

Research Article

Neuromarketing Insights for Predicting Consumer Purchase Intent

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Abstract: Consumer purchase behavior has traditionally been at the center of attention for marketers aiming to create persuasive advertisements and to increase engagement. Conventional survey-based methods, which are still the popular choice, have their limitations in terms of self-report biases and they do not fully measure subconscious reactions that usually influence consumer decisions. Neuromarketing, which is the application of neuroscience to marketing research, is equipped with impartial instruments to determine consumers' responses by physiological and neural measures. This research is about applying brain science in marketing research, especially the use of EEG and eye-tracking, to figure out if a consumer is going to buy a product. The physiological data of 285 people were studied in order to figure out the relationships between physiological responses and self-reported purchase intent in response to marketing stimuli. The descriptive, correlation, and regression analyses were used to investigate the relationships between the independent variables (type of advertisement and product category) and the dependent variable (purchase intent). According to the findings, both neural engagement, which was assessed through frontal alpha and beta activity, and visual attention, which was gauged through fixation duration and number of fixations, substantially predicted purchase intent with fixation duration being the most powerful predictor. The emotional advertisements produced higher purchase intent than the informational advertisements, and the product category had a moderating effect on these changes. This research shows the potential of EEG and eye-tracking integration in the comprehension of consumer behavior and offers practical suggestions to marketers who want to improve their advertising strategies.

Keywords: neuromarketing, consumer behavior, purchase intent, EEG, eye-tracking.

INTRODUCTION

The ability to understand consumption purchase intent is a matter of great concern to companies that seek to have the highest return on investment for their advertising campaigns within a highly competitive market. Purchase intent, a term that indicates the probability of a consumer to choose and buy a product or service, is influenced by a complex interaction of cognitive, emotional, and attentional processes [1]. Conventional methods of research such as questionnaires and focus groups have been commonly utilized to evaluate consumer preferences and predicted behavior. These methods are useful for gaining a deeper understanding of the problem, but they are also limited in that they depend on data reported by people themselves [2]. Respondents may inaccurately present their real views because of such factors as social desirability bias, memory inaccuracies, or limited introspective awareness, thus, differences between stated intentions and actual purchase behavior may arise. Therefore, traditional research methods may not reflect the intricate psychological and subconscious factors that play a role in

consumer decision-making, thus, the insights obtained may be incomplete or less trustworthy for marketers. Neuromarketing, through the use of brain research results and techniques, is changing the way the above limits are dealt with [3]. Unlike traditional methods, neuromarketing offers a chance to detect physiological and neural changes as a result of marketing stimuli in real-time, therefore, it can provide very accurate measurements of attentiveness, emotion, and memory trace. It should be noted that the most significant instrumental techniques in neuromarketing are, by and large, electroencephalography (EEG) and eye-tracking [4]. EEG displays the brain activity pattern; hence it can be utilized to figure out the cognitive load, emotional engagement, and even the neural bases of the decision-making process. As an example, normally, frontal alpha activity is associated with positive affect and approach motivation, while beta activity has been proved to be highly correlated with attentional focus and cognitive arousal, both of which have a decisive role in the formation of purchase intent. On the other hand, eye-tracking is the method that enables the creation of a picture of the visual attention patterns of people, such as fixation duration, gaze

sequences, and areas of interest, all of which indicate the allocation of attention and the facets of the advertisements that attract consumers most [5]. By using these brain and behavioral indicators in a coordinated way, marketers will be able to collect very large data sets on consumer reactions to advertising stimuli and the ways in which they make purchasing decisions. Combining EEG with eye-tracking measurements permits the prediction of purchase intent to a great extent than traditional self-report methods. Earlier research has shown that physiological changes, e.g. attention or increased brain activity, usually happen before preference becomes consciously recognized, thus emphasizing the significance of capturing subconscious processes in the buying behavior [6]. In general, emotional advertising is more capable to evoke extreme neural activity as well as longer visual attention which in turn can result in stronger purchase intentions than informational or feature-based ads. Though these conclusions have been drawn, there is still a demand for methodologically sound studies integrating EEG and eye-tracking across various advertisement types and product categories with support of enough sample sizes for statistical validity and generalizability [7]. This research is designed to fill the void by employing EEG and eye-tracking on 285 participants exposed to different advertisements of various product categories. The first goal is to find out which brain and attention signals can best predict purchase intent and also explore the traits of advertisements that effectively captivate consumer engagement [8]. Combining EEG and eye-tracking data with strict statistical analyses such as correlation, regression, and analysis of variance, this research provides a multidimensional view of consumer decision-making. The results are expected to help in theoretical understanding of cognitive and emotional processes leading to purchase intent, as well as giving practical insights to marketers for advertisement optimization and ROI increase.

LITERATURE REVIEW

One of the most important issues in the highly competitive and digitized market environment of today is to grasp the consumers' purchase intentions. A purchase intent, which is the chance of a consumer to purchase a particular product or service, is a complicated idea that is influenced by cognitive, emotional, and behavioural processes [9]. These preferences and decision-making of consumers have been measured through traditional research methods such as surveys, interviews, and focus groups. However, the approaches are still dependent on their self-report data. People's conscious reactions are most of the time affected by social desirability, memory biases, and their inability to explain their unconscious motivations even to themselves [10]. Therefore, what consumers say they will do and what they actually do in a real purchase context is often a huge discrepancy, that marketers find themselves in. In order to cover the distance between consumer statements and real purchase behavior, the field of neuromarketing has been supported as an effective interdisciplinary domain that integrates neuroscience, psychology, and marketing knowledge [11]. As a result, neuromarketing aims to reveal the truth behind consumer behavior by recording the physiological and brain activity of the consumers to the advertising stimuli, and hence may offer totally objective

metrics of attention, emotion, and cognitive processing. In contrast to the traditional techniques, neuromarketing devices can track consumers' conscious as well as subconscious responses. Also, the results are more extensive since they allow for a more complete and nuanced understanding of the drivers behind consumer choices. EEG and eye-tracking are the foremost two techniques that are often used in neuromarketing [12]. That records electrical signals from the brain by electric wires that are connected to the head of the subject. Thus, it can give information on mental workload, emotional involvement, and motivation-approach. For example, frontal alpha asymmetry is related to the positive mood and approach motivation while beta activity is related to increased attention and arousal [13]. Contrary to that, eye-tracking gives data about the visual attention of the person which may comprise of fixation duration, number of fixations, and gaze trajectories, thus identifying which parts of an advertisement or product grab the consumer's focus and interest. By combining EEG data with eye-tracking data, researchers can gain a multidimensional understanding of how consumers interact with marketing stimuli, that enables more accurate purchase behavior predictions. In recent years, knowing what a consumer intends to buy has become more crucial than ever due to the rise of digital platforms, online shopping, and omnichannel marketing strategies [14]. Advertisements are not only competing for the consumer's attention but also for the consumer's engagement, and within a very short span of time. Therefore, figuring out the parts of an advertisement that attract attention, create emotional engagement, and hence influence purchase decisions has become indispensable for the creation of efficient marketing campaigns [15]. It has been found in previous studies that the neural and physiological changes in consumers occur even before they become aware of their decision, thus implying that traditional self-reported measures may miss most of the subconscious influences [16]. Emotional advertisements have been found to induce stronger neural and attentional responses which, in turn, increase the probability of purchase as compared to informational advertisements only. Also, products towards which consumers allocate longer visual attention or to which they direct repeated fixations are those that consumers are more likely to purchase, thus drawing attention to the role of attention in marketing effectiveness [17]. What is more, despite the existence of substantial evidence advocating for the usage of neuromarketing in marketing practices, it still calls for studies that combine EEG and eye-tracking measurements with comprehensive statistical analyses across various advertisement types and product categories [18]. Most of the studies that have been conducted so far suffer from limitations such as small sample sizes, inadequate methodological rigor, or the fact that they consider only one of the neural or attentional measures, thus the findings obtained cannot be generalized and cannot be practically applied unconditionally. The present research closes up these holes by using a sufficiently powered sample of 285 participants who are shown both emotional and informational ads from various product categories [19]. Moreover, it applies extensive statistical techniques such as correlation, regression, and analysis of variance. The purpose of the study is to determine the

extent to which neural engagement and visual attention are two factors that interactively influence consumer purchase behavior and to offer market players practical guidance on how to make the best of advertisement optimization concerning both the content and the strategy [20]. Neuromarketing research has been increasingly showing that physiological and neural responses that occur subconsciously and automatically are more accurate predictors of consumer behavior than self-reported data, thus emphasizing the boundaries of traditional survey-based approaches. One of the neuromarketing instruments that have been mostly employed is EEG, which helps to detect the brain activity linked with the emotional excitement, the mental processing, and the motivational drive of approach-avoidance. To be more exact, the consumers' emotional reactions and a willingness to buy have been found to be strongly associated with the brain activities in the frontal lobe, especially when the alpha and beta frequency bands are involved [21]. Changes in alpha power in the left and right frontal regions reflecting positive emotional states and approach-related motivation have been reported to be the crucial mediators that link marketing stimuli with purchase behavior, whereas the beta band is more sensitive to the increased cognitive load and focused attention during the presentation of the commercial. In light of this evidence, EEG appears to bridge the gap between the consciousness and the subconscious, thus challenging the validity and comprehensiveness of verbal reports [23]. Eye-tracking is another instrument of neuromarketing that has been used with the purpose of measuring the behavioral aspect of attention allocation, as well as the visual engagement of advertisements. The researchers may use different indicators of visual attention, including fixation duration, number of fixations, and gaze trajectories, to better understand the role that the different elements of an advertisement play in drawing the audience's attention [24]. They try to figure out, for example, whether it is the product images, the brand logos, or the promotional text that most grabs the attention of the consumers. The longest fixation duration, as well as the repetition of the visual attention to the particular element, is the factor that most strongly predicts the consumer's purchase intention, while the visual heatmap serves the purpose of making the distribution of attention in the advertisement more understandable and visible to the consumer [25]. Besides, the eye-tracking findings are not just the quantification of attentional engagement; they also serve as a source of actionable insights that enable the designers, thereby, to come up with the best strategies for optimizing the design and placement of the key elements that lead to the maximization of their effectiveness [26]. Latest studies have emphasized the power of prediction by merging EEG and eye-tracking metrics. The combination of neural and visual attention data leads to improved accuracy of consumer purchase intent prediction [27]. This is because these measures, being complementary, represent different facets of the decision-making process: neural responses indicate emotional and cognitive engagement, while eye-tracking helps in identifying attentional focus and information processing strategies. Various predictive modeling techniques such as support vector machines random forests, and other machine learning algorithms on EEG and eye-

tracking data have been able to achieve classification accuracies of more than 70% in identifying high and low purchase intent [28]. The accumulating evidence positions neuromarketing as a powerful tool that not only can explain but also predict consumer behavior with a high level of accuracy.

Research Gap

However, a significant research gap in this area can be identified besides these innovations. The majority of the research works cited have limitations such as the number of participants, single-modality measurements, or laboratory-based stimuli which may not represent the actual behavior of consumers [29]. There is a dearth of studies that offer statistically sound, sample-size-powered models integrating both EEG and eye-tracking metrics across different product categories and advertisement types. Therefore, there is a demand for empirical research that merges these neuromarketing instruments in nature-valid settings and is supported by stringent statistical analyses so as to predict purchase intent reliably and produce actionable insights for marketers [30]. By closing this gap, the current study employs EEG and eye-tracking on a sample of 285 participants exposed to multiple advertisement types and product categories in order to comprehend how neural engagement and visual attention together influence consumer purchase decisions.

Research Objective

Examine the predictive relationship of neuromarketing metrics (EEG and eye-tracking) on consumer purchase intent across different advertisement types and product categories.

1.1. Hypotheses:

- H1: Higher frontal alpha activity during ad exposure is positively related to purchase intent.
- H2: Longer fixation duration on product images predicts higher purchase intent.
- H3: Emotional advertisements generate stronger physiological responses and higher purchase intent than informational ads.

METHODOLOGY

1.2. Sample

Summarily, the researchers sought 285 individuals, with the demographic composition being gender-wise, 145 males and 140 females, to balance the representation of the different demographic groups. The volunteers were between 18 and 45 years of age, with an average age of 28.7 years ($SD = 6.2$). They were enlisted via web registration and community advertisements, and the volunteers were paid for their time. Participants before being allowed in the study underwent a screening test, which excluded those with neurological disorders, severe vision problems, or those who had seen the study announcement, thus ensuring that the measured neural and attentional responses during the test were not affected by pre-existing conditions or familiarity effects.

1.3. Stimuli

The people involved in the study saw 20 different video ads that covered four product categories: electronics, fashion, fast-moving consumer goods (FMCG), and lifestyle

products. Ads were divided into two categories: emotional, which were narratives and music-heavy, and informational, which were features-focused and text-based. Every ad was between 30 and 60 seconds long, thus giving enough time for the participants to show neural and attentional responses that can be measured and also not to cause them fatigue. The presentations were in a random order to limit order effects, and the participants accessed the advertisements in a controlled lab environment to keep the exposure conditions the same for everyone.

1.4. Measurement Tools

EEG Recording: Neural activity was recorded with a 32-channel Emotiv EEG system, which had a sampling rate of 256 Hz. Besides the alpha band activity (8–13 Hz) and beta band activity (13–30 Hz) being the main features of interest, the study also focused on the frontal asymmetry, which has been linked to emotional engagement, cognitive processing, and approach-avoidance motivation. The EEG data were pre-processed to ensure the removal of artifacts and noise; thus the neural responses recorded during the expose of the advertisement were accurate.

Eye-Tracking: Visual attention was determined through the Tobii Pro Nano eye-tracking system. The metrics were total fixation duration (in milliseconds), number of fixations, and gaze heatmaps, which showed the visual representation of attention that different advertisement elements received. Eye-tracking data helped to find the places of interest that not only attracted participant attention but also led to purchase intent.

Purchase Intent: Self-reported purchase intent was gauged right after each advertisement viewing on the 5-point Likert scale. The scale had 1 to represent "very unlikely" and 5 to represent "very likely" to purchase the product. This variable was the dependent one in the study; thus it was

possible to establish the relationship between neural activity, visual attention, and the chance of buying the product.

1.5. Variables

Variable Type	Name	Description
Independent	Advertisement Type	Emotional vs. Informational
Independent	Product Category	Electronics, Fashion, FMCG, Lifestyle
Dependent	Purchase Intent	Self-reported 1–5 Likert scale
Predictor Variables	EEG Metrics	Alpha & Beta activity, frontal asymmetry
Predictor Variables	Eye-Tracking Metrics	Fixation duration, number of fixations

1.6. Statistical Analysis

The study adopted used SPSS 28.0 and R 4.3 to carry out the data analysis. Descriptive statistics such as mean, standard deviation, and minimum and maximum values were computed for EEG, eye-tracking metrics, and purchase intent. Correlation analysis using Pearson's *r* was done to identify the relationships between EEG and eye-tracking variables and purchase intent. They also ran a multiple regression analysis with purchase intent as the dependent variable and EEG and eye-tracking metrics as independent variables. Furthermore, ANOVA was applied to compare purchase intent across different advertisement types and product categories. The assessment of model fit and effect size through *R*² and Cohen's *f*² helped to understand the extent to which the predictors explained the variance.

RESULTS

1.7. Descriptive Statistics

Table 1: Descriptives Statistics

Metric	Mean	SD	Min	Max
Purchase Intent	3.72	0.91	1	5
Frontal Alpha	12.5 µV	2.3	7.2	18.6
Frontal Beta	15.3 µV	3.1	9.8	22.7
Fixation Duration	2.85 s	0.76	1.2	4.5
Number of Fixations	14.7	3.6	7	24

This research used stats to check if brain metrics from neuromarketing could predict consumer purchase intent. 285 people. First, the researchers figured out the averages and ranges of the main things they measured. The average purchase intent of all advertising was 3.72 on a five-point Likert scale, and the standard deviation was 0.91, which means that the variation of the self-reported Purchase Intent was moderate. EEG frontal alpha activity had a mean of 12.5 µV (SD = 2.3), and frontal beta activity was 15.3 µV (SD = 3.1) on average. The eye-tracking metrics, thus the fixation duration and the number of fixations, had mean values of 2.85 seconds (SD = 0.76) and 14.7 fixations (SD = 3.6), correspondingly. So, the descriptive statistics revealed that the participants were paying a lot of attention and their brains were working in response to the stimuli.

1.8. Correlation Analysis

Table 2: Correlation Analysis

Predictor	r with Purchase Intent	p-value
Frontal Alpha	0.42	<0.001
Frontal Beta	0.31	<0.01
Fixation Duration	0.48	<0.001

Number of Fixations	0.35	<0.01
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Both EEG and eye-tracking metrics have a positive relationship with purchase intent, and fixation duration is the variable that correlates most strongly. To determine the extent and the direction of the relationships between neuromarketing metrics and purchase intent, Pearson correlation analyses were performed. Frontal alpha activity had a significant positive correlation with purchase intent ($r = 0.42$, $p < 0.001$), which means that a higher level of frontal alpha activity, i.e. positive emotional engagement and approach motivation, was associated with a stronger intention to purchase. Frontal beta activity also correlated positively with purchase intent ($r = 0.31$, $p < 0.01$), thus, the involvement of cognitive arousal and attentional engagement in participants' purchase decisions was confirmed.

Eye-tracking measures revealed even stronger correlations. Fixation duration correlated with $r = 0.48$ ($p < 0.001$) and the number of fixations with $r = 0.35$ ($p < 0.01$), meaning that the most robust predictor of purchase intent was the unbroken visual attention to product-related elements.

1.9. Multiple Regression Analysis

Table 3: Regression Analysis

Predictor	B	SE B	β	t	p
Frontal Alpha	0.12	0.03	0.31	4.00	<0.001
Frontal Beta	0.08	0.03	0.18	2.67	0.008
Fixation Duration	0.19	0.04	0.38	4.75	<0.001
Number of Fixations	0.09	0.03	0.21	3.00	0.003

Delving deeper into these relationships, a multiple regression analysis was utilized to estimate the joint EEG and eye-tracking metrics influence on behavior while controlling for confounding variables such as age, gender, and prior brand familiarity. The regression model including frontal alpha, frontal beta, fixation duration, and number of fixations as predictors accounted for 53% of the variance in purchase intent ($R^2 = 0.53$, Adjusted $R^2 = 0.51$, $F(4,280) = 78.3$, $p < 0.001$). Among the predictors, fixation duration had the highest standardized beta coefficient ($\beta = 0.38$, $p < 0.001$), followed by frontal alpha ($\beta = 0.31$, $p < 0.001$), number of fixations ($\beta = 0.21$, $p = 0.003$), and frontal beta activity ($\beta = 0.18$, $p = 0.008$). The results demonstrate that both attentional and neural engagement are separate factors that co-vary with purchase intent, and that visual attention as captured by eye-tracking is a little more powerful than the EEG measures.

ANOVA Results

Moreover, an ANOVA was performed to compare the purchase intent by different advertisement types and product categories. Emotional advertisements resulted in significantly higher purchase intent ($M = 4.01$) than informational ads ($M = 3.43$), $F(1,283) = 16.8$, $p < 0.001$, revealing that emotionally engaging stimuli lead to more purchase decisions. Product categories also significantly changed purchase intent, $F(3,281) = 4.27$, $p = 0.006$, with fashion-related products producing the highest intent ($M = 3.95$) and electronics the lowest ($M = 3.51$). The findings here are consistent with the argument that the effectiveness of advertising depends largely on both the emotional appeal and the nature of the product.

Table 4: Model Summary

Model Summary	Value
R^2	0.53
Adjusted R^2	0.51
F-statistic (df)	78.3 (4, 280)
p-value	< 0.001

This model accounts for 53% of the variability in consumer purchase intent, and the adjusted R^2 of 0.51 shows that the model fits well after taking into consideration the number of predictors. The result of the F-test is significant ($p < 0.001$), which means that the predictors, as a group, have a statistically significant effect on purchase intent.

FINDINGS

Statistically, the different tests done have pointed to the fact that metrics from neuromarketing such as EEG and eye-tracking are very influential in predicting purchase intent. The regression results emphasize that even though emotional engagement and cognitive arousal (EEG metrics) are significant, visual attention (fixation duration) is the most powerful predictor of purchase decisions. Correlation and ANOVA results also support the idea that emotionally engaging ads get more attention and cause a stronger purchase intent, and that product category influences these effects. The findings are like a roadmap for marketers showing that the use of neuromarketing methods

can be the way to advertising optimization, consumer engagement, and the accurate prediction of purchasing behavior.

DISCUSSION

The research provides evidence that neuromarketing technologies, mainly EEG and eye-tracking, can accurately forecast consumer purchase intentions. The brain activity recorded through frontal alpha and beta bands and the visual attention reflected in fixation duration and gaze patterns were both indicators of the likelihood of purchase. This confirms the hypothesis that physiological and attentional reactions are dependable predictors of consumer

behavior. The emotional advertisements triggered the brain engagement more strongly and the viewers' eyes were more glued to the screen for longer time compared to the informational ads, thus proving that emotionally charged content captures consumer attention and facilitates their decision-making. On a practical level, these results mean that marketers are able to optimize the advertisement of their products by using emotional storytelling as well as by placing the pictures of the products and the brand name in such a way that it would attract visual attention to the maximum. Eye-tracking is a tool that makes easy changes in ad elements, while EEG gives information about the cognitive and emotional reactions behind the scenes. The findings are consistent with previous work, such as the study by Afshar and Azimi (2025), which concluded that eye-tracking is a better predictor of purchase intent than EEG when used alone, and with research that associates frontal alpha asymmetry with the motivation to approach and purchasing behavior (Vecchiato et al., 2014). However, it faces challenges due to a number of limitations. The experiment was done in a controlled environment, and maybe people's behavior when shopping in real life is different because of the influence of the surrounding environment. Besides that, EEG and eye-tracking need special equipment and skills, so they cannot be used by a large number of people. Consequently, the next generation of the study might wish to develop field-based applications and affordable neuromarketing tools that not only facilitate work but also make the validation process accessible in real consumer environments.

CONCLUSION

The present study reveals that the combination of EEG and eye-tracking indices offers a powerful and comprehensive way to predict consumer purchase intent, as it reflects both neural engagement and visual attention. Emotional ads activated stronger cognitive and emotional reactions and the participants looked at them for a longer time, which led to a higher purchase intent compared to informational ads, thus proving the effectiveness of emotionally engaging content. These results provide clear and practical directions for marketers, indicating that advertisement creation can be more effective if the main focus is on the story-telling, music, and by placing the product and brand elements in the most attractive spots in order to get the consumer's attention and influence their decision-making. The research highlights the role of neuromarketing in revealing the subconscious drivers of consumer behavior that are less likely to be detected by traditional self-report methods. From a management point of view, spending on neuromarketing research can lead to more effective advertising, better return on investment, and the creation of strategic content that can be used for various purposes. Furthermore, policymakers and practitioners ought to put in place well-thought-out ethical models that guide the use of neuromarketing techniques so as to ensure that consumers are influenced in a responsible manner. Subsequent studies may broaden these understandings by integrating everyday purchase records, utilizing AI-powered predictive modeling, and delving into affordable instruments for a wider practical application, thus deepening the connection between laboratory discoveries and real market behavior.

2. Policy and Managerial Implications

This research provides marketers, brand managers, and policymakers with a lot of important information. Marketers can utilize brain science marketing instruments like EEG and eye-tracking to advertise the pre-testing method. Practically, the company can evaluate consumer engagement, attention allocation, and purchase intent two prediction through a small campaign test, thus content optimization and maximization of ROI are feasible. Brand managers can gain a lot from the investment in consumer research, especially in neuroscience and behavioral analytics, where they benefit from both neural and attentional measures to design more effective and persuasive marketing strategies. This is a considerable advantage in the fight of brands for the market. For the policymakers, the main message of the given research is the necessity of enacting regulations with respect to the use of neuromarketing techniques for ethical purposes. It is to ensure that enterprises do not take advantage of consumers' sub-conscious responses in the most manipulative manners and also to encourage the proper use of these technologies in the marketplace. In general, the use of neuromarketing in management decision-making is a way of leading to more targeted, effective, and ethically informed marketing practices.

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