Neuromarketing: Understanding the effect of emotion and memory on consumer behavior by mediating the role of artificial intelligence and customers' digital experience

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CHRONICLE	ABSTRACT
	Artificial Intelligence (AI) techs help businesses turn internal and external data into real gold by analyzing customer data, extracting valuable insights, and offering individual solutions. The current study aimed to identify the mediating effect of artificial intelligence and digital experience on the relationship between neuromarketing (emotional appeal and memory encoding) and consumer behavior. The current study was applied to consumers within the MENA region by using an online questionnaire self-administered by (837) individuals. The study hypotheses were all accepted, and results confirmed that there is a mediating effect of AI and digital experience (DX) on the relationship between neuromarketing (emotional appeal and memory encoding) and consumer behavior. The degree to which digital experiences can modulate the association between emotional appeal, memory encoding, and consumer behavior, is not absolute; other factors and external cues that may be integral parts of a seller's marketing campaign remain relevant as well. The marketing strategy, quality of the product, prices, and effect of the enclosing environment influence consumer behavior from the digital dominion. Consequently, the comprehensive study of the digital situation is the premise of comprehending as well as using the mediating influence of digital experience on a consumer's mind. The study supports the idea that it is crucial for digital experience to bring up good feelings and provide opportunities for better information memory. Building visualizations that are appealing, interactive, and immersive to the users is intended to keep them interested and promote remembering. Through this approach, information on the brand can be associated with, recalled, and can become a significant decisive factor in future purchase decision-making.

1. Introduction

The field of neuromarketing received its first significant recognition in 2002, as the term 'neuromarketing' can be attributed to Ale Smidts in 2002. However, the groundwork was laid in the 1990s by pioneers like Gerald Zaltman, who patented the Zaltman metaphor elicitation technique (ZMET) (Alsharif et al., 2021). The concept is responsible for bridging consumer behavior and neuroscience and has been gaining rapid credibility among advertising and marketing professionals. Credible statistics suggest that over $400 billion is annually invested in advertising, with traditional methods often failing due to reliance on consumer self-reporting (Cueva et al., 2020). Neuromarketing follows a different approach, offering a direct technique to probe consumer minds. This revolutionary mentality regarding marketing is highly adaptable to the modern marketplace, given the technological advancements in artificial intelligence, blockchain, Internet of things, and other similar technologies. The global neuromarketing market size was valued at USD 3,324.98 million in 2023 and is expected to reach USD 6,576.76 million by 2032. This growth rate stands at a CAGR of 8.9%, which is quite phenomenal, according to (Murti

& Ghosh, 2023). Companies that have invested heavily in this approach are PepsiCo, eBay, Daimler, and Frito-Lay. Their reliance on neuromarketing showcases the field's growing practical relevance and power. The approach has become more prominent as a digital marketing means during and after the COVID-19 pandemic (Zeng & Marques, 2023). Ethical and data security concerns, particularly in the context of GDPR in Europe and consumer data privacy, pose challenges and shape the future trajectory of neuromarketing. Neuromarketing combines artificial intelligence and digital experience technologies to model consumer behavior (Singh, 2020). For this reason, many businesses apply neuromarketing tactics in conjunction with or within the framework of these technologies.

Electroencephalography (EEG) has been extensively employed in recent developments in neuromarketing. The goal has been to measure brainwave activity in real time, furnishing potentially accurate spatial and temporal data. In conjunction with EEG, eye-tracking technology captures gaze data. Another study (Dahouda & Joe, 2021) reports that this data provides valuable insights into the attention and engagement of consumers. Furthermore, there are a variety of consumer behavior metrics, such as arousal, engagement, attention, memory, attitudes, preferences, and decision-making processes (Khrais, 2020). These metrics are assessed utilizing the instruments mentioned above. Firms embracing this multidimensional approach in neuromarketing have reported better results in core business metrics (Murti & Ghosh, 2023). The reason for attaining these objectives is the marketing team's thorough comprehension of consumer reactions to marketing stimuli.

Implementing neuromarketing strategies has contributed to the prosperity of numerous business operations. An area for improvement is the increased comprehension of consumer behavior. Applying biometrics such as EEG has facilitated a more profound investigation into the cognitive and affective mechanisms that influence consumer choices Bermudez-Contreras et al. (2020). The investigation has resulted in an enhanced comprehension of implicit processes. Frequently, these processes are challenging to quantify through conventional means such as surveys (Cueva, et al., 2020). Its influence on branding and marketing strategies is an additional aspect of achievement. Insights derived from neuromarketing research are reportedly exerting an impact on businesses' advertising, pricing, and branding strategies (Singh, 2020). The capacity to establish causal connections between marketing stimuli and cognitive reactions influences the development of more precise and efficient marketing tactics (Yau et al., 2021). In light of neuromarketing's critical role, this study investigates the impact of two essential neuromarketing elements—memory encoding and emotion—on consumer behavior, with artificial intelligence and digital experience serving as mediators.

2. Literature Review

2.1 Neuromarketing

The neuromarketing market interacts with consumers more effectively and comprehends them through a cognitive process. The various approaches employed in neuromarketing, a field grounded in neuroscience, streamline examining consumer behavior, including responses, decision-making, and other related subjects (Bermudez-Contreras et al., 2020). A customer's pattern may be identified via facial expression coding and eye movement monitoring for neuromarketing. These methodologies ascertain the attractive attributes of a product that capture a consumer's attention, the duration for which they fixate on those attributes, the extent of dilation and expansion of the client's pupils, and additional factors about the product (Ala, Nair, & Rasul, 2022). Two key attributes of neuromarketing are emotional appeal and memory encoding.

2.1.1 Emotional Appeal

The emotional appeal component of neuromarketing is anchored on the limbic system, automatic response measurement, facial coding systems, and sentiment analysis on social media. Emotional appeals employed in neuromarketing predominantly aim to stimulate the limbic system, which is the part of the brain processing emotions (Mogaji et al., 2019). Functional magnetic resonance imaging (fMRI) and electroencephalography (EEG) quantify limbic system activity. In Autonomic response measurement, instruments such as heart rate variability (HRV) and galvanic skin response (GSR) are the primary tools used in the quantification process (Kim, Jeon, & Lee, 2020). This process effectively utilizes physiological responses to track emotional arousal. The outcome offers valuable insights into hidden emotional reactions about individuals' perceptions of advertisements. The Facial Coding System interprets emotional responses by analyzing micro-expressions and facial movements (Alsharif et al., 2023). At the same time, sentiment analysis methodologies use Natural Language Processing techniques to extract crucial preferences and biases by users towards specific brands and products.

2.1.2 Memory Encoding

On its part, memory encoding involves converting an event in marketing into an impression on an individual. Its core tenets are cognitive load assessment, neuro-imaging of the memory centers, implicit memory testing, priming, and contextual influence (Dewey, 2022). One of the powerful capabilities of memory encoding is its ability to evaluate the cognitive load that individuals experience when exposed to marketing content. This ability makes extracting an individual's insight into information processing possible. It is also a gateway to understanding the mechanics of information encoding done by the brain. Functional magnetic resonance imaging (fMRI) is a crucial technique to track memory-related brain regions' activity (Murti & Ghosh, 2023). The hippocampus is one region that is often triggered while consuming promotional materials.

Regarding implicit memory testing, neuromarketing employs tools like the Implicit Association Test (IAT). This tool effectively assesses methods such as Implicit Association Tests (IAT) and the quality and consistency of memory encoding. This understanding is possible without the need to explicitly recall because it works by evaluating the unconscious associations (Cueva et al., 2020). Research on the effects of contextual factors and priming on the encoding of memories in marketing is rife. Several sources have intimated that input examination regarding the impact of music and graphic appeal have on the quality of memory encoding during a promotional exercise.

2.2 Artificial Intelligence

Artificial intelligence's emergence and progressive refinement are slowly becoming a hallmark of e-commerce best practices in the modern-day business landscape. Key areas of application are social media and product recommendation engines.

2.2.1 AI on Social Media

Social media are considered among the top sources of customer information and have become viable targets for AI modeling to influence consumer behavior. AI-driven behavioral analytics particularly train models to analyze vast amounts of data to understand people's behavior and detect trends (Dahouda & Joe, 2021). Machine learning and data mining are two of the often-used methods in predicting the tastes and preferences of social media users based on their profile information. AI also employs Natural Language Processing (NLP) algorithms to perform sentiment analysis on social media content (Yau et al., 2021). The outcome provides deep insights into consumer attitudes and emotions towards brands, products, or campaigns. Social media content is also crucial in personalized content delivery, which involves using predictive analytics in personalizing promotional content on users' timelines. This approach increases user engagement with advertisements (Khrais, 2020). Additionally, based on their previous engagements with promotional content, the systems determine what content to share with the users. AI-driven social media platforms significantly impact consumer behavior by shaping opinions and preferences through targeted content. Nevertheless, this technique has resulted in informed and impulsive purchasing decisions. Apart from NLP, other models and frameworks are used to leverage social media data in building AI systems and programs. Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs) are some examples currently in practice. CNNs are particularly useful for processing image-based content on social media. Their usage is majorly on understanding and categorizing visual posts. On the other hand, RNNs are effective for analyzing sequential data like time-stamped user interactions. Advanced deep learning models such as Long Short-Term Memory (LSTM) networks and Transformers have also proven instrumental in using social media data for predictive analytics. The two can provide a more detailed sentiment analysis of social media content. As a result, they help in capturing complex patterns in textual data. The ARIMA (Autoregressive Integrated Moving Average) is another model central to learning social media users' behavioral tendencies. It achieves this goal of forecasting future user actions based on past behavior. The models can be used in solitary or in combination with others to build more potent hybrid systems for predictive analytics.

2.2.2 Product Recommendation Algorithms

Product recommendation algorithms are integral to artificial intelligence in the business sector, especially ecommerce. They are machine and deep learning technologies that predict a user's preferences based on their sentiments on previous purchases (Saura, Reyes-Menendez, Matos, Correia, & Palos-Sanchez, 2020). Collaborative filtering is an approach that is particularly applied in this context to determine a user's potential purchase intentions. It comes in three forms, namely, user-based, item-based, and hybrid. User-based collaborative filtering involves predicting a user's interests based on what other similar users have purchased but which the target user has not (Yu et al., 2024). On the other hand, item-based collaborative filtering focuses on the item on which a user has expressed their sentiments. The algorithm will then consolidate a list of all other users who have expressed similar sentiments on that item and create a list of their likes and dislikes. The hybrid method combines the essence of user- and item-based algorithms to develop a more formidable predictive algorithm (Dahouda & Joe, 2021). Other techniques also used in product recommendations are content-based filtering, contextual bandit, and deep learning for enhanced accuracy.

2.3 Digital Experience

Customer digital experience can be influential in determining their behavior in the marketplace. As (Lee, 2020) notes, giving customers a better purchase experience makes them more susceptible to promotional and other marketing initiatives. Technological sophistication using immersive technologies has simplified this process, as one only needs to apply them rather than design them from scratch. Two good examples are virtual reality and augmented reality. Virtual reality refers to technology that immerses users in a different digital reality in which they can interact with objects within that environment (Saura et al., 2020). On the other hand, augmented reality overlays the current environment with virtual objects with which a user can interact. Immersive technologies have significantly improved consumer experience, especially in fashion and cosmetics (Venkatraman et al., 2021). Nevertheless, their installation costs remain an inhibiting factor to adoption by small and medium businesses.

2.4 Consumer Behavior

Consumer behavior is a critical marketing component, as it is the goal of all marketing initiatives. Other study (Rita & Ramos, 2022) finds that it is a complex field encompassing several concepts. Management needs to appreciate consumer psychology, the purchasing decision process, cultural influences, group dynamics, and behavioral economics to successfully mitigate the influence on target consumers. For example, social factors like family, reference groups, and role status significantly impact consumer choices. The influence of peers and trendsetters often plays a pivotal role in decision-making (Chandra et al., 2022). These influences mold consumer attitudes, influencing their behavior in the market. It is critical to understand consumer behavior to develop successful marketing strategies. It enables businesses to customize their pricing, distribution, products, and promotions to meet the desires and needs of their target market.

3. Theoretical Background

3.1 Dual Process Theory

The Dual Process Theory is a theory in psychology attributed to Daniel Kahneman and Amos Tversky. It posits that human cognition consists of two systems, namely system 1 and system 2. The operations of system 1 are subconscious and thus offer quick and heuristic decisions. (Grayot, 2019) finds that this system is majorly responsible for emotional reactions. In neuromarketing, this aspect is often relied upon to deliver responses to marketing stimuli, such as ads and product designs. On the other hand, system 2 is slower because it involves conscious and rational thinking (Dewey, 2022). This part of the dual process system is responsible for a more critical analysis of products and their features. For example, a consumer may employ system 2 to compare two or more products while determining which offers the best value. The two systems interact as they play two distinct but interdependent roles. Once system 1 draws a customer to a product, system 2 intervenes to determine whether they should complete the purchase by questioning its value. The theory is highly applicable in this study. Regarding emotional appeal and memory encoding, neuromarketing strategies often target System 1 processing, resulting in strong emotional appeals and memorable brand associations. These two significantly influence consumer behavior subconsciously. The theory also associates well with measuring cognitive responses. Neuromarketing tools like fMRI and EEG measure responses indicative of the Stem 1 and System 2 processes (Alsharif et al., 2021). The responses obtained from the tools provide insights into how customers cognitively process different marketing strategies. When it comes to balancing emotional and rational appeals, effective marketing campaigns ought to balance the two appeals, corresponding to systems 1 and 2 (Singh, 2020). In this case, system 1 works on attracting customers, while system 2 kicks in only to help with more advanced purchase decision-making.

3.2 Conceptual Framework

The conceptual framework for this study shows the interrelationships between and among key variables. Neuromarketing is the main independent variable comprising emotional appeal and memory encoding sub-variables. We seek to establish how these two variables directly affect end consumers' artificial intelligence and digital experience. AI and digital experience, in turn, affect consumer/customer behavior. They mediate between neuromarketing (emotional appeal and memory encoding) and consumer behavior. Fig. 1 below graphically illustrates these relationships.
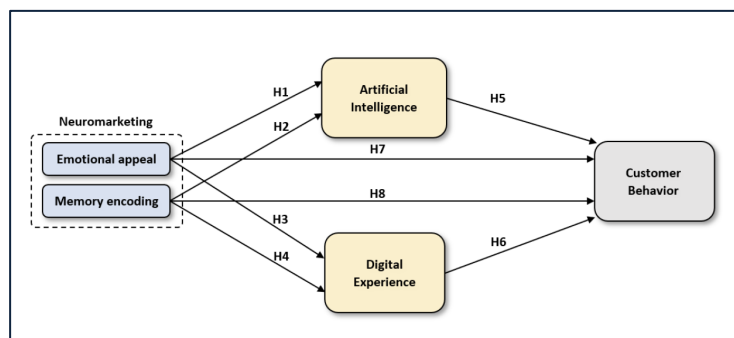

Fig. 1. Study's Conceptual Framework

3.3 Hypotheses Development and Conceptual Model

3.3.1 The Effect of Emotional Appeal on Artificial Intelligence

Studies have examined the effect of emotional appeal, as an aspect of neuromarketing, on artificial intelligence. According to (Mogaji, et al., 2019), AI emotion recognition advancements are significantly influenced by neuromarketing data. Facial expressions and patterns are key data that provide fodder for the AI models. As such, neuromarketing provides rich emotional response data for AI modeling. Furthermore, another study (Yu et al., 2024) opines that enhanced AI predictive analytics are now possible through emotional insights from neuromarketing. The study finds that the technology will only improve with time but will still rely on data from neuromarketing. This view is similar to the findings in (Liu-Thompkins

et al., 2022), where the researchers report that AI algorithms incorporate neuromarketing findings for improved consumer behavior prediction. These studies effectively show a symbiotic relationship between AI development and neuromarketing emotional data. For this reason, we hypothesize that:

H₁: *Neuromarketing statistically significantly influences Artificial Intelligence through emotional appeal.*

3.3.2 The Effect of Memory Encoding on Artificial Intelligence

Apart from emotional appeal, neuromarketing also encompasses memory encoding as one of its integral components. This component measures a consumer's memory of a brand or product. Regarding its relationship with AI, (Cueva, et al., 2020) finds that memory encoding insights from neuromarketing inform AI consumer behavior models, as the insights contain crucial data readily usable in these models. Furthermore, the source suggests that AI utilizes neuromarketing data for better memory-based prediction algorithms. This view is also shared by Bermudez-Contrras et al. (2020) in their study, concluding that neuromarketing studies on memory improve AI's targeted marketing strategies. The paper explains that the cross-application of AI memory encoding principles fundamentally stems from neuromarketing research. The authors recommend that e-commerce and social media businesses invest more in harnessing memory-encoding data as it has proven effective in training AI models. Another study (Dahouda & Joe, 2021) argues that enhanced AI personalization and recommendation systems are primarily a product of neuromarketing memory findings. These findings push the researcher to the hypothesis that:

H₂: *Neuromarketing has a statistically significant influence on Artificial Intelligence through memory encoding.*

3.3.3 The Effect of Emotional Appeal on Digital Experience

Customer digital experience has also featured considerably in scholarly debates regarding how neuromarketing's emotional appeal influences it. (Mogaji et al., 2019) specifically discusses the effect of emotional appeal on digital experience and reports that emotional appeal in neuromarketing shapes digital experience design by promoting best practices. The source further asserts that user interface and UX improvements are a direct product of neuromarketing findings on emotional appeal. In (Zeng & Marques, 2023), the authors mention that enhanced digital engagement is driven strongly by neuromarketing-based emotional strategies. The source cites immersive technologies such as augmented and virtual reality as direct consumers of emotional data. The study by (Murti & Ghosh, 2023) also lauds emotional appeal in enhancing the digital experience by stating that neuromarketing insights influence emotional content curation in digital platforms. The researchers also claim that personalized digital experiences are developed from neuromarketing emotional research. These arguments led us to contend that:

H₃: *Neuromarketing statistically significantly influences Digital experience through emotional appeal.*

3.3.4 The Effect of Memory Encoding on Digital Experience

Several studies have also deliberated on the effect of memory encoding (an aspect of neuromarketing) on digital experience. (Tirandazi, Bamakan, & Toghroljerdi, 2023)'s investigation is in this line and reports that memory encoding techniques in neuromarketing enhance digital content retention. The paper argues that memory encoding provides data and is responsible for its persistent usage throughout a user's interaction with an ecommerce system. The systems manage to allow this high level of digital experience by tapping into the retention capabilities of memory encoding. This notion is supported by Al-sharif et al. (2023) who find that digital experience designs leverage neuromarketing insights for memorable interactions. The source argues that neuromarketing research informs the creation of sticky digital experiences, essentially pieces of memorable data that digital systems can call to action whenever required. Another study (Ala, Nair, & Rasul, 2022) finds that memory encoding and neuromarketing techniques provide a seamless user experience, enhancing user engagement. The study claims that neuromarketing memory principles drive long-term brand recall in digital experiences. For the reasons and arguments above, we hypothesize that:

H₄: *Neuromarketing has a statistically significant influence on Digital experience through memory encoding.*

3.3.5 The Effect of Artificial Intelligence on Consumer Behavior

The effect of artificial intelligence on consumer behavior has also been a subject of scholarly interest (Freihat et al., 2023; Sommer, 2024). According to (Khrais, 2020), data from social media forms a significant part of the input given to AI models. In return, these models analyze and predict consumer behavior. The study claims that AI predictive analytics effectively foresee and shape consumer preferences. Apart from social media data in AI predictions, recommender systems are part of the discussion. Yau et al. (2021) report that AI-driven personalized recommendations significantly impact purchasing decisions. Their accuracy levels are high, which suggests that they can effectively recommend the correct products to customers. The outcome is higher consumer engagement on ecommerce sites. The source also claims that AI algorithms influence consumer engagement and interaction patterns. Also arguing along these lines is (Cabrera-Sánchez et al., 2020),

as the paper contends that behavior modification is now possible through AI-curated content and targeted advertising. Similar to the conclusions arrived at by the previous study, the source finds that AI-responsive systems result in enhanced customer experience. Therefore, we find it reasonable to contend that:

H₅: *Artificial Intelligence has a statistically significant influence on customer behavior.*

3.3.6 The Effect of Digital Experience on Consumer Behavior

Digital experience and consumer behavior are two variables in the ecommerce business environment linked in several papers. (Sawal, 2023; Hashem et al., 2023) opines that UI/UX designs profoundly affect consumer purchase patterns. The source argues that this trend ensues because the enhanced user interface and UX lead to increased consumer engagement and satisfaction. Similarly, (Chandra et al., 2022; Ajina et al., 2023; Alofan & Almarshud, 2024) reports that personalized digital experiences positively impact purchasing decisions and brand loyalty. This view seems consistent with the dual process theory's system 1, asserting that visual attraction is paramount to boosting consumer interest in a product. The use of immersive technologies such as AR and VR has also been responsible for molding consumer attitudes and behaviors, according to (Lee, 2020). The researchers also claim that ease of navigation and real-time feedback from user interactions positively shape consumer expectations, influencing consumer behavior. We, therefore, contend that:

H₆: *Digital experience has a statistically significant influence on customer behavior.*

3.3.7 The Mediating Effect of Digital Experience on The Relationship between Emotional Appeal and Consumer Behavior

The mediating statistical influence of digital experience between emotional appeal and consumer behavior has limited literature but is still an area of scholarly interest. Saura et al. (2020) suggest that digital experiences enhance the impact of emotional appeal on consumer actions and choices. The source argues that the effectiveness of emotional marketing is amplified through immersive digital platforms in the form of augmented and virtual reality simulations. A similar study by (Lou & Xie, 2020) posits that emotional responses evoked through digital experiences mediate consumer purchase decisions. While the effect ranges from moderate to high, the paper finds that these interactive digital environments intensify the emotional connection, influencing consumer behavior. Furthermore, the study acknowledges that the synergy between digital experience and emotional appeal alters consumer perceptions and actions for the better. These arguments compel us to hypothesize that:

H₇: *There is a mediating statistical influence of digital experience on the relationship between Emotional appeal and customer behavior.*

3.3.8 The Mediating Effect of Digital Experience on The Relationship between Memory Encoding and Consumer Behavior

There is also scholarly evidence on the mediating effect of digital experience on the relationship between memory encoding (an aspect of neuromarketing) and consumer behavior. According to (Venkatraman et al., 2021), digital platforms amplify memory encoding's effect on consumer behavior. The paper suggests enhanced recall of marketing messages is possible through quality and interactive digital experiences. The researchers continue to argue that digital experience is a conduit for strengthening memory's influence on purchasing decisions. This view is also shared by (Flacandji & Krey, 2020), who states that interactive and engaging digital content reinforces brand memory, impacting behavior. In explaining this position, the source notes that the synergy between digital experiences and memory encoding shapes consumer habits and preferences. These habits and experiences become part of a consumer's purchase patterns and behavior. Given these arguments, we hypothesize that:

H₈: *There is a mediating statistical influence of digital experience on the relationship between Memory encoding and customer behavior.*

4. Research Methodology

The current study utilized a quantitative approach to address its research questions and accomplish its main goal. The choice of the quantitative technique is justified by its ability to be applied to a larger sample size, thereby improving the generalizability of findings .

4.1 Sample procedure, data collection, and data analysis strategy

The study focused on individuals living in the MENA region who participate in online shopping for electrical equipment. A sample of 1,000 customers was selected through a simple random sampling method, and the online questionnaire was distributed to them via the SurveyMonkey platform. The questionnaire was available online for a duration of 5 weeks. A thorough analysis was conducted on a total of 837 valid questionnaires, which accounted for an impressive 83.7% of the research sample. The questionnaire consisted of two distinct components. The initial analysis covered the demographic characteristics of the research sample, such as age, gender, qualification, and income. The subsequent section provided statements regarding research variables, which were rated using a Likert 5-point scale.

In its final version the questionnaire consisted of (25) items as in the following Table 1.

Table 1
Questionnaire Items According to Controls

Variable	# of Statements
Emotional Appeal (EA)	5
Memory Encoding (ME)	5
Artificial Intelligence (AI)	5
Digital Experience (DE)	5
Consumer Behavior (CB)	5
Total	25

The management and analysis of primary data relied on the use of statistical package for social sciences (SPSS) v. 26th and the AMOS program. Additional statistical tests utilized in current research included:

- Frequency and percentages

- Mean an standard deviation

- Validity and reliability tests

- Path Analysis

5. Results

The current research focuses on exploring the impact of emotion and memory on consumer behavior, specifically examining the mediating role of artificial intelligence and customers' digital experience.

Frequency and percentages were utilized to analyze the descriptive statistics of the study demographics. According to Table 2, a significant portion of the respondents were males, making up 58.3% of the sample. Additionally, the age range of 40-50 years old accounted for 34.3% of the sample. Additionally, the largest percentage of the sample holds a Bachelor's degree, making up 35.3% of the sample. Furthermore, it was observed that 28.3% of the entire sample had an income ranging from $1000 to $2000 per month.

Table 2
Descriptive of Demographics

		Frequency	Percentage
Gender	Male	488	58.3
	Female	349	41.7
Age	18-28 years	95	11.4
	29-39 years	187	22.3
	40-50 years	287	34.3
	above 50 years	268	32
Qualification	High school or less	50	6
	Diplmoa	91	10.9
	Bachelor	296	35.3
	Master	268	32
	Ph.D	132	15.8
Income	Less than 1000$	228	27.2
	1000-2000$	236	28.3
	2001-3000$	145	17.3
	More than 3000$	228	27.2

5.1 Descriptive Statistics of Questionnaire

The responses suggest that the respondents generally have an optimistic view, as indicated by the mean and standard deviation. There is a mismatch between the average of the questions and the fixed average of the scale, resulting in a discrepancy. The study assessed the reliability of the measurement scales for multiple variables based on the results of factor analysis. The researcher employed PCA extraction and Varimax rotation techniques to obtain the most precise data available (Sekaran & Bougie, 2016). The researchers utilized a convergent validity test, also referred to as a factor loading test, to assess the questionnaire's validity. Table3 presents a clear and concise representation of the test results. After careful consideration, it was agreed upon that artifacts with loadings over 40% would be classified as authentic. A further investigation was carried out to evaluate the scale's reliability using Composite reliability (CR), average variance extracted (AVE), and Cronbach's Alpha. The instrument's reliability was assessed using Cronbach's alpha, resulting in a value that exceeded 0.70. This evaluation confirms the instrument's reliability and suitability for the investigation. According to the CR test results, the acquired value exceeds the critical value of 0.70 (Black & Babin, 2019).

Table 3
The results of the factor loading

	M	σ	FL	KMO test	AVE	(CR)	α
EA1	3.074	.912	.923				
EA2	3.607	1.065	.874				
EA3	3.582	1.050	.847				
EA4	3.395	1.201	.875	0.811	0.744	0.9355	0.912
EA5	3.428	1.201	.789				
Emotional Appeal (EA)	3.327	1.311					
ME1	3.468	.950	.891				
ME2	3.571	1.112	.814				
ME3	3.607	1.035	.772				
ME4	3.485	1.236	.852	0.625	0.67	0.91	0.871
ME5	3.722	.988	.758				
Memory Encoding (ME)	3.449	1.241					
AI1	3.567	.972	.838				
AI2	3.204	1.105	.934				
AI3	3.208	1.111	.817				
AI4	3.204	1.113	.963	0.832	0.763	0.941	0.914
AI5	3.149	1.158	.804				
Artificial Intelligence(AI)	3.054	1.251					
DE1	3.164	1.047	.973				
DE2	2.602	1.064	.977				
DE3	3.422	1.168	.976				
DE4	3.682	.973	.946	0.824	0.849	0.965	0.949
DE5	2.925	1.051	.706				
Digital Experience (DE)	2.810	1.136					
CB1	3.088	.892	.818				
CB2	3.074	.912	.771				
CB3	3.607	1.065	.758				
CB4	3.582	1.050	.898	0.778	0.69	0.916	0.883
CB5	3.395	1.201	.886				
Consumer Behavior (CB)	3.428	1.201					

A = Cronbach's Alpha
(CR) = Composite Reliability
(AVE) = Average variance extracted
FL = Factor Loading

The study conducted an analysis of discriminant validity to confirm that each construct is clearly differentiated from the other constructs (Black & Babin, 2019). In order to conduct this analysis, we assessed the correlation matrix of latent constructs. The diagonal elements of the matrix represent the square roots of the average variance extracted (AVE). The correlations between constructs are displayed in the cells located outside the lower left diagonal of the matrix. This analysis emphasizes the importance of the shared variance between a construct and its measures being greater than the variance shared between the constructs and other constructs in the model. Therefore, discriminant validity is attained when the diagonal elements (square root AVE) surpass the off-diagonal elements in the corresponding row and column, as illustrated in Table 4.

Table 3
Discriminant validity

	Emotional Appeal (EA)	Memory Encoding (ME)	Artificial Intelligence (AI)	Digital Experience (DE)	Consumer Behavior (CB)
Emotional Appeal (EA)	0.744				
Memory Encoding (ME)	0.655	0.67			
Artificial Intelligence (AI)	0.684	0.561	0.763		
Digital Experience (DE)	0.461	0.442	0.423	0.849	
Consumer Behavior (CB)	.609[**]	0.68	0.665	0.514	0.69

The sample did not exhibit a multivariate normal distribution, so the bootstrapping technique was employed for 500 consecutive steps or samples, with a significance level of 5%. Bollen-Stine's corrected p-value was utilized to test the null hypothesis regarding the accuracy of the model. The model demonstrated a strong overall fit, as indicated by the high values of GFI (0.998), NFI (0.995), TLI (0.96), CFI (0.996), AGFI (0.966), and the value of RMSEA (0.068). These values align with the recommended thresholds (Lai & Li, 2005).

5.2 Hypotheses testing

The statistical significance of the structural loads of the SEM was examined in order to assess it. The findings from the study hypotheses and the applied structural equation analysis are displayed in Table 3. When considering relationships, it is important to consider the p-value for each variable. If the p-value is less than 0.05, it indicates that there are significant relationships. Every relationship in this study is important.

Table 4
Hypothesized relationships

			direct effect	Indirect effect	S.E.	C.R.	P	Result
Artificial Intelligence (AI)	←	Emotional Appeal (EA)	.409		.036	12.221	***	Supported
Digital Experience (DE)	←	Memory Encoding (ME)	.139		.041	3.435	***	Supported
Digital Experience (DE)	←	Emotional Appeal (EA)	.158		.043	4.258	***	Supported
Artificial Intelligence (AI)	←	Memory Encoding (ME)	.128		.034	4.159	***	Supported
Consumer Behavior (CB)	←	Artificial Intelligence (AI)	.161		.027	5.491	***	Supported
Consumer Behavior (CB)	←	Emotional Appeal (EA)	.419	0.08	.030	13.512	***	Supported
Consumer Behavior (CB)	←	Memory Encoding (ME)	.216	0.033	.027	7.504	***	Supported
Consumer Behavior (CB)	←	Digital Experience (DE)	.104		.022	3.961	***	Supported

The literature and statistical results confirm that Hypothesis 1, which suggests that Neuromarketing has a significant impact on Artificial Intelligence through emotional appeal, is supported (direct effect = 0.409; p-value ≤ 0.001). The results obtained in this study supported Hypothesis 2, which suggests that Neuromarketing has a significant influence on Artificial Intelligence through memory encoding. This finding is consistent with previous research and is further supported by the statistical results (direct effect = 0.128; p-value ≤ 0.001), which align with other recent studies in the field. The study findings strongly support the idea that Neuromarketing has a significant impact on the Digital experience through emotional appeal, as previously indicated in the literature. The results of this study (direct effect = 0.158; p-value ≤ 0.001) provide strong evidence for this relationship. In addition, the obtained results confirmed that Hypothesis 4 holds true, indicating that Neuromarketing has a significant impact on Digital experience by affecting memory encoding. The results of Hypothesis 4 (direct effect = 0.139; p-value ≤ 0.001) are consistent with recent studies.

The literature and statistical results confirm that Artificial Intelligence has a significant influence on customer behavior. The direct effect is 0.161 with a p-value of ≤ 0.001. The results of Hypothesis 6 indicate that Digital experience has a statistically significant influence on customer behavior (direct effect = 0.104; p-value ≤ 0.001), which aligns with previous research findings. In addition, Hypothesis 7 suggested that digital experience plays a mediating role in the connection between Emotional appeal and customer behavior. This was confirmed by the statistical findings (indirect effect = 0.08; p-value ≤ 0.001) and aligns with previous studies. The results obtained confirm a statistical influence of digital experience on the relationship between Memory encoding and customer behavior, supporting Hypothesis 8. This finding is consistent with recent studies in the field. The results reached are summarized in Fig. 2, based on the presented tests of hypotheses.
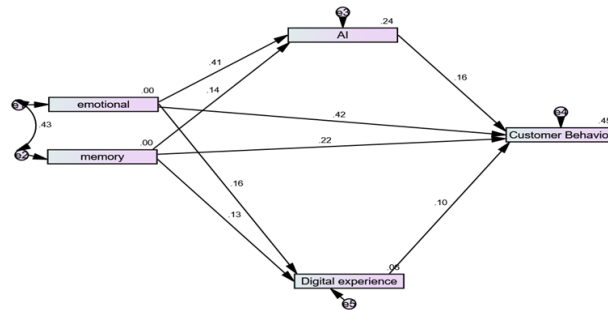

Fig. 2. Path Analysis

6. Discussion

The current research study aimed at exploring the mediating effect of artificial intelligence and customers' digital experience in the relationship between emotion and memory as a neuromarketing approach and customers' behavior. The main aim of the study was to utilize the quantitative methodology. For that, a questionnaire was distributed on a sample of (837) customers through an online medium for primary data collection purposes. Depending on AMOS, the results of the study accepted the fact that neuromarketing can influence consumer behavior through emotions and memory encoding. In addition, the study proved that AI and DX mediated the relationship between neuromarketing and consumer behavior.

6.1 The effect of neuromarketing on AI through emotional appeal and memory encoding

As a start, current research hypothesized that neuromarketing positively influences AI through emotional appeal and memory encoding. It was logical as study results indicated that neuromarketing, through cognitive science and marketing strategies, can positively affect AI by making use of images that deeply draw people's emotions and encode their memory to give out vital information that refines AI algorithms and systems. Results agreed with previous studies Mogaji et al. (2019) and Yu et al. (2024). On the level of emotional appeal, it was seen that neuromarketing is basically conducted to understand the brain's reaction, which includes, both emotional and rational responses, towards the marketing stimuli. This

way, AI systems can learn to address consumers' emotions through various advertising or marketing strategies, which later can be applied to their communications or marketing efforts. Artificial intelligence algorithms could be used to analyze the large datasets of the neuroimaging and the physiological reactions acquired by micro-marketing research so that the common trend would be ascertained to maximize the emotional appeal of adverts. Hence, it may affect improved customer engagement, better brand loyalty, and great results for businesses in general.

Regarding memory encoding, neuromarketing research is oriented at the mechanisms by which the brain stores and looks up memories associated with ads and branding. Through an investigation of how memory encoding of processes works, AI devices can be set up to encode and deliver content to improve memory retention. AI algorithms can scrutinize data for information on memory retrieval patterns and discover tactics that aid in presenting information, such as repetition, narration, or visual perception. It helps businesses craft more comprehensive consuming moments by the clients whose effect is better brand memorization and recognition.

6.2 The effect of neuromarketing on DX through emotional appeal and memory encoding

The study was based on the allegation that neuromarketing can influence consumers' digital experiences through emotional appeal and memory encoding. Such allegations were accepted and agreed with previous research, including Mogaji et al. (2019); Zeng and Marques, (2023); Tirandazi, et al. (2023) and Alsharif et al. (2023) as neuromarketing have positive impacts on the digital experience by appealing to emotions and encoding the memory as the brain responds to data, thus leading to a more engaging and memorable digital experiences through understanding which parts control the mind processing of info and applying that knowledge while designing digital interfaces. The concept of affecting digital experience through neuromarketing appeared in the following spectrum:

- Emotional Design: By adding the principles of emotional design, neuromarketing will be able to shape the face of the digital space, the sites as well as the apps that arouse good feelings in the users. These functions can be provided through the use of graphics, colors, styles, and easy to use activities.
- Personalized Content: The neuro-marketing data can allow the supplier to understand the individual buyers' preferences and emotional pathways. The AI systems based on analyzing data subject to user's emotional responses to different content could be used to perform a number of decisions like the personalized recommendations of content, advertisement or messaging that impact users emotionally.
- Storytelling and Narrative: Telling tales can be compared to a great torch. It can remove any obstacle that blocks the path to the recollection of something important. Neuromarketing technique aim to be able to create digital experiences that exploit the narration and history plot line in order to engage the users and deepen memory recall.
- User Feedback and Testing: Neuromarketing methods, e.g., neuroimaging and physiological measurement, gives opportunities to receive feedback from the users as well as improve the experience significantly.

We also hypothesized that AI and DX have a statistically significant influence on customer behavior. After analysis of individuals' responses to questionnaire, results of analysis indicated the acceptance of the hypothesis as AI and digital experience clearly have the best chance to impact on consumer experience through several mechanisms which included personalization, AI algorithms are able to dig through enormous data related to customers, even browsing history, purchase patterns and demographics, which results in personalized recommendation and enhanced identity. In addition to predictive analytics as AI collects and processes consumer data to formulate predictions on their future actions and tendency. Also, interactive chatbots and virtual agents based on AI technology really improve customers experience having the right speed and personal approach expected. They are able to answer queries, give advice, and pick up orders, which altogether ensures an uninterrupted interaction experience. The study also indicated through the analysis of the questionnaire that AI can study customer feedback as a sentiment analysis, social media discussions, and online reviews to get the vibe of their thoughts and good/bad services. Such results agreed with Khrais (2020); Yau, et al. (2021) and Cabrera-Sánchez, et al. (2020) who argued that knowledge about sentiment and trends in the customer opinions may enable the businesses to detect the area for improvement, resolve customer complaints and utilize valuable data. Engaging customers actively in finding out what they are thinking and sensing and then acting on it appropriately can prove effective in changing the behavior and increasing the loyalty of the customers.

The current study saw through building hypotheses that DX can positively influence consumer behavior, results supported this allegation, arguing that digital experiences unveil statistical effects that directly influence the customers' behaviors by different mechanisms. When coming to positive user experience (UX) design shows attractive and straightforward navigation with high-quality graphics, it helps attract readers, maintain their search time and enhance customer satisfaction; that, in turn, increases conversions. Personalization in content and the targeted communication approach aimed at specific customers have made the messages more relevant and memorable that contribute to users' engagement, and conversion, as well as build customer loyalty. Creating interactive and immersive content, for example, through quizzes, surveys, and gamification, results in higher involvement and enjoyment and are what build emotional connection; thus, the probability of engaging in desired behaviors and preferably sharing this on social media is very high. This agreed with Sawal (2023); Chandra, et al., (2022); Homsi et al.(2023) and Lee (2020) who confirmed that customers base their decisions and trust not only the brands' messages but also the peers and the recommendations, being positively demonstrated on client behavior and

conversion rates. Correctly set and customized CTA points (call to action) guide potential customers into taking specific actions they choose, whereas data driven insights let you use which information for which purpose and make informed decisions, further refine marketing strategies, and make sure it's aligned with customer preferences and behaviors. Identifying the consumers, realizing effective strategic planning, testing and continuing optimization will present the defiance of digital experiences on customer attitudes.

We also built current research on the main allegation that digital experience as a whole has a mediating influence on the relationship between consumer behavior and emotional appeal form one side, and consumer behavior and memory encasing from the other. Results also came positive on this relationship arguing that digital experiences can have dual role where at one side it serves as a mediating channel between emotional appeal and consumer behavior but on another side, it acts as a primary factor in memory encoding and stimulation. On the level of emotional appeal, digital experiences can add an emotional dimension in the execution of design and content, utilizing visual storytelling and interactive features. The visuals can be engaging, the narratives representing a compelling story and the experience can be immersive, all whilst creating an association of the brand or product by making the user feel a certain emotion. Such emotional reactions might even affect a consumer's behavior as he determines his purchase decision, creates loyalty to a brand, or shares his experience with others (Hashem,2019). Digital experiences function as a medium of communicating the emotional appeal of a product or service, and plus, this medium magnifies the impact of its influence on the consumer's behavior.

On the level of memory encoding, it can be said that digital experience can help enhance the brain's ability to encode with both direct and indirect methods. Humanization of content made appealing and interactive with personalized experience and gamification aspects are efficient methods for gaining user attention and improving information retention. Through unique user experiences, these platforms create long-lasting impressions, up to a willingness to buy the brand, product, or message as such. This long-term memory process, which involves burying the impression deep, controls decision making in the form of recall, recognition, and past experience. Digital experience means a channel through which a person can encode the information. It does so, therefore, that affects consumers' behavior. Consumers connect both the scenes of the product and the encoding of the emotional impression and further consumer behavior through digital technologies. This is the condition or background where these processes occur, and it explains, and shapes the relationship between these elements. Having digital experiences tailored to arouse emotions or memory encoding, which is more reflective of consumers, is a tactic companies can use to be more targeted and effective in that endeavor. Such results agreed with Saura, et al. (2020) and Lou & Xie (2020).

7. Implications and conclusion

The Current study examined the mediating effect of AI and DX on the relationship between neuromarketing (emotional appeal and memory encoding) and consumer behavior. It is expected from the current study to have both theoretical and practical implications. From a theoretical perspective, the current study is expected to add to the theoretical framework for the intricate web between emotion, memory, AI, and digital activities that one must understand to define consumer behavior. On top of this, digital amp is the outcome of the mediating role of AI between emotional appeal or memory encoding and relevant end-user behavior response. This integration convinces us to a point where we will be able to know precisely what is happening in the psychological thinking of consumers every time they are shopping. From a practical perspective, the study underlines the decisions' practical meaning of artificial intelligence-driven personalization in the digital experience. AI has become one of the crucial mediums for businesses to analyze customer data, preferences, and behavior to help create personalized content, recommendations, and offers. In addition to that, this study shows the vital role of orchestrating digital experiences filled with positive feelings and tight emotional connection with the memory. The area for the businessmen is getting their interfaces to look great and offering the users interactive elements and immersive storytelling to bring them closer emotionally and retain a memory.

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