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CONSUMER NEURO-EMOTIONAL AND COGNITIVE REACTIONS TO DIGITAL GAME ADVERTISEMENTS

Mesut KILIÇER [1], Ferdi AKBIYIK [2], Lidija KRAUJALIENĖ [3]✉, Ömer Kürşad TÜFEKCI [4], Andreea MARIN-PANTELESCU [5]

[1]*Isparta University of Applied Sciences, Isparta, Türkiye*
[2]*Buyukkutlu Faculty of Applied Sciences, Isparta University of Applied Sciences, Isparta, Türkiye*
[3]*Business Innovation and Communication School, Kazimieras Simonavičius University (KSU), Vilnius, Lithuania*
[4]*Faculty of Tourism, Isparta University of Applied Sciences, Isparta, Türkiye*
[5]*Faculty of Business and Tourism, Bucharest University of Economic Studies, Bucharest, Romania*

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Abstract. The primary aim of this study is to examine consumers' neuro-emotional and cognitive responses to digital game advertisements using EEG. Within this framework, 18 visual stimuli, totaling 150 seconds, were selected from five publicly accessible online advertisements for PUBG, one of the leading games in the digital gaming market. These visuals were chosen to trigger and measure specific emotional responses. The study focuses on assessing five fundamental emotions identified in Plutchik's Wheel of Emotions: joy, sadness, anticipation, fear, and anger. In the study, the results indicate that participants exhibited varying levels of neural responses to all visual stimuli. Overall, this finding can be attributed to the high average values observed in the frontal region, indicating the active involvement of the prefrontal cortex in attention, planning, and decision-making processes. Notably, this study provides practical implications for advertisers and producers in selecting similar scenes and identifying the most impactful visuals in advertisement production. In this regard, the study can also be considered a useful resource for evaluating advertisement feedback.

Keywords: cognitive reactions, emotional reactions, advertisement effectiveness, digital game, consumer behaviour, neuroscience.

JEL Classification: M31, D91, C91.

✉Corresponding author. E-mail: ***lidija.kraujaliene@ksu.lt***

1. Introduction

Understanding consumer responses in the context of digital game advertising requires an interdisciplinary perspective integrating biological, social, and psychological dimensions. Extensive research has been conducted to identify the determinants of human behavior. Particularly, the Industrial Revolution and the subsequent wave of globalization have brought about significant change and transformation. The competitive environment in the production and service sectors has influenced consumer preferences. To comprehend purchasing behavior, it is essential to thoroughly understand the consumer as its subject, along with the environmental, psychological, and emotional factors that shape their decisions. Recent research has further highlighted the complexity of consumer decision-making processes by demonstrating

that purchasing choices are influenced not only by personal preferences but also by broader social and environmental considerations. Tüfekci et al. (2026) found that health concerns, environmental awareness, and sustainability perceptions significantly shape consumers' food-related decisions. Their findings suggest that consumer behaviour is increasingly driven by a combination of cognitive evaluations and value-based judgments, supporting the view that decision-making involves multiple interconnected psychological factors. This perspective is consistent with contemporary consumer behaviour research, which emphasizes the importance of both rational and emotional processes in shaping purchasing decisions.

Recent advances in digital analytics and artificial intelligence have expanded opportunities to model complex behavioural responses and decision-making processes in dynamic environments. Studies by Kraujalienė and Gruodis (2025, 2026) demonstrate that neural-network-based approaches can improve the evaluation of multidimensional behavioural patterns and support more accurate interpretation of decision-making mechanisms. These developments complement neuroscience-based methods, such as electroencephalography (EEG), by providing additional insights into the factors underlying consumer responses to marketing stimuli.

The growing digitalization of markets has intensified scholarly interest in the factors that influence consumer perceptions and behavioural responses. Evidence suggests that the credibility of marketing messages, perceived authenticity, and digital transformation initiatives play an important role in shaping consumer engagement and decision-making. Such insights further underline the need to examine the cognitive and emotional mechanisms underlying consumer responses to marketing stimuli in digital environments (Abdulateef et al., 2026; Musaib et al., 2026).

Other studies have highlighted the complexity of consumer behaviour in digital environments. Marin-Pantelescu et al. (2025) showed that purchasing decisions in e-commerce ecosystems are influenced by multiple interconnected factors, emphasizing the importance of understanding consumer responses through both behavioural and cognitive perspectives.

The growing need to understand the drivers of consumer choice in a saturated marketplace has led researchers to adopt diverse methodological approaches. Therefore, the trends in recent decades suggest that the use of new methods in order to better understand human behavior is now required due to the limitations of traditional approaches. Neuroscience-based studies have produced extensive evidence to support the use of contemporary research methods since 2000. Not surprisingly, neuroscientific techniques have been successful in many areas (e.g., economics, politics), and the main technique EEG is extensively used in consumer neuroscience. EEG's superior temporal resolution relative to other imaging modalities allows for significant advantages in evaluating the instantaneous cognitive and emotional response associated with marketing stimuli (Li et al., 2022; Costa-Feito et al., 2023).

EEG, with its high temporal resolution, is widely used to understand consumer decision-making processes and serves as an important analytical tool for analysis in marketing and advertising strategies, as well as in the digital gaming industry (Binark, 2005). EEG allows researchers to examine the process of decision-making, particularly in the context of gaming, providing insights into consumer behaviour as evidenced by EEG-identified components (ERPs, e.g. P300) and frontal theta activity associated with cognitive load during risk-taking tasks and anticipation of reward (Moore et al., 2022). Studies of the use of EEG in digital gaming have also shown that events within a game (i.e. victory, loss, offer/acceptance of an offer, reward) correspond with both cognitive and emotional processes that shape consumer decision-making (Li et al., 2025).

Significant advances in technology and trends in user's behaviours have resulted in a broadening scope within the digital gaming marketplace over the last few years. This change is expected to continue through 2050, resulting in numerous economic/technological/cultural transformations (Grand View Research, 2023). According to the World Economic Forum, by 2026, the global digital gaming marketplace will be worth an estimated $321 billion (Samur, 2022). An instance of such transformation can be found in the AVGC-XR policy adopted in India to stimulate investment and generate high-end employment opportunities over time (Ghulgule, 2025). Additionally, technological trends (including virtual reality (VR), augmented reality (AR), and artificial intelligence (AI)-driven interactive media) are projected to significantly influence the nature of interactive digital gaming experiences by 2050 (Jia et al., 2024). The growing digital gaming sector has also drawn attention to other important issues such as regulation and sustainability within that sector. One of the major ways to regulate online gaming sites through regulation of the industry itself and safeguard users as a result of those regulations, was the Online Gaming Promotion and Regulation Act that was passed in India in 2025 (Press Information Bureau, Government of India, 2025).

Türkiye stands out as one of the fastest-growing countries in this field. A PwC report forecasts that between 2021 and 2026; Türkiye's gaming industry will grow at an average annual rate of 24.1%. Similarly, the Gaming in Türkiye 2021 report indicates that the number of players in Türkiye increased from 36 million to 41 million, while revenue from the gaming sector rose from $880 million to $1.2 billion. Another study forecasts that in-game purchases at the microtransaction level will reach a market value of 355 billion dollars by 2036 (Çavuşoğlu, 2024). Notably, half of this revenue comes from mobile gaming, positioning Türkiye as the 18th highest-grossing country in the global gaming market. However, rather than solely spending on games, strengthening the domestic game development ecosystem through local production is emphasized as a crucial strategy (Samur, 2022).

PlayerUnknown's Battlegrounds (PUBG), developed by PUBG Corporation (currently PUBG Studios under Krafton), was released on the Steam platform in 2017. Within less than two years, it became one of the best-selling PC games worldwide and reached record-breaking concurrent player numbers on Steam (Johnson & Woodcock, 2019; De Luisa et al., 2021). At first, only Steam users could purchase the game, but they later offered it on Microsoft Xbox Live and Sony PlayStation Networks. After only 3 months, they had sold 4 million copies. They wanted to reach as many users as possible, so they developed a mobile version of the game. The mobile version is free to play (Cansever, 2021).

Recognizing the role that emotion has on how consumers perceive products, ideas and services is critical to understanding how consumers respond to digital advertising for games. Consumers' attitude toward a product, the evaluation of the product, the judgments made about it and how satisfied they are overall after using the product are all influenced by how they feel about it. Recent studies have examined which emotions are most prevalent in marketing communications and how important it is that there is a strong emotional connection between the consumer and the brand they are purchasing from. Emotions play an important role in the brand-consumer relationship and how experiences (Tosun et al., 2019).

Plutchik made significant contributions by schematizing emotions and expanding emotion theory through his Wheel of Emotions. Plutchik categorized emotions into three levels primary, secondary, and tertiary and proposed the existence of eight fundamental (primary) emotions (Plutchik, 2001; Semeraro et al., 2021). In this regard, EEG-based emotion recognition studies typically employ two distinct approaches: (1) Plutchik's categorical emotion classes and (2) valence-arousal (V-A) dimensions. Both approaches contribute to a multidimensional

understanding of consumer responses in neuromarketing research (Hamzah & Abdalla, 2024). Frequency bands and time-wave analyses of EEG signals reflect the qualitative distinction of emotions more precisely (Li et., 2022).

This study employs EEG technology to examine consumers' emotional and cognitive responses to digital game advertisements. The purpose of this research is to determine how individuals' brains respond unconsciously (neuro) as well as consciously (cognition) to these ads in order to uncover the relationships between neural activity and emotional state (and possibly evaluate the appropriateness of Plutchik's framework of emotion). The study will also have implications for marketers in the digital gaming industry by discovering what kinds of digital advertising strategies will provide the best results, which means improved high return on investment on advertising spend. There are three sections of this research. The first section explains the terms that apply to both consumer behavior and neuroscience as relevant to this project. Section two contains a literature review of past studies on how people are marketed to through digital game advertising, the effectiveness of the EEG technique in determining the effectiveness of advertising, and the state of the digital gaming industry in Türkiye. The third section will provide a detailed description of all aspects of the study's objectives, scope, limitations, sample, methodology, results, and findings.

2. Conceptual framework

Consumer behaviour is increasingly understood as the outcome of interconnected cognitive and affective processes that operate through attention, emotional arousal, memory encoding, and evaluative judgment. Prior research indicates that strategic brand positioning and communication influence consumers' cognitive schemas, brand associations, and trust perceptions, thereby affecting subsequent behavioural intentions (Kraujalienė & Kromalcas, 2022; Kromalcas et al., 2024). Advances in digital analytics and artificial intelligence have further expanded opportunities to model complex behavioural responses and decision-making patterns in digitally mediated environments (Kraujalienė & Gruodis, 2025, 2026). Within the consumer neuroscience paradigm, advertising effectiveness is linked to neurocognitive mechanisms associated with attentional engagement, emotional valence, arousal regulation, and memory consolidation. Nevertheless, empirical evidence regarding these mechanisms in the context of digital game advertising remains scarce, particularly concerning how interactive advertising stimuli affect consumers' neuro-emotional responses and cognitive processing. Such a gap highlights the need for integrating neuromarketing approaches into the study of digital game advertisements and their influence on consumer decision-making.

Before the rise of neuroscience research methods, tests, surveys and interviews were often the methods of choice for discovering the factors that drive consumers' purchasing behaviours. More recently, however, researchers have realised the ability of neuroscience-based research techniques and methodologies to better understand consumer preferences and the cognitive, psychological and emotional factors that contribute to creating these preferences; this can be demonstrated through both national and international studies. Examples of neuroscience research methods include: Electroencephalography (EEG), Functional Magnetic Resonance Imaging (fMRI), Eye Tracking, Facial Coding and Galvanic Skin Response (Dezhekam, 2022); all of which have proven to be the most common and effective techniques for understanding consumers' behaviours and measuring their purchasing and consumption preferences.

EEG measurement technique, also known as Electroencephalography, is a method used to study electrical activity in the brain. In this technique, participants wear a cap containing electrodes. The EEG device records the brain's activity on the surface of the scalp. A limitation of this measurement technique is that it cannot capture deeper brain activity, especially in areas related to effects, reactions, and decision-making. As a result, behavioral predictions based on EEG recordings remain at a partial level (Warren, 2010; Dezhekam, 2022; Kacan, 2023).

The biggest advantage of EEG in recording brain regions is its high-resolution capacity. The measurements made with EEG are based on the assumption that emotions express themselves through physiological activities in the brain. From a marketing and advertising perspective, the interpretation of these measurements suggests that a high level of brain activation may be associated with increased attention and engagement, which have been linked in previous studies to behavioral tendencies such as purchase intention (Çoşkun, 2023). Indeed, EEG has been frequently used in research on advertising effectiveness (Fugate, 2007; Donmuş, 2018; Donmuş & Yücel, 2020; Aydın & Çelik, 2022; Kılıçer & Akbıyık, 2025), measuring product appeal, the effectiveness of logos and slogans (Dizar, 2021), political campaigns and propaganda creation (Görgülü, 2015), brand sensitivity (Sadedil, 2022), brand growth strategies (Ma et al., 2007), and product design (Khushaba et al., 2013). This is because EEG, with its high temporal resolution, can instantly capture cognitive processes (Cohen, 2011) and directly measure neural activity (Teplan, 2002). It offers practical use with its simplicity (Alyar, 2018) and portability (Cohen, 2011), allowing the monitoring of cognitive and emotional processes in the brain without behavioral responses (Ohme et al., 2010; Polat & Özerdem, 2016). Thus, it contributes to a better understanding of the brain (Krugman, 1971).

Türkiye's digital gaming industry is among the most time-consuming online activities. This is being primarily driven by the accessibility of the internet. Today, over half of Türkiye's population is connected to the internet and approximately 70% of internet users play games on the web. This has resulted in many companies and brands choosing to utilize marketing, advertising and promotional opportunities in the digital gaming sector (Büyükbaykal & Cansabuncu, 2020). The work that Türkiye has done within the gaming sector will play an important role in the success of Türkiye's economy, development and job growth opportunities (Sayar, 2024). Although advancements in digital gaming continue to develop rapidly alongside technological advancements, Türkiye's digital gaming industry is still not legally regulated and Türkiye has many obligations that need to be met with regard to the digital gaming industry. As a result, a multidimensional evaluation of the Gaming Sector is required. The gaming sector must be evaluated with respect to its Legal, Social, and Economic aspects at the same time (Akçetin et al., 2017).

If I think about digital games, the first game that comes to mind would be PUBG as it was released into early access prior to its full release date. Early access has its disadvantages in that the game does not yet have a completed project. On the other hand, early access gives developers an opportunity to showcase an unfinished idea to gain player feedback and create additional revenue by selling the game, easing some of the financial burden of developing the completed product. Many early-access titles, including PUBG, encounter difficulties maintaining stability for long periods of time after launch due to their being a continuously updated product (Akkaya, 2021). PUBG is a highly popular global title. Much of this success can be attributed to extended development support provided by its developers (Gül, 2019).

According to Plutchik's (1980) model of emotional responses has proven to be quite useful for understanding how consumers can have an emotional response to products. This model is frequently used to study a player's experience in the video game industry. Well-known

video games such as PUBG have developed marketing strategies that assist them in learning how players develop an emotional connection to their game and what drives them to compete. Furthermore, Plutchik developed the psych evolutionary theory to create a model of eight basic emotions, which distinguishes between complex emotional experiences and simple emotional experiences based on two primary emotions. The eight emotions that Plutchik identifies are: happiness; disgust; trust; sadness; anticipation; fear; anger; and surprise. All other emotional states can be thought of as a combination of those basic emotions. For example, love is defined as a psychological state created by an interaction between joy and trust. Combinations of emotions are identified as pairs (Arıkan, 2021).

Figure 1. Robert Plutchik's Wheel of Emotions (source: Positive Psychology, 2017; as cited in Baykan, 2019)

Plutchik's psychoevolutionary theory (Figure 1) offers a well-established framework for understanding the structure and development of human emotions. He proposed that emotional experience is organized around eight primary emotions-joy, trust, fear, surprise, sadness, disgust, anger, and anticipation-which serve as the foundation for more complex affective states. According to this perspective, emotions are not independent entities but interact with one another to generate a wide range of emotional experiences. Complex emotions arise through combinations of these primary emotions, often with varying degrees of intensity. For example, love is described as the result of combining joy and trust, which shows how distinct emotional states can merge to produce richer and more nuanced experiences. By emphasizing the relationships among basic emotions rather than treating them as isolated categories, Plutchik's model became an influential theoretical foundation across diverse fields, including

psychology, consumer behavior, neuroscience, and affective computing (Plutchik, 1980, 2001; Semeraro et al., 2021).

3. Research

The following subsection describes the following: research design, selection of sample, the process of collecting data, and data analysis methods. The methods with which the study was conducted were intended to provide measurable, systematic, and scientific answers to the research questions of this study.

Materials and methods

The present research involved an experimental design of a quantitative nature and utilized a standardized experimental design. The original problem and the issue addressed within the research project were defined prior to developing the operationally defined research objectives. Based on these original problems, research questions were developed to identify the methodology. Once the research questions were determined, the aim of the research was specified, and the rationale for conducting this research was provided, as were the implications for using those questions to determine the significance of the evaluation process. The research questions were described in terms of their relationship to the overall purpose of the project and their role in determining a general direction for the study. The assumptions and limitations of the research project are also discussed. Visual stimuli were chosen from a variety of categories because they could represent specific emotions (for example, action intensity). These categories (action intensity, narrative content, and visual tone) reflect continuous representation of emotional representation. The frequency ranges used in selecting the visual stimuli reflect frequency ranges previously used to examine cognitive and emotional processing in EEG studies (Cohen, 2011; Li et al., 2022).

Problem statement. The digital gaming industry is growing rapidly due to globalization and advancements in technology, presenting opportunities to develop new and innovative ways to market games, requiring all stakeholders to adopt new and different approaches to how they understand consumer behavior. As a result of this need and the limitations of traditional methods of measuring how people act when purchasing something, researchers have begun using various neurological techniques (such as EEG) for understanding consumers' attention, interest, and emotional reactions toward digital game advertisements and other forms of digital game marketing; however, there is limited work completed that specifically investigates the use of EEG in marketing digital games. In comparison, the application of EEG is significant within education, healthcare, and other industries, but little research has been done regarding how the advertising of digital games has an emotional impact on consumers.

Aim and importance. This section presents the methodological framework developed in line with the research aim defined in the Introduction.

Research questions. In line with the research aim defined in the Introduction, the following research questions were addressed:

- How do visual elements in digital game advertisements influence consumers' attention and emotional responses as measured by EEG?
- How do emotional responses measured by the EEG technique influence consumers' purchase decisions in digital game advertisements?

- What are the differences in how digital game advertisements reflect consumers' primary emotional reactions within the framework of Plutchik's Emotion Wheel model?

Research limitations. This study has several limitations related to time and setting. It is an experimental study, and thus the findings were obtained under laboratory conditions. However, the restricted availability of the laboratory at specific time intervals also presents a time constraint for data collection. Although measurements conducted in the laboratory are free from external stimuli (e.g., varying temperatures, sounds, or visuals), there is a potential for differences in participants' perceptions of the laboratory setting. This could be considered another limitation regarding the impact of perceived external stimuli on the measurement outcomes. Cost is another significant limitation in experimental research. Furthermore, the varying emotional states and participation of participants at different times during the research process may lead to variability in their responses. The small size of the sample and the over-representation of males in the sample severely restrict generalized findings across all population groups. Therefore, while these results provide useful information, they should be interpreted with caution when it comes to males versus females or young versus old gamers. Furthermore, the small sample size and the presence of mostly male participants restrict the generalizability of the findings. Thus, researchers should exercise care when interpreting the results, especially when they consider differences based on demographics such as gender or age among gamers. Because only one type of digital game (specifically, PUBG) was studied, the resultant findings may not translate across all types of digital games or their advertising forms. Furthermore, because all data was collected from a single country, emotional and cognitive responses may vary according to cultural factors, so it is important to interpret the findings within this context. Additionally, due to the relatively small sample size, there is a potential risk of Type II error, which may limit the ability to detect subtle effects. Therefore, the findings should be interpreted with caution. In addition, the use of a fixed stimulus order may introduce potential order or fatigue effects. Furthermore, although a short inter-stimulus interval was used to facilitate a return to baseline, longer intervals may provide more stable baseline measurements in future studies.

Research process. There are five different types of steps involved in this research project. Step one focuses on identifying ads that promote the PUBG digital video game via the internet; therefore, five (5) video ads for PUBG were identified from various sites and numbered (one ad = 1). The length of time that each of the ads is played back-to-back without interruption, when combined, is approximately 11.2. Because of the fact this length of time is too long for participants to stay focused on a video ad and may have influenced the overall results of this study, five (5) shorter video clips were created from the five different ad videos to visually depict the five (5) emotions [i.e. joy, sadness, anticipation, fear, and anger] that result from each video according to the Plutchik's Wheel of Emotions. This resulted in 150 seconds total of visual content being produced. There was a two-second blank screen between visual transitions (providing a brief opportunity for the participant to return toward baseline levels of neural activity). Additionally, since baseline correction was performed by reference to the pre-stimulus interval, every participant had an individual baseline. EEG signals were analyzed in terms of spectral power values [in this case, alpha (8–12 Hz) and beta (13–30 Hz)], which have been associated with attention, cognitive processing, and emotion engagement in the literature. Band power values were extracted from the frontal electrodes (Fp1, Fp2, F3, F4, F7, F8, and Fz) using the WinEEG software package. The order of presentation was kept constant across participants so there is no way to completely rule out potential order and fatigue effects.

Statistical analyses. EEG data were examined with the use of SPSS software. Descriptive statistics (means and standard deviations) were computed for each of the eighteen visual stimuli at twelve frontal electrodes (left frontal, right frontal, and midline). Repeated-measures ANOVA was conducted to determine whether there were significant differences among the visual stimuli associated with the five emotions examined in the study. Post hoc analyses using the Bonferroni correction were performed to control for Type I error resulting from multiple pairwise comparisons between visual stimuli and emotional categories. Statistical significance was set at $p < .05$. The analyses were conducted based on band power values obtained for each frequency range.

Table 1. First created 5 advertisements

List	Emotion Perceived in PUBG Visual	Original Duration of Image	Duration of the Created Image
1	Joy	152 second	16 second
2	Sadness	46 second	24 second
3	Anticipation	219 second	52 second
4	Fear	120 second	28 second
5	Anger	135 second	30 second

The advertisements range in length from 46 to 219 seconds (see Table 1). If the advertisements were played back-to-back without interruption, they would create approximately 11.2 minutes (672 seconds) of footage. Because this duration is too long for EEG recordings, and it's unlikely the subjects could maintain their attention for that long, potentially affecting the research results, each advertisement was cut into shorter segments that best represent one of the five emotions on Plutchik's emotion wheel. This resulted in a total visual of 162 seconds.

The EEG recordings were conducted in the laboratories of the Isparta Neuroscience Application and Research Centre. The effectiveness of advertisements used in the marketing of digital games was measured using the EEG device at the centre, specifically focusing on the digital game PUBG. All recordings were carried out with the Mitsar EEG device available in the centre's inventory and analysed using the WinEEG software. Additionally, the numerical values provided by WinEEG were evaluated using the SPSS software.

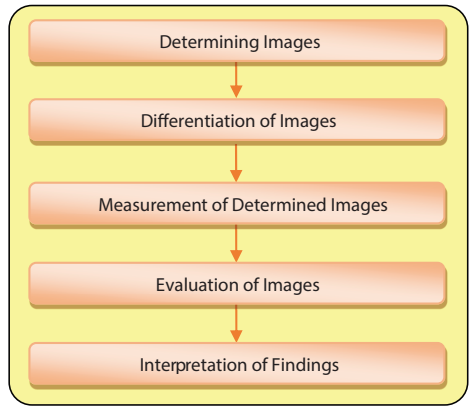


Figure 2. Research process

The research process (Figure 2) consists of five steps. In the first step, advertisements previously shown on the internet promoting the PUBG game were identified within the framework of the research's purpose and subject. For this purpose, five advertisements promoting the digital game PUBG found on the internet were numbered and arranged consecutively.

In this study, the data collection process began with the approval of the Isparta University of Applied Sciences Ethics Committee, under permit number 168/08 dated October 31, 2023.The data was collected between 20th of November and 20th of December in Türkiye in 2023, accordingly. The study involved 21 voluntary participants from various age groups, genders, professions, and income levels. While some studies indicate that sample size should be quantitatively considered in experimental research, in human-centred electrophysiological studies (such as EEG and ERP), determining the sample size may be left to the discretion of the researcher (Larson & Carbine, 2017). Prior to the EEG measurements, participants were provided with a "Volunteer Participation Form" and a "Research Information Form," through which they were given detailed information about the research process, and their voluntary participation was ensured. Although the sample size could seem small compared to what is generally utilized by EEG-based experimental studies (due to the complexity, cost and amount of time taken to collect such data), it is similar to what has been reported in previous literature (Larson & Carbine 2017). As such, this sample size will be acceptable for exploratory neurophysiological research.

Emotions in the advertisements. The study titled "Consumer Neuro-Emotional and Cognitive Reactions to Digital Game Advertisements" aims to measure five basic emotions (joy, sadness, anticipation, fear, and anger) using the EEG technique. In this context, a total of five videos prepared for the PUBG game were analysed. The first, the second, the fifth, and the sixth videos each contain three different visuals, while the third video includes six different visuals. The third video in the study is related to the emotion of anticipation. Due to the heightened emphasis on the emotion of anticipation in the PUBG promotional advertisements, more visuals related to this emotion were evaluated in the study. Thus, a total of 18 trials were conducted in the experimental design. This arrangement aims to collect data for triggering and measuring the specified emotions.

4. Findings

To better understand what emotions were stimulated by visuals of PUBG through emotion wheel reseach identified five different emotions: joy, sadness, anticipation, fear, and anger. Results of this research were obtained through an Emotions Identification Results phase and an EEG analysis phase. During phase 1 (Emotions Identification Results Phase) of research, emotions associated with each visual stimuli were examined. Emotions were further studied in phase 2 (EEG Analysis Phase) where outcomes of EEG activity were analysed to tag brain activity in response to what brain saw during experiment. EEG analysis interval values in front of the brain were used to derive measurable alpha and beta wave values which were used for further analysis of memory and behaviour resulting from identified feelings of the experimenters who had viewed images from the game.

4.1. Findings on participants

All the individuals who took part in the research were aged 18–45 years old, which has been identified as the most common market demographic for digital gaming consumers.

Participants consisted of a diverse range of educational backgrounds, with some having received an Associate's Degree, others an Undergraduate Degree, and some a Graduate Degree; therefore, having multiple educational backgrounds will allow researchers to examine the effect that different levels of educational attainment have on how respondents perceived advertising. Another aspect of diversity between the study participants was their income level; Participants' incomes were classified into three categories: Low Income, Middle Income, and Upper Income, therefore researchers will have the ability to compare how different income levels affected people's perceptions of advertisements. In addition to the above-mentioned variables, findings also indicated a predominance of males over females in responding to the survey, and that the majority of study participants were single because of this demographic predominance when analyzing the survey results, researchers should keep this factor in mind.

4.2. Emotion determination findings

As demonstrated in the theoretical framework of the study, the emotion wheel discussed in this research contains various shades of emotions, each labelled with different names. In this study, to more clearly differentiate the visuals from one another, the evaluation was conducted based on only five primary emotions. The promotional visuals of the PUBG game, available for open access on the internet, were watched, and 18 different visuals were selected, which were believed to appeal to the emotions in the emotion wheel. To determine the emotional response these visuals might evoke in individuals who have played the game, a group of 40 people who had previously played PUBG was shown all the visuals, and they were asked to indicate which emotion each visual corresponded to. Based on the participants' markings, the meaning of each visual was determined, and the visuals were labelled according to the emotion they conveyed. Figure 3 displays the emotions generated based on the participants' responses.

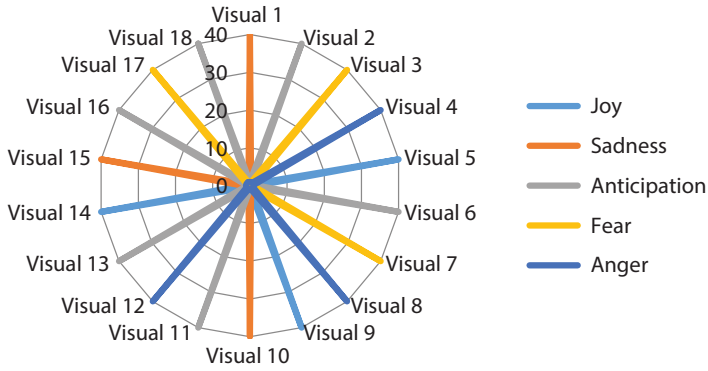
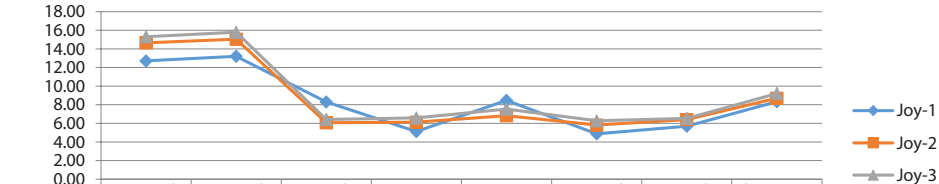


Figure 3. Emotions described in images

Based on the distribution of emotions in Figure, each visual was defined to represent a specific emotion. As shown in table, Visual 5, Visual 9, and Visual 14 correspond to joy; Visual 1, Visual 10, and Visual 15 correspond to sadness; Visual 2, Visual 6, Visual 11, Visual 13, Visual 16, and Visual 18 correspond to anticipation; Visual 3, Visual 7, and Visual 17 correspond to fear; and Visual 4, Visual 8, and Visual 12 correspond to anger.

4.3. EEG analysis findings

Repeated-measures ANOVA results indicated significant differences among the emotional visual stimuli in terms of frontal EEG band power values, $F(4, 80) = 5.84$, $p = .001$, partial $\eta^2 = .23$. Bonferroni-adjusted post hoc comparisons revealed that anticipation- and anger-related visuals produced significantly higher frontal activation compared to several other emotional categories. To determine the emotional responses elicited by the advertisements used in the study, feedback from 40 voluntary participants was collected at the beginning of the research. Based on their evaluations, it was identified that the advertisements triggered five fundamental emotions. Subsequently, these five emotions were assessed by a new group of 21 voluntary participants, who were invited to the laboratory setting and were different from the initial 40 participants. At this stage, the mean band power values and standard deviations for each visual were calculated, and statistical analyses were conducted. This approach provided comparative data to evaluate the differences among the visuals. The study first focused on analysing visuals that evoked the emotion of joy. In this context, Alpha and Beta wave values in the frontal region of the 21 participants were recorded, and the mean band power values for each visual were calculated using the WinEEG software package. The obtained data were then transferred to the SPSS software for statistical analysis.



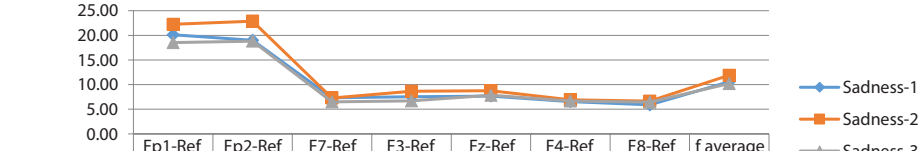
	Fp1-Ref	Fp2-Ref	F7-Ref	F3-Re	Fz-Re	F4-Ref	F8-Ref	f average
Joy-1	12.71	13.21	8.31	5.12	8.46	4.87	5.69	8.34
Joy-2	14.65	15.04	6.07	6.13	6.83	5.83	6.40	8.71
Joy-3	15.30	15.79	6.42	6.59	7.53	6.28	6.54	9.21

Figure 4. EEG analysis results for joy-related images

Based on the research objective, an examination of Figure 4 reveals that in the evaluation of the joy emotion, the joy-3 visual has the highest mean value (statistical significance levels are reported in the analysis) at electrode positions Fp1, Fp2, F3, F4, and F8. When considering the average F values, the joy-3 visual also exhibits the highest overall mean. These findings suggest that participants in this study appear to be more influenced by the visual elements in the joy-3 visual, leading to a stronger joyful emotional response and increased brain activity associated with this visual. This response may be associated with specific visual characteristics of the Joy-3 stimulus, such as dynamic action sequences, bright color contrasts, and rewarding in-game scenarios (e.g., victory or achievement moments), which are known to enhance emotional engagement and attention.

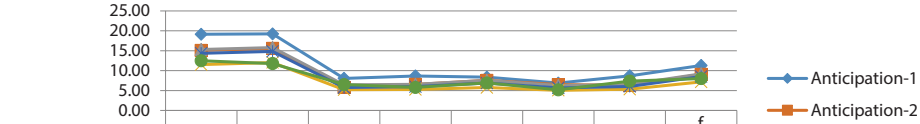
For the evaluation of the sadness emotion, three different visuals identified as conveying sadness in the PUBG game were analysed. Among these, the sadness-2 visual exhibited the highest mean band power values (statistical significance levels are reported in the analysis) at electrode positions Fp1, Fp2, F3, Fz, F4, and F8 with regard to the highest average they have. These findings indicate that participants in this study appeared to be more influenced by the visual elements in the sadness-2 visual, leading to a stronger sad emotional response

and increased brain activity associated with this visual (Figure 5). The stronger response observed for the Sadness-2 stimulus may be related to narrative elements such as character loss, failure scenarios, or darker visual tones, which are typically associated with negative emotional processing.



	Fp1-Ref	Fp2-Ref	F7-Ref	F3-Ref	Fz-Ref	F4-Ref	F8-Ref	f average
Sadness-1	20.11	18.99	7.33	7.54	7.68	6.55	5.89	10.59
Sadness-2	22.25	22.87	7.28	8.65	8.75	6.91	6.66	11.91
Sadness-3	18.53	18.82	6.51	6.70	7.84	6.67	6.45	10.22

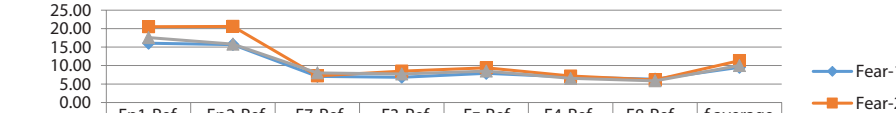
Figure 5. EEG analysis results for sadness-related images



	Fp1-Ref	Fp2-Ref	F7-Ref	F3-Ref	Fz-Ref	F4-Ref	F8-Ref	f average
Anticipation-1	19.14	19.24	8.05	8.66	8.35	6.87	8.69	11.29
Anticipation-2	15.08	15.58	5.83	6.53	7.56	6.49	6.31	9.05
Anticipation-3	15.30	15.79	6.42	6.59	7.53	6.28	6.54	9.21
Anticipation-4	11.50	12.04	5.20	5.27	5.76	5.06	5.34	7.17
Anticipation-5	14.34	14.84	5.76	5.98	6.86	5.67	6.03	8.50
Anticipation-6	12.48	11.78	6.48	5.79	6.91	5.19	7.37	8.00

Figure 6. EEG analysis results for anticipation-related images

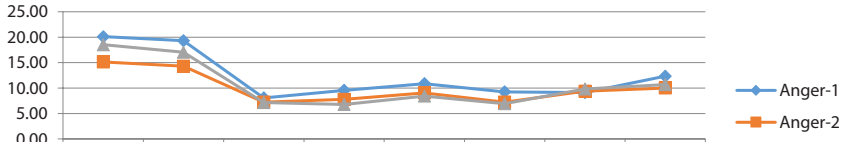
In Figure 6, six different visuals related to the anticipation emotion were analysed. These visuals were selected based on PUBG players' perceptions of anticipation. Among them, the anticipation-1 visual exhibited the highest mean band power values (statistical significance levels are reported in the analysis) at electrode positions Fp1, Fp2, F7, F3, Fz, F4, and F8. These findings suggest that PUBG players were most influenced by the visual elements in the anticipation-1 visual, leading to a stronger anticipatory emotional response and increased brain activity associated with this visual. This effect may be explained by suspense-building elements within the visual, such as uncertainty, upcoming action, or reward expectation, which are central to anticipatory emotional states.



	Fp1-Ref	Fp2-Ref	F7-Ref	F3-Ref	Fz-Ref	F4-Ref	F8-Ref	f average
Fear-1	16.06	15.68	7.06	6.86	7.90	6.90	6.31	9.54
Fear-2	20.52	20.62	7.19	8.51	9.39	7.16	6.09	11.35
Fear-3	17.57	15.84	8.03	7.73	8.51	6.55	5.87	10.01

Figure 7. EEG analysis results for fear-related images

In Figure 7, three different images related to the fear emotion were analysed. These images were selected based on PUBG players' expressions of fear and the visual elements thought to evoke this emotion. Among these images, the fear-2 image exhibited the highest average values at Fp1, Fp2, F3, Fz, and F4. These findings indicate that PUBG players were more influenced by the visual elements of the fear-2 image in generating a sense of fear, leading to significant brain activity related to this image. The heightened response may be linked to threatening or high-risk scenarios, sudden visual changes, or intense action sequences that are commonly associated with fear-related processing.



	Fp1-Ref	Fp2-Ref	F7-Ref	F3-Ref	Fz-Ref	F4-Ref	F8-Ref	f average
Anger-1	20.11	19.33	8.07	9.56	10.86	9.24	9.11	12.33
Anger-2	15.14	14.30	7.25	7.78	9.05	7.24	9.38	10.02
Anger-3	18.52	17.05	7.15	6.78	8.43	6.92	9.81	10.67

Figure 8. EEG analysis results for anger-related images

In Figure 8, three different images related to the anger emotion were analysed. These images were selected based on PUBG players' expressions of anger and the visual elements thought to evoke this emotion. Among these images, the anger-1 image exhibited the highest average values at Fp1, Fp2, F7, F3, and Fz. These findings indicate that PUBG players were more influenced by the visual elements of the anger-1 image in generating a sense of anger, leading to significant brain activity related to this image. This pattern may be associated with competitive or conflict-driven scenes, such as combat situations or perceived injustice, which are known to trigger anger-related emotional responses.

5. Discussion

Digital games not only serve commercial purposes but also stand out as important tools in education and training. In fact, research shows that visual content used in digital games significantly contributes to educational processes, particularly in word teaching (Hung et al., 2018). In this context, it can be concluded that there is a meaningful relationship between the visual content of digital game advertisements and the level of attention and interest measured through EEG. This highlights the potential of visual content in digital games to engage users cognitively, influencing both their emotional responses and their learning processes. In both commercial and educational terms, digital games are promising. The present research has shown that the visual content in games increases attention, learning, and trains memory.

Studies investigating the effectiveness of advertising used in digital game marketing are generally determined using traditional methods (Abbasi et al., 2021; Ghosh et al., 2022; Klose & Truong, 2022; Hussain et al., 2023; Anubha & Jain, 2024; Sreejesh & Ghosh, 2024; Adıgüzel, 2024; Zagni et al., 2026). This study employed an experimental approach using neuroscience techniques like EEG to assess the effectiveness of advertising used in digital game marketing, specifically on the game PUBG. This highlights the originality of the study and

thus contributing to the literature. These findings align with prior research indicating that emotionally salient stimuli enhance neural engagement and attention processes in digital environments.

From the perspective of marketing and advertising, the interpretation of these measurements is as follows: high levels of brain activation may reflect increased cognitive and emotional engagement, which may be indirectly related to behavioral tendencies such as purchase intention (Coşkun, 2023). Indeed, EEG has been widely used in studies investigating advertising effectiveness (Fugate, 2007; Donmuş, 2018; Aydın & Çelik, 2022; Kılıçer & Akbıyık, 2025), measuring product attractiveness, the effectiveness of logos and slogans (Dizar, 2021, pp. 23–24), shaping political campaigns and propaganda (Görgülü, 2015), brand sensitivity (Sadedil, 2022), investigating brand growth strategies (Ma et al., 2007), and determining product design (Khushaba et al., 2013). EEG is particularly valuable because its high temporal resolution allows for real-time capture of cognitive processes (Cohen, 2011) and it can directly measure neural activity (Teplan, 2002). Its simple usage (Alyar, 2018) and portability (Cohen, 2011) make it practical for use, allowing for the monitoring of cognitive and emotional processes in the brain without behavioural responses (Ohme et al., 2010; Polat & Özerdem, 2016). Therefore, it contributes to a better understanding of the brain (Krugman, 1971). Additionally, it was also observed that many studies are mainly literature reviews (Shoka et al., 2019; Alsuradi et al., 2020; Pei & Li, 2021; Reaves et al., 2021; Prabowo et al., 2023; Kurnia et al., 2023; Rahul et al., 2024; Khondakar et al., 2024).

In this study, which also aims to determine the impact of visual elements used in digital game advertisements on consumers' emotional responses, the findings indicate that all volunteer participants experienced emotions such as "joy, sadness, anticipation, anger, and fear," which are part of Plutchik's Wheel of Emotions. These emotions were selected in accordance with the experimental design defined in the methodology section. It is particularly evaluated that the related visuals created an impression that the game was more attractive and intriguing to consumers, which confirms the objectives of the research accordingly. Indeed, the use of eye-catching designs can increase user engagement (Çoşkun, 2019). Similarly, studies examining how attention processes are affected during virtual reality games using EEG (Fan et al., 2018; Gomez-Romero-Borquez et al., 2023) have shown that brainwaves, especially alpha and theta waves associated with attention and focus, change during the virtual game experience.

In line with the sub-goals of the study, the findings related to how digital game advertisements resonate with consumers' basic emotional reactions, revealed that certain emotions (joy, sadness, anticipation, anger, and fear) are highlighted in the visuals used to promote the PUBG game, which also verifies the research objectives. Given that PUBG is an action, combat, and strategy game, emphasizing these emotions may appeal to gaming enthusiasts. Research on action games, such as those by Green and Bavelier (2007, 2012), has demonstrated that regular play of action games enhances visual attention abilities, allowing players to process visual information more quickly and accurately. Similarly, another study by Kam et al. (2019) used EEG to examine the impact of game experience on the brain's frontal and attention networks. The findings indicated that brain activity changes while playing games and that gaming experiences influence mental processes, which verifies the objectives of research accordingly.

The findings related to another sub-goal of the study, which aimed to determine how emotional responses measured by the EEG technique influence consumer purchase decisions in digital game advertisements, suggest that emotions measured by EEG offer deeper

predictions. When comparing the results from both face-to-face interviews and EEG analyses, it was observed that EEG results generally supported the outcomes of the face-to-face interviews (Balconi et al., 2022), which is among the objectives of the research. Furthermore, the study also supported the thesis that there are differences between people's realistic verbal statements and the results obtained through face-to-face interviews and EEG analysis (Roslan et al., 2019). In this context, it was concluded that EEG analysis may provide more objective insights compared to self-reported measures (Bazzani et al., 2020).

From a practical standpoint, these findings have several ramifications for marketers and advertisers in the digital gaming industry. First, results imply that emotionally-engaging and high-intensity visual elements (such as action scenes, reward-based moments, suspenseful storylines) may be more successful in gaining consumer attention and enhancing neural connectivity than other types of stimuli. Additionally, it appears that the use of contrasting colors, movement and immersive storytelling may elicit higher levels of cognitive and emotional response. As such, it is recommended that advertisers leverage both visual intensity and emotionally-meaningful contexts when creating their content. Secondly, results indicate that different types of emotional appeal (anticipation, joy or fear) may generate varying degrees of engagement, suggesting that tailoring advertisement strategies to target emotional responses will result in increased success within the digital gaming space. Finally, the incorporation of neuroscience based evaluations (such as EEG) into advertisement evaluation processes may yield greater insight than traditional self-report measures.

6. Conclusions

This research investigated how consumers respond to advertisements for digital games from an emotional neuroscience perspective using EEG data. The results show that different types of visual stimuli create different levels of responses in the brain, especially in areas of the frontal lobes related to cognition and attention. The results also suggest that visually rich and emotionally charged stimuli that relate specifically to the advertised video game would increase engagement among users; thus, stimuli featuring elements typical of joy, anticipation, or both would be associated with higher levels of neural activity than are typically generated by other types of stimulus material. This research contributes to the developing literature on the integration of neuroscientific techniques into digital advertising by providing insights regarding how visual stimulation affects cognitive/emotional engagement. Finally, the results should be interpreted with caution given the limitations inherent to these findings, including sample size, limited types of games (one game), and limitations of the experimental design. Future studies are encouraged to use larger samples, vary the types of contexts, and use more sophisticated experimental controls. This research study provides exploratory evidence of how neural/physiological reactions are used to measure the success of digital advertisement campaigns.

However, considering that experimental methods, particularly in terms of costs, can impose a heavy burden, the effective utilization of other resources will enhance the efficiency of future studies. In terms of awareness, well-prepared advertising content will prompt consumers to make quick decisions and focus more effectively.

Based on the emotional framework of the study, it is predicted that different emotions may emerge if other commercial films are analysed using EEG, beyond the emotions identified in this study. The primary reason for this is that the study specifically focused on the action game PUBG. If advertisements from different sectors such as healthcare, cosmetics, or political propaganda were analysed within a similar emotional analysis framework, it is

likely that different emotional reactions would emerge, depending on the content of the commercial. Additionally, conducting the study with a different group of participants may yield different results. Activity in the prefrontal regions suggested increased cognitive and emotional engagement during exposure to the game-related visual stimuli. Future research directions will also consist of examining cross-cultural variations to decode the subconscious factors that determine player behaviour. In this regard, future research may also focus on conducting other neuroscience devices like eye tracking, fMRI, and GSR under the scope of experimental method to better analyse human behaviour along with the traditional methods like questionnaire form and focus group studies on different advertisement regarding health, education, textile, furniture, construction and so on by using Plutchik's Wheel of Emotion or valence-arousal (V-A) dimensions. In addition, future studies are encouraged to include larger and more diverse samples in terms of gender, age, and gaming experience to enhance the generalizability of the findings. It should also be noted that the findings are context-specific and may vary across different cultural settings and gaming environments. Future studies may consider using randomized stimulus presentation and longer baseline intervals to enhance experimental control. The findings also offer practical insights for the development of more effective and emotionally engaging advertising strategies in digital gaming contexts.

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Author contributions

The dataset for this study was constructed by Mesut Kılıçer, Ferdi Akbıyık, and Ömer Kürşad Tüfekci. EEG recordings were performed by Ferdi Akbıyık and Ömer Kürşad Tüfekci, and subsequent data analyses were carried out by the same authors. The initial draft of the manuscript was prepared by Mesut Kılıçer, Ferdi Akbıyık, and Ömer Kürşad Tüfekci. Andreea Marin-Pantelescu and Lidija Kraujalienė contributed to the further development and elaboration of the study concept, provided critical revisions for intellectual content, and offered guidance on interpretation and the formulation of relevant recommendations. All authors have read, reviewed, and approved the final version of the manuscript.

The authors contributed equally to the elaboration of this research.

Disclosure statement

Authors have no competing financial, professional, or personal interests from other parties.

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