provided, with focus on Hypotheses 1a, 1b, 3, 4, and 6. Taken altogether, the following is a discussion of evidential proof that nostalgia is present, that it is related to functional outcomes, and is being triggered by stimuli present in all ballparks.

### 5.1. Presence of spectator nostalgia

Various studies linking psychological traits to nostalgia proneness (See [Tullett et al., 2015](#); [Wildschut et al., 2006](#)) gave the study a starting point by which to identify its indicators. These indicators were then tested in a live baseball setting using mobile EEG technology in conjunction with respondents' self-report measures of nostalgia. The study's results revealed significant relationships between spectators' nostalgia and their levels of inward attention and arousal. These findings add supportive evidence of previous nostalgic interpretations and reinforce its use as a guide for scholars wishing to explore the cognitive functions representative of nostalgia.

Inward attention is suggested to be a component of nostalgia as the experience comprises inward contemplation and reflection. Mental feelings such as these can be linked with oscillations in theta band frequencies present in the medial prefrontal cortex, which are thought to inhibit high-frequency activity and engage the parasympathetic nervous system ([Lagopoulos et al., 2009](#)). This knowledge permitted an ability to track mental processing activity that may be emblematic of a state consistent with nostalgia. The positive association between inward attention and number of times participants expressed feeling nostalgic aligns with previous works. In fact, multiple studies aimed at triggering nostalgia in research participants work at inducing forms of self-reflection (see [Pierro et al., 2013](#); [Routledge et al., 2011](#)). Further, those who tend to engage in assessment regulatory behavior (e.g., rigorous self-reflection and assessment) are believed to be more receptive to nostalgic musing ([Pierro et al., 2013](#)). Jointly, the current study gives credence to Boym's (2001) reflective description of nostalgia as a kind of mental processing that links existing experiences to the past.

The effect one's tendency to engage in inward attention had on their respective nostalgia, and subsequent behavioral intentions, reveals what could be affective outcomes being experienced by spectators in ballparks as a result of their distinctive settings. According to [Young \(2010\)](#), while attending a baseball game, you can't help but find yourself engaged in a calming conversation with those around you. And then there is the repeated contemplation of what just happened, and the wondering of what may come next. Baseball, in this way, possesses an unreplicable culture that is accompanied by calmativ characteristics.

Unlike sports that are more violent and fast-paced, baseball may be more inclined to deliver an experience that is relaxed, thereby facilitating reminiscent thoughts. As [Wenner and Gantz \(1998\)](#) put it, attending a baseball game may offer spectators the ability to "wind-down" and "escape" (p. 242). Additionally, it highlights the manifestation of spectators' identities as many fans' childhood, adolescent, and adult memories occurred at a ballpark. Thus, a platform that facilitates consideration of one's thoughts, memories, emotions, and actions is unquestionably good for the immediate and possibly persistent future, which adds affirmation to nostalgia's link to behavioral intentions.

In line with this, the positive relationship between nostalgia and arousal is very compelling. While initial examination might suggest that this contradicts nostalgia's relationship with inward attention and withdrawal motivation in previous research, the stimuli within the context of the study must be considered. Specifically, Sound was one of the three senses that spectators indicated as the impetus for their nostalgic response. This aligns with previous literature exhibiting the positive association between music and arousal ([Barrett et al., 2010](#)). In a very practical sense, popular baseball songs "Glory Days" and "Cheap Seats" are upbeat in nature, and thus the hearing of these songs may evoke nostalgia, bringing back memories of previous experiences while also increasing spectators' arousal due to the excitement associated with the song. Similarly, while the current study did not conduct linear analyses between senses and arousal, the experience socializing with family and friends may also have evoked both nostalgia and increased levels of arousal. While conclusive explanations cannot be made for the result, the positive relationship between nostalgia and arousal suggests that the baseball experience comprises both opportunities to experience nostalgia and excitement.

### 5.2. Stimuli reveal practical implications

The number of nostalgic instances experienced displayed positive relationships with behavioral intentions, providing evidence of nostalgia's ability to aid organizational goals (e.g., increased attendance) as well. Further, the study's focus on the senses that contributed to spectators' nostalgic experiences, and the times in which such nostalgia occurred, offers practical contributions to MiLB managers and marketers. Sight, for instance, was rated as a stimulus for nostalgia a total of 93 times by study participants, which along with Social was the highest-rated sense. This finding reinforces the construction of architectural features designed to engender an aesthetically-pleasing response from attendees. Sound meanwhile was identified as a nostalgic stimulus 89 times. Thus, the music played throughout these experiences is shown to evoke nostalgia amongst spectators, indirectly yielding positive emotional, and behavioral results. Future research should conduct deeper investigation of the specific stimuli that contribute to the Sight and Sound nostalgia.

Equal to Sight, the social experience was identified as a nostalgic stimulus 93 times. Research has consistently shown nostalgia to involve meaningful interactions with close ones ([Wildschut et al., 2006](#)). Even analyses of nostalgic narratives have discovered greater usage of first-person plural pronouns (e.g., we, ours), as well as social words, such as mother, father, and friend when describing reminiscent memories ([Robertson et al., 2014](#)). As it pertains to sounds, [Batcho, DaRin, Nave, and Yaworsky \(2008\)](#) noted that individuals more prone to nostalgia favor song lyrics which emphasize social relationships. Collectively, these findings, in conjunction with recent conclusions made in this study, reveal the positive impact of the nostalgic social experience on spectators' emotions and behavioral intentions.

While Taste and Smell received fewer responses concerning their impact on spectators' nostalgia, these senses should not be undermined due to the nature of the senses. For example, the smells of the ballpark are likely to evoke nostalgia upon spectators' arrival at the ballpark. After some time, smells will dissipate and so too their ability to evoke nostalgia. Similarly, nostalgia evoked via Taste will be limited to spectators' consumption of food and beverages, likely limited to specific periods of the game. Therefore, while these senses do not account for as much nostalgia throughout the entire experience, they still serve as contributors to the ballpark nostalgic experience.

The time periods in which nostalgia was most experienced was also informative. For example, during the initial time epochs of 7 p.m. and 7:20 p.m., visual cues were most pronounced. This finding reveals the importance of visual stimuli being introduced to attendees as they enter the ballpark and make their way to their seats. However, as the game continued on, spectators' self-reported nostalgia increased. In fact, spectators responded to feeling nostalgic most at 8 p.m. (80 responses) and 7:40 p.m. (61 responses). With participants beginning the study at 7 p.m. and concluding at 9 p.m., this suggests that nostalgia peaked during the middle innings, following an inverted U pattern. This knowledge could assist MiLB managers and marketers in looking to highlight spectators' nostalgic experiences and also attempt to influence spectators' behavior (i.e., purchasing food and beverages, merchandise, etc.) during this time period. Future research should look more into this pattern of nostalgia and attempt to determine if nostalgic responses could be extended throughout the game experience.

## 6. Conclusion and limitations

In conclusion, the current study utilized a novel method of data collection to ascertain the social, emotional, and behavioral impact of nostalgia on baseball spectators. Yet, this created limitations that should be discussed. For example, a major challenge with mobile EEG studies lies in linking environmental factors to variations in neurological sensors. While one's location can provide evidence to interactive stimuli being experienced, most factors that are randomly encountered such as social interactions, aesthetics, tastes, sounds, and smells are more difficult to track and isolate. The prevalence of what could be spurious effects favored a conservative approach to any attempt at citing instances of state nostalgia. Consequently, it was more defensible to suggest that states, such as inward attention, were likely more emblematic of trait nostalgia rather than state nostalgia.

EEG data collection presents unique complications, including issues of artefact rejection, source localization, and signal interpretation. Portable devices with low spatial resolution may paint a crude picture wanting of replication. Additionally, EEG methods render it difficult to obtain sample sizes comparative with survey design research. Although multiple works have been published with subjects totaling just 12 (see [Aspinall et al., 2013](#)), 10 (see [Bailey et al., 2017](#)), and five (see [Ehinger et al., 2014](#)), smaller, heterogeneous samples taken from one region within the U.S. limits the external validity of the data. The current study also examined nostalgia as a dichotomous variable, a unique method of investigation. While necessary for the current study, this approach also serves as a limitation.

Despite these limitations, the results of the study provide support for the positive impact of nostalgia. This study supports the behavioral results found by [Slavich et al. \(2019\)](#) and provides an extension to literature by uncovering the psychological states associated with nostalgia, too. These results provide a foundation for continued study of the psychological and emotional outcomes of nostalgia in the sport experience, a topic worthy of more focus. Further, the use of EEG supports the utilization of other novel data collection techniques in attempt to unveil the causes of and impact of nostalgia in the real-time sport environment. With the theoretical, methodological, and practical findings, the current study provides a meaningful contribution to the sport discipline.

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