

Self-Reported and Electroencephalogram Responses to Evaluate Sponsorship Congruence Efficacy

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Information for measuring the performance of a commercial action is essential for any organization. Sponsorship actions have increased significantly in the last few decades, but academics and practitioners have not yet found a suitable indicator for measuring their performance. This is the first study to propose an objective indicator—frontal alpha asymmetry using an electroencephalogram. Our goal was to investigate the effectiveness of sports sponsorships by examining both stated preferences and neural responses. We measured the congruence of the stated preferences, attitude, purchase intention, and loyalty, as well as the effective congruence. A 76-subject experiment revealed greater left frontal activity (approach behavior) during congruent versus incongruent sponsorship (avoidance behavior). Electroencephalogram results were consistent with self-reports, but we found that frontal alpha asymmetry is positively related to loyalty when sponsorship is congruent and inversely related in the incongruent case. This new indicator of sponsorship effectiveness could be useful for examining the performance of commercial action at both academic and professional levels.

Keywords: electroencephalography, sport sponsorship, congruence, willingness to purchase, attitude

Over the past decades, global investment in sports sponsorship has increased significantly from US\$55.3 billion in 2014 (International Events Group, 2017) to US\$65.2 billion in 2021 (Infinium Global Research, 2021). High investment and the remarkable saturation of the retail space (Mikhailitchenko et al., 2012) put pressure on marketers to evaluate and justify the

performance of retail actions (Boronzczyk et al., 2018). Accordingly, research on sponsorship has grown steadily since the 1990s (Walliser, 2003). However, the information currently available to managers for examining the success of sponsorship actions is scarce, if not nonexistent (Cornwell & Kwon, 2020).

Among the indicators used to measure consumer response, attitude toward the sponsor has been one of the most popular indicators to measure sports sponsorship performance (Ko et al., 2017), along with brand recall, brand equity, or purchase intention (Cornwell & Kwon, 2020). Congruence has also received significant attention in the academic literature (Pappu & Cornwell, 2014). Congruency or fit is an efficient predictor of

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sponsor recall, attitude, or purchase intention (Olson & Thjømøe, 2011; Silva & Veríssimo, 2020). Congruency is one of the most important determinants of sponsorship for predicting its success. Despite studies of congruency in multiple situations (Henderson et al., 2019; Madrigal & King, 2021), little is known about the neural processes underlying brand congruency in sponsorship.

Recently, research has begun to capture objective information through neurophysiological means, such as electroencephalogram (EEG; Alonso Dos Santos & Calabuig Moreno, 2018), galvanic response (Breuer, Rumpf, & Boronczyk, 2021) or visual attention (Boronczyk et al., 2022; Breuer & Rumpf, 2015) to measure the effectiveness of sports sponsorship in response to the demand for new measures of sponsorship effectiveness requested by the professional and academic sectors (Cornwell & Kwon, 2020). Understanding how congruence in sponsorship affects brain responses can provide a deeper and more objective perspective on the cognitive and emotional mechanisms underlying the relationship between a brand and a sponsor. This could help companies make more informed decisions about their sponsorship strategies, more effectively aligning brands with sponsored events or personalities. Neurophysiological consumer response measurement techniques have been applied more frequently in the measurement of advertising effects (e.g., Kolar et al., 2021; Ohme et al., 2010; Wajid et al., 2021), but very rarely in the study of sport sponsorship. There is a lack of understanding about how congruence between a brand and a sponsor affects brain responses as measured by EEG. Understanding how congruence in sponsorship affects brain responses may provide a deeper and more objective perspective on the cognitive and emotional mechanisms underlying the relationship between a brand and a sponsor. This could help companies make more informed decisions about their sponsorship strategies, more effectively aligning brands with sponsored events or personalities.

Sports management practitioners and academics have been calling for new (Cornwell & Kwon, 2020) and objective indicators of sports sponsorship effectiveness for some years, mainly due to its scarcity, growth of investment in the sector, and competition (Boronczyk et al., 2018; Mikhailitchenko et al., 2012). This article examined the relationship of frontal alpha

asymmetry (FAA) and self-report measures between congruent and incongruent conditions and studied the effectiveness of a regression model of consumer loyalty using self-report and FAA measures. A growing body of research has emerged in the literature demonstrating how prefrontal asymmetry can explain approach and avoidance behaviors (Ramsøy et al., 2018).

Our research contributes to the literature by shedding light on new avenues for assessing sponsorship effectiveness (Cornwell & Kwon, 2020; Lin & Bruning, 2021; Rumpf & Breuer, 2018; Wakefield et al., 2020). The contribution of this study is the use of an EEG to measure the effect of congruency on frontal asymmetry by comparing EEG results with self-reports. This approach allows for a deeper understanding of how fans process sponsorship messages, among other circumstances, because sponsor fixation and costs in the professional domain (Breuer, Boronczyk, & Rumpf, 2021) are agreed upon without considering the degree of exposure and attention (Jensen & Cobbs, 2014).

Background

The increased use of neurophysiological means in the area of marketing is making it possible to overcome certain deficiencies in capturing information about the consumer's choice and purchase process. The introduction of such techniques overcomes the problems associated with self-reporting (Solnais et al., 2013): (a) It allows the identification of the underlying processes responsible for the behaviors studied, as similar behaviors may be the result of different psychological processes; (b) it provides objective physiological data, as participants have little or no influence on the results; and (c) it eliminates bias owing to the tendency to provide socially acceptable responses.

Additionally, the emergence of new tools (software and hardware) but above all objective indicators allows the body of literature combining marketing and neuroscience to grow. For example, it is feasible to find several systematic reviews that collect the definition, provenance, and advantages and disadvantages (Alsharif et al., 2023; Bhardwaj et al., 2023; Ramsøy, 2019). Among the literature, several authors (e.g., Byrne et al., 2022; Metzen et al., 2022) suggest that FAA is the most reliable preference signal capable of differentiating positive from negative consumer responses.

Frontal Asymmetry

According to Davidson's (2004, 2009) motivational model, approach and withdrawal motivation is conditioned by the interaction between two separate neural systems (the left and right anterior brain regions). Relatively higher left frontal activity (lower alpha power) indicates a propensity to approach or engage with a stimulus, whereas relatively higher right frontal activity indicates a propensity to withdraw or disengage from a stimulus (Ravaja et al., 2013). A significant part of the literature has focused on measuring frontal asymmetry in the alpha band (FAA): Metzen et al. (2022) found approximately 2,000 results in 2021 for the search "alpha asymmetry." Most studies have linked the frontal alpha rhythm (8–12 Hz) to information processing, attention, decision making, and emotion regulation (Di Gruttola et al., 2021). Although the way in which the FAA is processed varies among the articles published in the literature (Smith et al., 2017), Byrne et al. (2022) concluded that FAA was the most reliable signal of preference and was able to differentiate positive from negative consumer responses.

However, some research has also shown that gamma (Ramsøy et al., 2018), theta (A. Wang et al., 2022), and beta (Boksem & Smidts, 2015; Zeng et al., 2022) frequencies are also correlated with preference judgments. According to Zeng et al. (2022), preference indices based on brain asymmetries, such as the approach-withdrawal index, valence, choice index, and effort index, are also used to predict consumer preferences (Aldayel et al., 2021). According to Boksem and Smidts (2015), this method allows marketers to obtain information that cannot be reliably obtained using traditional methods with a relatively small sample size with a true predictive ability of commercial success.

Frontal EEG Asymmetry and Congruence

Congruence is one of the indicators traditionally and currently used to measure the effectiveness of sponsorship (Graeber & Scheinbaum, 2022). Different definitions have been used to refer to congruence: fit, link, relatedness, similarity, match-up, or perceived alignment (Fleck & Quester, 2007). Schema congruity theory has been used to support various research in advertising and marketing, such as consumer

perception of the similarity between sponsor and sponsored property (Henderson et al., 2019); creating a better congruence is the key to creating a favorable attitude toward the brand (Madrigal & King, 2017; Olson & Thjømmøe, 2011).

Pappu and Cornwell (2014) defined "fit" as the degree to which a sponsor's association with a sponsored property (such as an event, team, cause, or organization) is relevant to the brand's logic. Most authors define congruence in terms of their antecedents, meaning there is an established link, relevance, or alignment around brand schemas and expectations in terms of functional or image attributes (Fleck & Quester, 2007).

Congruence can stem from geographical, functional, cultural, and even visual similarity, depending on whether the sponsoring brand and sponsored property are linked by geographical distances, product usage, times of use, or matching colors (Henderson et al., 2019). Globally, congruence has often been examined as the logic or meaning of a particular brand sponsoring a particular object (event, organization, cause, or player; Olson & Thjømmøe, 2011). This definition has produced the widest variety of results in the literature, including a positive effect on attitude, recall, recognition, and purchase intention (Alonso Dos Santos et al., 2019; Cornwell et al., 2006; Speed & Thompson, 2000). Therefore, we adopt this definition in this study.

Regarding motivational tendencies (Ravaja et al., 2013), the pleasure of discovering two brands that are logically connected or align with prior expectations is likely to be associated with approach motivation. This is because congruence represents semantic overlap or logical coherence between the brand and the sponsored entity (Henderson et al., 2019). By contrast, incongruence induces tension and conflict in the consumer's mind (Liu & Zhou, 2020), causing an effort to achieve balanced (congruent) structures between the cognitive elements (Woisetschläger & Michaelis, 2012). This incongruence increases cognitive conflict for consumers (A. Wang et al., 2022) because it is more difficult to process cognitively (Dini et al., 2022). As a result, it increases stimulus processing time and leads to higher identification error rates (Alonso Dos Santos & Calabuig Moreno, 2018). Considering neurophysiological studies that processed congruence, previous research has examined how incongruent information can lead to enhanced upper alpha power than congruent information

(Peng et al., 2022). For example, how congruent fearful faces produces EEG alpha asymmetry (Liu & Zhou, 2020) or how congruent advertising (context-music interaction) produces a higher percentage of time with positive alpha frontal asymmetry (Ausín et al., 2021). This leads to the following hypothesis:

Hypothesis 1: A congruent association between sponsor and sponsor property leads to relatively higher left frontal activation (i.e., higher asymmetry scores), whereas an incongruent relationship leads to right frontal activation (stimulus avoidance behavior).

The association between the pleasantness of a stimulus and the FAA is widely documented; however, authors such as Di Gruttola et al. (2021) question the ability of the FAA to predict consumer attitudes and final decisions is still debated. They found a negative correlation between attitude toward the message and FAA. van Bochove et al. (2016) also found a relationship between the asymmetry in alpha and beta of EEG measurements and attitude reported in the questionnaire. Olszewska-Guizzo et al. (2018) and Borawska et al. (2020) reported that increased right frontal alpha power (increased left frontal activity) indicated motivation, approach, and a positive attitude toward the presented view, whereas increased left frontal alpha power was associated with withdrawal, avoidance, and negative attitudes. Several studies report positively on the ability of congruency to improve attitudes toward a sponsor (Dees et al., 2010; Roy & Cornwell, 2003). The literature suggests that congruence enhances sponsor evaluation based on categorization-based affect transfer and attribution theories (Henderson et al., 2019). The former is based on the transfer of the characteristics of the sponsored object to the brand when it is successfully categorized, while the latter is based on the attribution of a benevolent action by the brand in the sponsoring action. Accordingly, we formulate the second hypothesis as follows:

Hypothesis 2: Relatively higher left frontal activation is more strongly associated with a positive attitude toward the sponsor when the sponsorship is congruent than when it is incongruent.

Several research studies have reported a positive correlation between willingness to pay and prefrontal asymmetry in the gamma, alpha, and beta band fluctuations (Ramsøy et al., 2018). For example, Garczarek-Bak and Disterheft (2018) found that the higher the frontal beta asymmetry score, the more likely the product purchase. Similarly, Ravaja et al. (2013) found that higher alpha asymmetry and approach motivation scores when viewing a product image predicted affirmative purchase decisions. By contrast, extreme incongruence between the two parts requires extensive cognitive processing that cannot be resolved, leading individuals to make negative evaluations that provoke feelings of frustration (Jagre et al., 2001). The previous research has demonstrated the direct and indirect positive effects of perceived congruence on attitudes toward the sponsoring company and purchase intention for sponsors' products (Silva & Veríssimo, 2020). Results have sometimes been contradictory (Prendergast et al., 2016; M. C.-H. Wang et al., 2011) but the mainstream literature supports that purchase intention increases when the relationship is congruent (Olson & Thjømmøe, 2011): Therefore, we formulate Hypothesis 3 as:

Hypothesis 3: Relatively higher left frontal activation is associated with higher purchase intention when sponsorship is congruent than when it is incongruent.

Among the factors measuring sponsorship outcomes at the individual level (Cornwell & Kwon, 2020), brand (not team) loyalty has received the least attention in recent years (Dreisbach et al., 2021; Pan & Phua, 2020; Woisetschläger et al., 2017) despite being positioned as one of the main objectives of sponsorship (Levin et al., 2004). Pan and Phua (2020) consider loyalty a continuous process of valuable and remarkable relationships between consumers and brands. We accepted the definition based on the attitudinal component (ingrained commitment to repurchase) to the detriment of the behavioral component (repeat purchase; Chaudhuri & Holbrook, 2001). Loyalty shows a strong correlation with purchase intention and attitude toward the brand (Biscaia et al., 2013); therefore, if relatively higher left frontal activation is associated with a favorable attitude toward the sponsor and higher purchase intention, this relationship may also hold true for loyalty.

Very few studies have examined the neurological connection between self-report and loyalty. Gregor et al. (2014) found that higher activation in the left frontal region (F3; related to positive emotions) was significantly related to loyalty to a website. However, they did not find a significant relationship between loyalty and activation in the right frontal region (F4; related to negative emotions). Franco et al. (2021) found inverse correlations between physiological signals in the alpha band of the prefrontal cortex and self-reports of their state when consuming products from sponsoring brands. Finally, although using a different technique functional magnetic resonance imaging, Plassmann et al. (2007) found significant differences between loyal and non-loyal customers in terms of neural activation patterns, based on the hypothesis that underlying information processing and subsequent decision making would have an emotional component for loyal customers. Considering the correlations examined above and the physiological and neural patterns presented, Hypothesis 4 is as follows:

Hypothesis 4: Relatively greater left frontal activation is associated with greater loyalty to the sponsoring brand when sponsorship is congruent than when it is incongruent.

Boksem and Smidts (2015), Fischer et al. (2018), and Hakim et al. (2021) are among the few authors to compare self-report measures with EEG measures. They found that EEG-derived measures significantly improved predictive ability, with a one to three percent improvement in predictive efficiency.

Hypothesis 5: Indicators of frontal asymmetry are related to preference and significantly improve the predictive power of the measures of stated preference.

Method

Participants

The sample was collected in the center of a Spanish capital city and consisted of 76 right-handed participants. Demographic information of respondents is in Table 1. None of the participants had any history of neurological or mental disorders. All the participants were native Spanish speakers.

Table 1
Demographic Information of Respondents

Variable	%
Age	
18–24	12
35–44	44
45–54	13
55–64	21
Gender	
Male	60
Female	40
Education level	
Primary	11
High school	29
Bachelor's degree	40
Master's degree	19
Prefer not to say	1
Employment status	
Employed full-time	50
Employed part-time	17
Students	18
Seeking opportunities	13
Prefer not to say	1
Family yearly income	
Less than 10 K	29
10 K–19,999	28
20 K–29,999	24
More than 30 K	18

An a posteriori power analysis using G*Power (Faul et al., 2007) software showed a power of 0.9, an effect size of 0.4 (large), and an α of 0.05.

Materials

An intersubject experiment was conducted by manipulating the congruence variable. The stimulus was a video chosen at convenience with four versions (2×2 : two congruent vs. two incongruent sponsors) of 13 s of the Tottenham-Manchester United match on June 19, 2020. The choice of English Premier League teams was made to avoid bias toward teams because the experiment was carried out in Spain. An example can be found here (congruent sponsorship): <http://ow.ly/4I1Z50KMGxk>. The method for selecting sponsors was as follows: (a) an open-ended survey of 100 participants in which they named the most congruent and incongruent sponsors that could sponsor a football event; (b) the five most frequent sponsors from the previous step were selected in both categories; (c) another survey of 100 participants asked about the congruence of each

sponsor on a Likert scale adapted from Speed and Thompson (2000); and (d) the sponsors with the highest (congruent) and lowest (incongruent) means in each category were selected. The sponsors chosen were Adidas and Puma—congruent and Whiskas and Apple—incongruent.

Data Acquisition

Before starting the experimental procedure, all participants read and signed an informed consent form and were initially informed and trained on the experimental procedure. This study was approved by the University Ethics Committee and conducted in accordance with the ethical standards of the Declaration of Helsinki. All the participants were monetarily compensated for their participation (25€). The participants were seated comfortably in front of a computer screen in a solar-isolated room. The distance between the monitor screen (1,920 × 1,200 pixels) and the subject was 60–100 cm. A mouse was provided for participants to move forward and subsequently express their opinions in the self-supplied survey. The EEG and eye tracking were then set up and calibrated. Each participant was randomly assigned to each of the four experimental groups (congruent: Adidas and Puma; incongruent: Whiskas and Apple) but keeping the groups balanced in terms of age and gender. The configuration of the experiment is described visually in Figure 1. The scale for measuring purchase intention was adapted from Baker and Churchill (1977), which was subsequently used in several research studies (Ko et al., 2008; Maricic et al., 2019); the scale for measuring brand attitude comes from Lardinot and Quester (2001); the scale for measuring brand equity was adapted from Yoo and Donthu (2001); and the scale for measuring congruence is derived from Speed and Thompson (2000).

Data Preprocessing

The neural response was collected using a 14-channel Emotiv EPOC+ headset with electrodes placed at AF3, F7, F3, FC5, T7, P7, O1, O2, P8, T8, FC6, F4, F8, and AF4 according to the 10–20 system with a sampling rate of 128 Hz. Additionally, M1 and M2 acted as ground reference (common mode sensor) and feed-forward reference (common mode cancellation sensor), respectively.

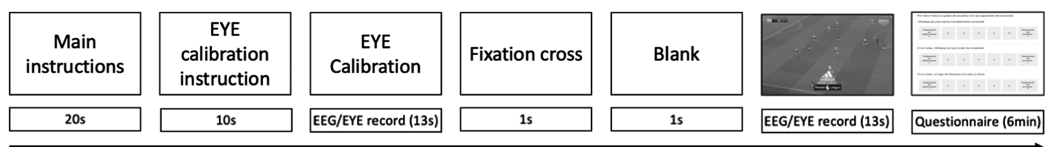
The contact and signal quality of each electrode was analyzed and channels with a quality below 95% were removed during the entire recording (Ramsøy et al., 2018). The signal quality in the analyzed channels was excellent (F3 $M = 81.45$, $SD = 27.72$; F4 $M = 77.93$ $SD = 19.41$).

The raw EEG data were filtered (Butterworth) using a zero-phase-lag band-pass filter (0.5–100 Hz) and a zero-phase-lag notch filter (50 Hz). Artifacts were removed when the absolute signal amplitude exceeded 120 μV (Peng-Li et al., 2022). The power spectral density (PSD) was obtained using the Fourier transform by splitting the preprocessed data into 1-s time windows with an overlap of 50%. The frequency bands were calculated by averaging the PSD within the standard power bands: delta (1–3 Hz), theta (4–7 Hz), alpha (8–12 Hz), beta (13–25 Hz), and gamma (26–40 Hz). Signal processing steps for the EEG were performed in iMotions using an integrated R algorithm, as previously described by Peng-Li et al. (2022).

Several studies have used prefrontal cortex asymmetry to indicate advertising effectiveness (Ohme et al., 2010). The left prefrontal cortex (F3) is involved in a system that facilitates approach behavior, whereas the right frontal cortex (F4) is involved in a system that facilitates withdrawal behavior from aversive stimuli (Davidson, 2004; F3 and F4 in the international 10–20 electrode placement system). Finally, the

Figure 1

Main Experimental Design



Note. EEG = electroencephalogram; EYE = Eyetracking.

FAA scores were computed using two frontal electrodes (F3 and F4) on each hemisphere using the formula described by Briesemeister et al. (2013): $FAA = \ln(\text{Alpha_Right}(F4)) - \ln(\text{Alpha_Left}(F3))$. Positive values denote approximation behavior (Ravaja et al., 2013).

Visual attention was tested using Tobii Pro Fusion at 250 Hz. The sponsor brand's screen appearance time was the object of measurement for calculating visual attention. The time to first fixation, total number of fixations, and total fixation time were calculated. These indicators allowed for control over the manipulation of the experiment.

The devices were synchronized using iMotions 9.2 software on a 15.6-inch MSI i9 laptop. JAMOVI, iMotions, and Matlab's EEGLab toolkit software were used for data analysis.

Results

Manipulation Check

Eye-tracking technology was employed to check whether the stimuli received the same visual attention in terms of complete fixation time, number of fixations, and time to first fixation (results in the same order) for congruent ($M = 1,330; 4.9; 455$ $SD = 1,200, 3.8, 421$) and incongruent ($M = 1,400; 5.4; 857$ $SD = 862, 3.6; 1,039$) sponsors. Analysis of variance showed no significant differences between the groups:

$F(1, 35.53) = 0.049, p = .826; F(1, 35.35) = 0.177, p = .677; F(1, 32.82) = 3.127, p = .086$.

Age, $F(1, 72.08) = 0.163, p < .68$, brand familiarity, $F(1, 72.42) = 0.687, p = .410$, sports involvement $F(1, 71.69) = 1.96, p = .166$, and team involvement, $F(2, 71) = .005, F = 1.79, p = .837$, were also tested. In all cases, there were no significant differences between the groups. These results indicate the internal validity of the experiment.

Results of the Hypotheses

Hypothesis 1

A congruent association between sponsors and property leads to higher left frontal activation, whereas an incongruent relationship leads to right frontal activation. The analysis of variance reports significant differences between congruence levels, $F(4, 72) = 19.8; p < .001$, with incongruent sponsorships receiving lower values on the FAA indicator. Figures 2 and 3 display the congruent versus incongruent FAA and alpha PSD in the F3 and F4 electrodes for a representative trial. Figure 4 plots the Z-scores (Vecchiato et al., 2011) of channels for the alpha band of the full sample set.

These results indicate that incongruent endorsements are associated with higher right frontal activity (lower alpha power), that is, withdrawal behaviors. In contrast, congruent sponsorships are associated with approach behaviors. Therefore, Hypothesis 1 is supported.

Figure 2

Congruent (Left) Versus Incongruent (Right) Frontal Asymmetry of Alpha in F3 and F4 Electrodes

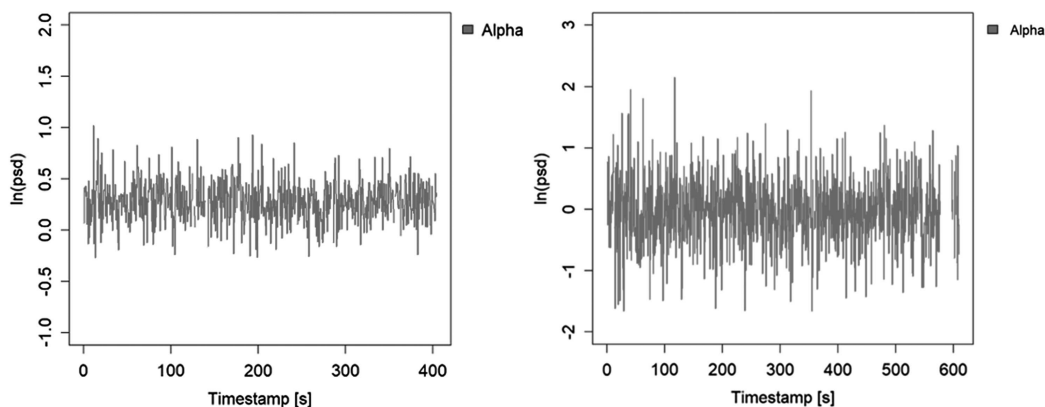
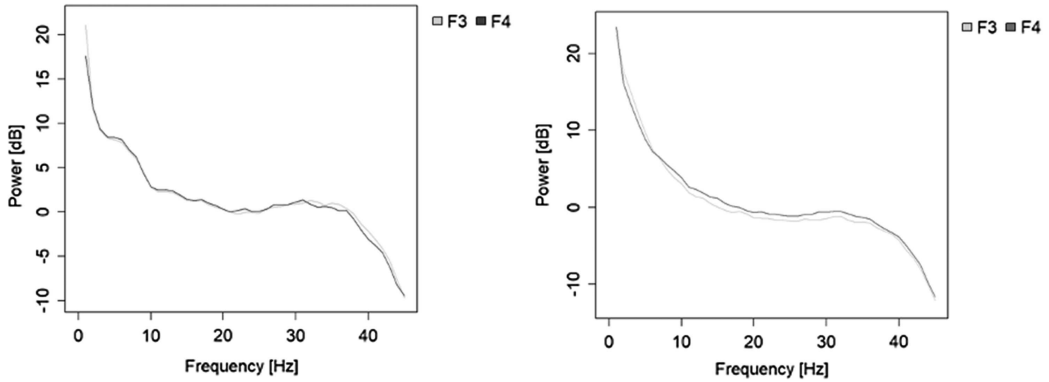


Figure 3
Congruent (Left) Versus Incongruent (Right) Alpha Power (dB) in F3 and F4 Electrodes

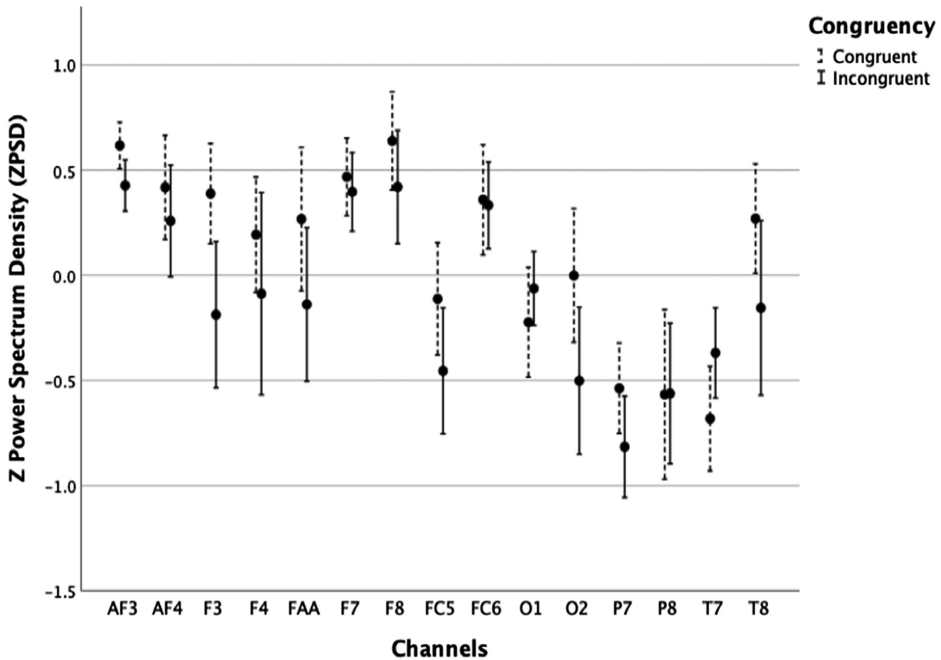


Hypothesis 2

Relatively higher left frontal activation is more strongly associated with a positive attitude toward the sponsor when the sponsorship is congruent than when it is incongruent. A general linear

model revealed a significant and positive effect of FAA on attitude toward the sponsor ($R^2 = 0.336$, $F = 5.771$, $p = .019$, $\eta^2 = 0.055$) indicating a positive approach sentiment toward sponsorships when attitude improves. There is no interaction

Figure 4
Change in Z Power Spectral Density (ZPSD) for the Alpha-Band (8–12 Hz) in the Indicated Channel Clusters During Viewing of Congruent and Incongruent Videos



effect ($F = 1.19, p = .279, \eta^2 = 0.011$) between congruence and FAA to explain variation in attitude toward the sponsor denoting that FAA explains variations in attitude regardless of the level of congruence between the sponsor and the sponsored. However, the attitude was favorable in congruent than in incongruent sponsorships ($F = 27.386, p < .001, \eta^2 = 0.263$). Hypothesis 2 is therefore supported.

Hypothesis 3

Relatively higher left frontal activation is associated with higher purchase intention when sponsorship is congruent than when it is incongruent. As before, the general linear model result showed a significant and positive effect of FAA on purchase intention ($R^2 = 0.221, F = 5.047, p = 0.028, \eta^2 = 0.057$), indicating a positive relationship between purchase intention and the FAA indicator of approach. Congruence had a positive and significant effect on purchase intention ($F = 13.431, p < .01, \eta^2 = 0.152$). There is no interaction effect ($F = 0.002, p = .962, \eta^2 = 0.000$) between congruence and FAA in explaining variation in purchase intention denoting that FAA explains variations in purchase intention regardless of the level of congruence between sponsor and the sponsored. Consequently, Hypothesis 3 is supported.

Hypothesis 4

Relatively higher left frontal activation is associated with greater brand loyalty when the sponsorship is congruent than when it is incongruent. The general linear model results show a nonsignificant effect of FAA on brand loyalty ($R^2 = 0.105, F = 0.624, p = .432, \eta^2 = 0.008$) but a significant interaction effect ($F = 6.119, p = .016, \eta^2 = 0.079$). The FAA indicator is positively related to loyalty when sponsorship is congruent and inversely related when the indicator is incongruent. Therefore, there is a positive correlation between loyalty and the approach behavior indicator but only when sponsorship is congruent. The relationship was negative when it was incongruent. Hypothesis 4 is therefore supported.

Hypothesis 5

Brand loyalty was the dependent variable in univariate multilevel regression. The independent

variables in the first stage were perceived congruence, brand attitude, and purchase intention. The actual congruence variable was used as a factor, and the FAA from the EEG was used as a second block variable. The model predicted loyalty with an R^2 value of 0.597 ($p < .01$) in the first stage. Indicators of visual attention did not improve the predictive ability of the model but incorporating the FAA variable increased the predictive ability of the model by 0.046 ($p < .001$). Therefore, the Hypothesis 5 is supported, as the FAA measure improves the predictive ability of the model compared to self-report measures.

Results and Discussion

This study examines how consumer response (efficacy) to sports sponsorship can be examined using EEG and how the classical indicators (attitude, intention, and congruence) relate to this new indicator. Our results (Hypothesis 1) showed that congruent sponsorships induce greater left frontal activity, which translates into an approach response, a more intense, and favorable response. In contrast, the participants responded to incongruent stimuli with greater right frontal brain activity, which is associated with withdrawal behavior, or responding more intensely to negative stimuli. These results are consistent with research using EEG to measure the effect of congruency (Dini et al., 2022; A. Wang et al., 2022). Studies have shown that congruency improves recognition and long-term memory (Packard et al., 2020). These results are consistent with those found in the academic literature.

The results (Hypothesis 2) further showed, like other studies, that frontal asymmetry is correlated with attitude (Di Gruttola et al., 2021; van Bochove et al., 2016). As expected, the attitude toward congruent sponsorship was favorable. However, the relationship between attitude and the FAA did not change as a function of sponsor type. This finding suggests that the relationship between FAA and attitude is consistent across sponsor types, and FAA is a predictor of attitude in all congruence circumstances.

FAA also showed a positive correlation with purchase intention (Hypothesis 3) and attitude; this result aligns with previous findings. Ravaja et al. (2013) found a positive relationship in the alpha band during the predecision period. As before, congruency had no significant effect; that is, the relationship between FAA and purchase

intention remained irrespective of the type of congruency relationship. This result is consistent with the result found in Hypothesis 2.

Participants obtained a higher FAA indicator score when they reported higher brand loyalty (Hypothesis 4). Although the information on the relationship between frontal asymmetry indicators and loyalty is scarce, our findings are similar to those reported by Gregor et al. (2014). Congruency moderates the relationship between FAA and loyalty. Participants showed a positive relationship between FAA and loyalty when the sponsor was congruent, but this relationship was the inverse for incongruent sponsorship. Accordingly, when the sponsor is congruent, there is higher left frontal activity and self-reported loyalty. However, when the sponsor is incongruent, self-reporting is associated with greater right frontal activity (feelings of rejection). This result could mean that the participants either did not understand the sponsorship relationship or failed to assimilate it. Several authors have shown that incongruent sponsorship is more difficult to classify and requires greater attention (Alonso Dos Santos & Calabuig Moreno, 2018; Coppetti et al., 2009; Dardis, 2009). This could explain the obtained result.

Regarding Hypothesis 5, the findings support previous results on the effects of congruence on attitude (Weeks et al., 2008), purchase intention (Graeber & Scheinbaum, 2022), and loyalty (Mazodier & Merunka, 2011). Like other research (e.g., Boksem & Smidts, 2015; Ramsøy et al., 2018) the inclusion of EEG data improved the predictive ability of the model. This demonstrates the added value that EEG data can provide to the assessment of consumer preferences and choices.

Theoretical Implications

The theoretical implications of the results of this research are varied. First, the literature on the use of EEG to measure the effectiveness of sponsorship is almost nonexistent although scholars suggest that objective measures are needed to measure the effectiveness of sponsorship (Cornwell & Kwon, 2020), and we are also aware of the disadvantages of interrogation-based information collection systems (Bhardwaj et al., 2023). Only a few articles have examined the relationship between sponsorship and EEG results (Alonso Dos Santos & Calabuig Moreno, 2018; Franco et al., 2021). Regarding congruence, scarce

research has linked frontal asymmetry to congruence in commercial advertising (Ausín, 2021), and no other study has linked congruence and frontal asymmetry in the field of sponsorship. Although cognitive conflicts has been associated with the upper alpha band of EEG signals (Peng et al., 2022), this is the first research that proposes to measure the effectiveness of sponsorship messages using frontal asymmetry. This new indicator could be a part of the solution to the search for objective measures in the literature (Cornwell & Kwon, 2020). Moreover, this predictive power can be extrapolated to other research areas beyond sports management.

The results complement and support the congruity theory as they show that congruent sponsorships improve sponsorship effectiveness. However, new research avenues remain unexplored. We are unaware of the degree of congruence necessary to achieve positive FAA. One stream of literature suggests that favorably resolved incongruent sponsorships imply a higher recall rate because they require a higher level of processing (Alonso Dos Santos & Calabuig Moreno, 2018). According to the moderate schema incongruity effect (Mandler, 1982), a moderately incongruent association improves product evaluation. We provided new information on how sponsorship is processed; however, new information is still required.

Limited research relates attitude and congruence to FAA, and virtually no research relates loyalty to FAA. Furthermore, there is no research on sports management. Although the literature has shown a relationship between congruence, attitudes, loyalty, and intention, however, there is a gap in how sponsorship information is processed and its relationship with self-reported variables.

Managerial Implications

We conclude that one of the most important objectives of sponsors is to increase their perceived congruence. The literature reports several methods to improve congruence, one of which is articulation. Articulation consists of explaining the relationship between the sponsor and the sponsor's property to the viewers. Investing in articulated messages can increase congruency (Cornwell et al., 2006), for example, by adapting to brand color. Henderson et al. (2019) recommended changing the color of sponsor logos depending on the event and

team. They reported a 16% improvement in purchase intent. However, some brands prioritize criteria other than congruency when selecting sponsor properties. In this case, the incongruent relationship can be improved through analogies. As Madrigal and King (2021) explain, the connection between the sponsor and sponsor property should be solved in a pleasant way as if it were a puzzle. Sponsors can also find their sponsorship niche by selecting a link to the main event, team, or even part of the event (e.g., Video Assistant Referee sponsorship—Alonso Dos Santos et al., 2023). Finally, some authors have suggested that congruence varies depending on the level of fan involvement (Koo & Lee, 2019). Thus, marketing initiatives can be segmented from this perspective. They can even be executed differently depending on the medium and intensity of the game, as recent research has shown significant advances in this area (Carrillat et al., 2015; Gillespie et al., 2018).

This research was conducted using a commercially available EmotivEpoC. Its reliability has been compared to other EEGs for medical use, and prestigious academic journals have published research using EmotivEpoC (David Hairston et al., 2014; Khng & Mane, 2020; Khushaba et al., 2013; Martinez-Leon et al., 2016). The use of this EEG is another practical advantage. Management practitioners can employ objective methods within the economic reach of small businesses.

Limitations and Future Lines of Research

This study has limitations that must be considered when interpreting and extrapolating the results to other populations. The time, cost, and means of conducting the experiments were limited. The location limits the extrapolation to other cultures or geographical regions; the discipline analyzed limits the extrapolation to other sports disciplines; and the cost and time also limit the representativeness of the sample and its extrapolation. The experiment did not consider possible types of congruence (e.g., functional, symbolic), types of articulation, or other variables measuring effectiveness. Additionally, the study design use only sports brands in the congruent conditions, and the stimuli incongruent stimuli may reduce preference, therefore creating a mediator variable. These limitations open new avenues of development using EEG to measure

whether congruent communication efficacy is maintained by modifying the sports discipline and congruency type, including articulation and the number of sponsors. We believe that the application of neurophysiological techniques in the study of sponsorship effectiveness is still in the early stages of development. Additionally, this study was limited to the examination of alpha asymmetry with a single simple automated algorithm implemented in the integrated R algorithm of iMotions software. This method is timesaving, easy to implement but considerably limits the ability to eliminate physiological artifact. However, this method can bring the field of neuroscience closer to business and researchers in other areas. Finally, it would be interesting to add additional information and analysis that could include mental workload, midline theta power or N400 component amplitude. These indicators and methods would improve our understanding of the processing of sponsorship messages.

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