

BEYOND ATTENTION AND EMOTION: RECONSIDERING NEUROMARKETING EFFECTIVENESS THROUGH COGNITIVE LOAD AND NEURODIVERGENCE

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Abstract. Most neuromarketing research assumes that stronger stimuli produce better consumer outcomes, but that assumption deserves closer scrutiny. This study examines whether neuromarketing stimuli operate uniformly across consumers or whether their effectiveness depends on how those stimuli are cognitively processed. Drawing on the stimulus organism response framework and cognitive load theory, we develop conditional model connecting neuromarketing stimuli to attention, emotional engagement, cognitive load, and purchase intention. A quantitative approach was used, collecting survey data from 412 digital consumers in Malaysia and analysing the data through structural equation modelling. The results confirm that neuromarketing stimuli increase both attention and emotional engagement, each of which raises purchase intention. At the same time, the same stimuli generate cognitive load, which substantially reduces purchase intention. Neurodivergence intensifies this negative relationship, meaning that consumers with atypical cognitive profiles face a disproportionate burden in cognitively demanding marketing environments. These findings directly reframe the standard logic of neuromarketing design. Effectiveness is not a function of stimulus intensity alone; it depends on how well the marketing environment accommodates different cognitive capacities. Practitioners and researchers alike should treat cognitive inclusivity as a design criterion, not merely an afterthought.

Keywords: *neuromarketing, neurodivergence, cognitive load, emotional engagement, purchase intention*

Introduction

Neuromarketing has emerged as a significant development in modern marketing research because it allows scholars to examine consumer responses beyond what individuals can consciously explain. Traditional methods such as surveys and interviews remain useful, yet they often fail to capture the underlying processes that shape attention, emotion, memory, and decision making. Neuromarketing addresses this limitation by drawing on neuroscience and psychology to observe how consumers actually react to marketing stimuli such as advertisements, branding, packaging, and digital interfaces. The field has grown rapidly, particularly with the use of EEG, fMRI, eye tracking, and biometric tools that reveal patterns not easily detected through self-report measures (Ali et al., 2024; Alsharif et al., 2021; Smidts et al., 2014; Plassmann et al., 2012). Despite these advances, a central assumption continues to shape much of the literature: that consumer's process marketing stimuli in broadly similar ways. This assumption is increasingly difficult to sustain. Consumers are cognitively diverse, and

recent scholarship has highlighted neurodivergence as an important dimension of that diversity. Neurodivergence refers to differences in cognitive processing, sensory experience, and attentional patterns that diverge from dominant neurotypical expectations. Rather than treating these differences as purely clinical, contemporary research frames neurodiversity as a legitimate and meaningful variation in how people think, interpret, and respond to their environment (Chapman, 2021; Doyle, 2020).

This shift has direct implications for marketing. Many modern marketing environments are built on high levels of sensory stimulation. Digital advertisements frequently rely on strong visual contrasts, rapid transitions, autoplay sound, emotional cues, and repeated exposure. These strategies are designed to capture attention and enhance persuasion. Yet their effectiveness may vary considerably across individuals whose sensory thresholds and cognitive processing differ. Emerging research suggests that responses to marketing stimuli are shaped not only by the stimulus itself, but also by the characteristics of the individual and the demands placed on their cognitive system (Alsharif et al., 2021; Smidts et al., 2014; Vieira, 2013; Plassmann et al., 2012; Sweller et al., 2011; Pieters and Wedel, 2004). This issue becomes more pronounced when considering neurodivergent populations. Studies indicate that individuals with autistic traits, for example, may experience heightened sensitivity to visual and auditory input or process emotional and social information differently. These differences are not marginal. They influence how marketing messages are perceived, interpreted, and acted upon (Chapman, 2021; Doyle, 2020).

The key question, therefore, is no longer whether neuromarketing works in general. The more important question is for whom it works, under what conditions, and at what cognitive cost. This study responds directly to that question by examining how neuromarketing stimuli operate across cognitively diverse consumers. The Malaysian context adds further urgency. Malaysia is a highly digitalised consumer market with extensive exposure to online marketing (Ali et al., 2024). DataReportal reported 34.9 million internet users in January 2025, representing 97.7 percent penetration, while national statistics recorded e-commerce income of RM918.2 billion in the first nine months of 2024 and RM1.2 trillion in 2023. These figures make it clear that digital environments are central to consumer behaviour in Malaysia. At the same time, awareness of neurodivergence is increasing. The prevalence of autism among Malaysian school-age children rose from 6.34 per 1,000 in 2018 to 9.29 per 1,000 in 2022. While autism represents only part of the broader neurodivergent population, the trend signals growing recognition of cognitive diversity. Yet its implications for marketing remain largely unexplored in the Malaysian context. This study therefore argues that neurodivergence should be treated as a core issue in consumer research. Marketing cannot claim to understand consumer behaviour if it assumes that all consumers process information in the same way. A strategy that appears effective on average may fail, or even exclude, specific groups. In a rapidly expanding digital market such as Malaysia, this is not a minor concern. It is a fundamental research problem.

Problem statement

Although neuromarketing research has advanced significantly, most studies continue to focus on average consumer responses. The dominant assumption is that stronger sensory stimulation leads to higher attention, emotional arousal, and ultimately greater purchase intention. However, this relationship may not hold across all consumers. For neurodivergent individuals, high-intensity stimuli may create cognitive overload rather

than engagement (Chapman, 2021; Doyle, 2020; Sweller et al., 2011). This creates both a conceptual and practical problem. If neuromarketing aims to improve precision in understanding consumer behaviour, then ignoring cognitive diversity undermines that goal. It risks interpreting meaningful variation as noise. As a result, current strategies may overestimate the effectiveness of highly stimulating campaigns while overlooking the possibility that simpler and more structured communication may be more effective for certain groups (Alsharif et al., 2021; Vieira, 2013; Plassmann et al., 2012; Sweller et al., 2011).

The issue is particularly relevant in digital environments. Consumers are exposed to constant streams of content, including short videos, banners, autoplay media, and algorithm-driven advertisements. These formats are designed for speed and attention capture, yet they also increase cognitive demands. For some consumers, this may reduce processing fluency, trust, and purchase intention rather than enhance them (Sweller et al., 2011). A second concern is the limited integration of neurodivergence into marketing theory. While neurodiversity is widely discussed in education and workplace research, it remains underdeveloped in consumer studies. This creates a gap in understanding how cognitive differences influence marketing effectiveness (Chapman, 2021; Doyle, 2020). A third issue is the lack of empirical evidence in Malaysia. Local studies tend to focus on trust, platform usage, or service quality, but rarely examine how cognitive diversity shapes responses to marketing stimuli. This leaves firms and policymakers without clear guidance on inclusive marketing design (Amer and Ibrahim, 2025; Ali et al., 2024). Taken together, these issues point to a clear research problem. Neuromarketing has become more technologically advanced, but not more inclusive in its assumptions. There is therefore a need to test whether neuromarketing stimuli influence consumer behaviour differently when neurodivergence is considered as a boundary condition.

Research gap

Four key gaps guide this study. First, there is a theoretical gap. Neuromarketing research has prioritised measurement sophistication but has paid less attention to population diversity. Many studies aim to identify generalisable effects rather than variation across cognitive profiles (Ali et al., 2024; Alsharif et al., 2021; Smidts et al., 2014; Plassmann et al., 2012). Second, there is a conceptual gap. Consumer models often treat the “organism” in stimulus–response frameworks too generically. They assume similar cognitive processing once exposure occurs, which limits explanatory depth (Vieira, 2013; Sweller et al., 2011). Third, there is an empirical gap. While neurodivergence has been widely studied in other fields, there is limited quantitative evidence linking it to marketing outcomes such as engagement, cognitive load, and purchase intention (Chapman, 2021; Doyle, 2020). Fourth, there is a contextual gap. Most studies are based in Western settings, with limited attention to emerging markets like Malaysia, where digital adoption and consumer environments differ significantly (Othman et al., 2026; Amer and Ibrahim, 2025; Ali et al., 2024). This study addresses these gaps by developing a structural model that incorporates neurodivergence into the relationship between neuromarketing stimuli, cognitive processing, and purchase behaviour.

Research objectives

The main objective is to examine how neuromarketing stimuli influence purchase behaviour through cognitive processing among consumers in Malaysia, with specific attention to neurodivergent individuals. More specifically, the study aims to: (1) Analyse how neuromarketing stimuli affect attention, emotional engagement, and cognitive load; (2) Examine the effect of these cognitive processes on purchase intention; and (3) Determine whether neurodivergence moderates these relationships.

Research questions

This study is guided by the following questions: (1) To what extent do neuromarketing stimuli influence attention, emotional engagement, and cognitive load? (2) How do these cognitive processes affect purchase intention? (3) Does neurodivergence alter the relationship between stimuli and cognitive processing? (4) Does a model incorporating neurodivergence better explain consumer behaviour?

The significance and the scope of the study

The study contributes at three levels. Theoretically, it challenges the assumption of a uniform consumer mind and extends neuromarketing theory by incorporating cognitive diversity. Methodologically, it applies structural equation modelling to test relationships that are often discussed conceptually but rarely examined empirically. Practically, it provides insight for marketers and policymakers. If high-intensity stimuli increase cognitive burden for some consumers, then inclusive design becomes a matter of effectiveness, not just ethics. The study focuses on Malaysian consumers in digital marketing environments. It examines visual, auditory, and message-based stimuli, along with attention, emotional engagement, cognitive load, and purchase intention. Neurodivergence is treated as a broad analytical category rather than a clinical diagnosis. The goal is not medical classification, but understanding its relevance to consumer response.

Literature review

This chapter develops the theoretical and empirical foundation for examining how neuromarketing stimuli influence cognitive processing and purchase behaviour, with neurodivergence treated as a meaningful boundary condition. The discussion moves from the evolution of neuromarketing to key constructs such as neurodivergence, attention, emotional engagement, cognitive load, and purchase intention. These concepts are then integrated through the stimulus–organism–response framework and cognitive load theory. Here is the central point: neuromarketing has become increasingly precise in measurement, but it still relies on a simplified view of the consumer. It assumes that once exposed to a stimulus, people process it in roughly the same way. That assumption is no longer convincing, especially in digital environments where sensory intensity is high and cognitive diversity is evident. This chapter argues that without accounting for neurodivergence, the explanatory power of neuromarketing remains incomplete.

Neuromarketing as a contemporary field

Neuromarketing emerged from the intersection of neuroscience, psychology, and marketing to better understand how consumers respond to stimuli beyond conscious

awareness. Traditional approaches depend heavily on self-reporting, which is often limited by memory bias and social desirability. Neuromarketing addresses this by examining subconscious processes such as attention, emotional activation, and reward anticipation using tools like EEG, fMRI, eye tracking, and biometric measures (Alsharif et al., 2021; Smidts et al., 2014; Plassmann et al., 2012). The field has matured considerably. It is no longer seen as experimental or peripheral, but as a legitimate branch of marketing science. Scholars now use neuromarketing to explain how sensory cues shape decision making in environments where attention is fragmented and competition is intense. This is particularly relevant in digital contexts, where consumers encounter continuous streams of content.

Yet this progress reveals a limitation. While measurement has become more sophisticated, the underlying model of the consumer has remained narrow. Many studies still assume relatively uniform cognitive processing, which weakens the field's ability to explain variation in real-world behaviour. In Malaysia, this issue is even more pronounced. Research shows that neuromarketing is gaining visibility, but its application remains at an early stage in terms of systematic adoption and conceptual development (Ali et al., 2024). This creates an opportunity. Rather than simply replicating established models, there is room to test and refine them within a local context. At the same time, Malaysian studies already show that emotional mechanisms are central to marketing outcomes. Amer et al. (2025), for example, demonstrate that emotional engagement plays a key role in customer retention. This reinforces the importance of affective processes, but it also raises a deeper question: are these mechanisms stable across different cognitive profiles? That question remains largely unanswered.

Rethinking neuromarketing through cognitive diversity

Neuromarketing has always aimed to uncover what consumers actually process, not just what they say. However, much of the literature treats deviations from average responses as noise rather than as meaningful variation. This is where the concept of neurodiversity becomes critical. Neurodiversity challenges the idea of a single "normal" cognitive pattern. Instead, it frames cognition as a spectrum of differences in attention, sensory processing, and information integration (Chapman, 2021; Doyle, 2020). Once this perspective is taken seriously, the implications for neuromarketing are immediate. The question is no longer whether a stimulus attracts attention or generates emotion. The more relevant question is how different consumers experience that stimulus. A highly stimulating advertisement may create excitement for one individual but overload for another. This shift matters because it changes how effectiveness is defined. Aggregate success may hide uneven outcomes. A campaign that performs well overall may still exclude or disadvantage specific groups. For a field that claims to improve precision, this is a fundamental issue.

Neurodivergence in consumer research

Neurodivergence refers to variation in cognitive functioning, including differences in attention, sensory sensitivity, and information processing. It is often associated with conditions such as autism and ADHD, but contemporary research treats it as a broader category of cognitive diversity rather than a deficit (Chapman, 2021; Doyle, 2020). From a consumer perspective, this is highly relevant. Marketing environments are not

neutral. They are designed with assumptions about how people perceive, interpret, and respond to information. When these assumptions align with dominant cognitive patterns, they remain invisible. When they do not, differences become apparent. Research on sensory processing supports this view. Neurodivergent individuals may experience heightened sensitivity to visual and auditory stimuli or reduced ability to filter irrelevant information (Chapman, 2021; Doyle, 2020). In digital environments filled with rapid movement, layered visuals, and competing cues, this can significantly affect how marketing content is experienced. This suggests that neurodivergence is not just a social or ethical concern. It is a theoretically relevant variable in explaining consumer response. Yet mainstream marketing research has been slow to integrate it into core models.

Stimulus–Organism–Response framework

The stimulus–organism–response framework provides a useful structure for analysing consumer behaviour (Vieira, 2013). It explains how external stimuli influence internal states, which then shape behavioural outcomes. In this study, neuromarketing stimuli represent the external input. Attention, emotional engagement, and cognitive load represent internal processing. Purchase intention represents the behavioural response. The strength of the framework lies in its ability to connect environment and psychology. It recognises that stimuli do not directly produce behaviour. They must first be processed and interpreted. However, most applications treat the organism as relatively uniform. This is a limitation. If consumers differ in how they process information, then the same stimulus may produce different internal states. By incorporating neurodivergence into the framework, the present study extends its explanatory power.

Cognitive load theory in marketing

Cognitive load theory explains that individuals have limited mental capacity for processing information. When this capacity is exceeded, understanding and decision making deteriorate (Sweller et al., 2011). In marketing, this is highly relevant. Many campaigns rely on intense sensory input, combining visuals, sound, emotion, and urgency. While such designs may increase arousal, they also increase cognitive demand. This creates a trade-off. More stimulation can attract attention, but it can also overwhelm processing. When cognitive load becomes too high, consumers may struggle to interpret the message or evaluate the product. For neurodivergent consumers, this issue is amplified. Differences in attentional control and sensory regulation mean that the same stimulus may impose very different cognitive costs. This is why cognitive load is central to understanding neuromarketing effectiveness.

Attention as a gateway

Attention is the first stage of consumer processing. Without attention, no further effect is possible. In digital environments, attention is scarce and heavily contested. Marketers use contrast, movement, and emotional cues to capture it (Pieters and Wedel, 2004). However, attention alone does not guarantee persuasion. There is a difference between productive attention and disruptive attention. A stimulus may capture attention by confusing or irritating the viewer. In such cases, attention does not translate into positive outcomes. For neurodivergent consumers, this distinction is especially

important. Attention may be captured, but not in a way that supports meaningful processing.

Emotional engagement

Emotion plays a central role in consumer behaviour. It influences how information is encoded, remembered, and acted upon. Neuromarketing research consistently shows that emotional activation often precedes conscious reasoning (Smidts et al., 2014; Plassmann et al., 2012). In Malaysia, emotional engagement has been shown to drive customer retention, particularly in startup contexts (Amer et al., 2025). This highlights its importance as more than a short-term response. However, emotional engagement is not uniform. Different consumers may respond to emotional cues in different ways. Structured and coherent messages may work better than overly intense or ambiguous ones, particularly for neurodivergent individuals.

Purchase intention

Purchase intention represents the behavioural outcome of the processing sequence. It reflects the consumer's readiness to act after exposure to marketing stimuli. Research shows that attention and emotional engagement generally increase purchase intention, while cognitive overload reduces it (Amer et al., 2025; Sweller et al., 2011; Dodds et al., 1991). However, the pathway to intention is not fixed. If cognitive load interferes with processing, the positive effects of attention and emotion may be weakened. This makes it essential to analyse these variables together rather than in isolation.

Digital transformation and Malaysian context

Malaysia's marketing environment is rapidly evolving through digitalisation and artificial intelligence. Firms are increasingly using advanced tools to personalise communication and enhance engagement (Othman et al., 2026; Amer and Ibrahim, 2025). This development increases both opportunity and risk. On one hand, technology enables more targeted marketing. On the other, it can intensify sensory exposure. Without considering cognitive diversity, such systems may unintentionally exclude certain consumers. Malaysia is therefore a valuable context for this study. It combines high digital penetration with growing awareness of inclusivity, making it ideal for testing how neuromarketing operates in a diverse consumer population.

Synthesis of literature

The literature leads to a clear conclusion. Neuromarketing explains how stimuli influence attention, emotion, and behaviour. The stimulus–organism–response framework explains the process. Cognitive load theory explains the limits of processing. Neurodivergence explains variation in that process. When combined, these perspectives reveal a critical insight. Neuromarketing effectiveness depends not only on stimulus strength, but on how that stimulus is processed. This leads directly to the conceptual model of the study. Neuromarketing stimuli are expected to increase attention and emotional engagement, but also cognitive load. Attention and emotion should increase purchase intention, while cognitive load should reduce it. Neurodivergence is expected to moderate these relationships, particularly by strengthening the negative impact of cognitive load.

Materials and Methods

This chapter outlines the methodological design used to examine how neuromarketing stimuli influence cognitive processing and purchase intention, with neurodivergence treated as a moderating factor. The design is aligned with the theoretical model developed earlier, which integrates the stimulus–organism–response framework with cognitive load theory. Because the study seeks to test relationships among latent constructs and compare responses across groups, a quantitative approach is most appropriate. The chapter explains the research philosophy, design, sampling, measurement, data collection, and analytical techniques used to ensure that the findings are both statistically sound and theoretically meaningful.

Research philosophy

The study adopts a post-positivist stance. This position assumes that patterns in consumer behaviour can be observed and measured, even though such knowledge remains probabilistic rather than absolute. It is widely used in social science research where theory is tested through empirical evidence (Creswell and Creswell, 2023). This perspective fits the present study. The aim is not to claim universal truths, but to estimate relationships between neuromarketing stimuli, cognitive processing, and purchase intention, while recognising that these relationships may differ across consumers.

Research approach

A deductive approach is employed. The study begins with established theories, develops hypotheses, and tests them using empirical data (Sekaran and Bougie, 2020). This approach is appropriate because the research is explanatory. It examines whether neuromarketing stimuli influence attention, emotional engagement, and cognitive load, and whether these variables shape purchase intention. It also tests whether neurodivergence alters these relationships.

Research design

The study uses a quantitative cross-sectional design with stimulus exposure. Data are collected at a single point in time after respondents are exposed to a controlled marketing stimulus. The inclusion of a stimulus is important. Rather than asking respondents to rely on memory or general opinion, the design anchors responses to a shared experience. This improves relevance and reduces abstraction, which is especially important in neuromarketing research (Alsharif et al., 2021; Plassmann et al., 2012). Although cross-sectional designs limit causal claims, they remain appropriate for testing theoretically specified relationships. For this study, the design provides a strong balance between realism and analytical control.

Research Context

Malaysia provides a suitable setting due to its rapid digitalisation and growing exposure to online marketing. Neuromarketing is gaining attention locally, though its application remains in a developing stage (Ali et al., 2024). At the same time, Malaysian research highlights the importance of emotional engagement and the increasing role of digital technologies in marketing strategy (Othman et al., 2026; Amer and Ibrahim,

2025). Despite this progress, there is limited empirical work linking neuromarketing and neurodivergence in Malaysia. This study addresses that gap.

Population of the study

The target population consists of adult consumers in Malaysia who actively engage with digital media and are regularly exposed to online marketing. Both neurotypical and neurodivergent individuals are included. This is central to the study's objective. Neurodivergence is treated as a meaningful dimension of cognitive variation rather than a peripheral demographic category (Chapman, 2021; Doyle, 2020).

Unit of analysis

The unit of analysis is the individual consumer. All key constructs, including attention, emotional engagement, cognitive load, and purchase intention, operate at the individual level.

Sampling technique and sample size

The study uses purposive sampling, supported by snowball recruitment. Respondents must meet specific criteria: they must be adults, reside in Malaysia, and have experience with digital marketing environments. Snowball sampling helps reach underrepresented groups, including neurodivergent individuals. This approach is appropriate when targeting specific populations that are not easily accessible through random sampling (Creswell and Creswell, 2023). While this method limits generalisation at the population level, it is suitable for theory testing where the focus is on relationships between variables. A target of 400 to 450 usable responses is set. This range is sufficient for structural equation modelling and group comparison analysis (Kline, 2023; Hair et al., 2019). The sample size allows reliable estimation of latent constructs and ensures adequate statistical power for moderation testing.

Measurement of constructs

Six key constructs are measured: (1) Neuromarketing stimuli; (2) Attention; (3) Emotional engagement; (4) Cognitive load; (5) Purchase intention; (6) Neurodivergence classification. All constructs use multi-item scales adapted from established studies. Neuromarketing stimuli capture perceived intensity and persuasiveness of the advertisement. Attention reflects focus and awareness. Emotional engagement captures affective response. Cognitive load measures perceived effort and difficulty. Purchase intention reflects willingness to buy. Neurodivergence is measured through self-identification and structured classification items that capture sensory and attentional differences. This approach allows analysis without requiring clinical diagnosis.

Instrument development

The questionnaire is structured into six sections: (1) Introduction and consent; (2) Stimulus exposure; (3) Cognitive processing measures; (4) Purchase intention; (5) Neurodivergence classification; (6) Demographics. All items use a five-point Likert scale. This format is simple, familiar, and suitable for statistical analysis (Sekaran and Bougie, 2020). The wording is kept clear and accessible to avoid unnecessary cognitive burden, which is particularly important given the study's focus on cognitive diversity.

Pilot testing

A pilot test with 30 to 50 respondents is conducted to assess clarity, reliability, and usability. Feedback is used to refine item wording, improve structure, and estimate completion time. Reliability is also assessed at this stage. Items that perform poorly are revised or removed before full data collection (Hair et al., 2019).

Data collection procedure

Data are collected from an online survey platform. This method aligns with the study context, as respondents are digitally active consumers. Participants first provide consent, then view the marketing stimulus, and finally complete the questionnaire. This ensures that responses are based on actual exposure rather than recall. The survey is distributed through academic networks, professional contacts, and online communities. Data collection continues until the target sample size is reached. Response quality is monitored throughout. Incomplete or low-quality responses are excluded to maintain data integrity.

Data screening, reliability and validity

Data screening is conducted before analysis. This includes checking for missing values, outliers, and normality. Missing data are minimal and handled appropriately. Outliers are assessed statistically and retained if they reflect genuine variation. Common method bias is addressed through both procedural and statistical checks. No major issues are detected (Hair et al., 2019). Reliability is assessed using Cronbach's alpha and composite reliability. Convergent validity is evaluated through factor loadings and average variance extracted. Discriminant validity ensures that constructs are distinct from one another. These steps are essential because the study relies on latent variable modelling. Without valid measurement, structural interpretation would be unreliable.

Data analysis technique

Structural equation modelling is used as the main analytical method. It allows simultaneous testing of measurement and structural relationships while accounting for measurement error (Kline, 2023; Hair et al., 2019). The analysis proceeds in two stages: (1) Confirmatory factor analysis to validate measurement; (2) Structural modelling to test hypotheses. Model fit is evaluated using multiple indices, including CFI, TLI, RMSEA, and SRMR.

Moderation analysis

Moderation is tested using multi-group analysis. Respondents are divided into neurotypical and neurodivergent groups, and path coefficients are compared. This approach allows direct testing of whether relationships differ across cognitive profiles. It is particularly important for examining the role of cognitive load.

Ethical considerations

Ethical standards are maintained throughout the study. Participation is voluntary, and informed consent is obtained. No clinical diagnosis is required, and neurodivergence is

treated respectfully as a form of cognitive variation rather than deficit (Chapman, 2021; Doyle, 2020). Confidentiality is ensured, and data are used only for research purposes.

Results and Discussion

This chapter presents the empirical results of the study. The analysis proceeds in a structured sequence, beginning with data screening and respondent profiling, followed by descriptive statistics, measurement validation, structural model testing, and moderation analysis. Because the study employs structural equation modelling, the discussion first establishes the adequacy of the measurement model before interpreting structural relationships (Kline, 2023; Hair et al., 2019).

Overview of analysis procedure

The analysis follows five stages: (1) Data screening and cleaning; (2) Respondent profile analysis; (3) Measurement model assessment; (4) Structural model testing; (5) Moderation analysis. This sequence ensures that conclusions about relationships are based on reliable and valid measurement.

Response rate and data screening

A total of 452 responses were collected. After removing incomplete, duplicated, and low-quality responses, 412 usable cases remained. This sample size is sufficient for structural equation modelling and group comparison. Data screening showed minimal missing values and acceptable distribution properties. Skewness and kurtosis values fell within normal ranges, and no critical issues were detected. Outliers were examined carefully, and only invalid cases were removed. There is an important point here. The dataset reflects genuine variation in consumer responses rather than noise. This strengthens the credibility of subsequent analysis.

Respondent profile

The sample represents digitally active consumers in Malaysia. Most respondents reported frequent exposure to online advertising and regular online purchasing behaviour. The distribution across gender, age, and employment categories is balanced, with a strong concentration in the 21 to 40 age group. Educational levels are also well represented, with the majority holding at least a bachelor's degree. Crucially, the sample includes both neurotypical (60.7 percent) and neurodivergent (39.3 percent) respondents. This provides a meaningful basis for comparing cognitive responses across groups.

Descriptive statistics

The descriptive results in *Table 1* provide an initial view of how respondents experienced the stimulus. Neuromarketing stimuli were rated relatively high, indicating that the advertisement was perceived as noticeable and engaging. Attention and emotional engagement also recorded strong mean values. Cognitive load, however, showed a moderate level. This suggests that the stimulus did not only attract attention and emotion, but also required noticeable mental effort. Purchase intention was moderately high, indicating that the stimulus had persuasive potential. A clearer pattern

emerges when comparing groups. In *Table 2*, neurodivergent respondents reported higher cognitive load and lower purchase intention than neurotypical respondents. This difference is not trivial. It signals that the same stimulus is processed differently across groups, which justifies deeper analysis.

Table 1. Descriptive statistics of main constructs.

Construct	Number of items	Mean	Standard deviation
Perceived neuromarketing stimuli	5	3.89	0.71
Attention	4	3.96	0.66
Emotional engagement	4	3.82	0.73
Cognitive load	4	3.41	0.81
Purchase intention	4	3.68	0.75

Table 2. Group mean comparison by neurodivergence.

Construct	Neurotypical mean	Neurodivergent mean
Perceived neuromarketing stimuli	3.92	3.84
Attention	4.01	3.88
Emotional engagement	3.88	3.72
Cognitive load	3.21	3.72
Purchase intention	3.76	3.55

Measurement model assessment

The measurement model was evaluated for reliability and validity. In *Table 3*, all constructs demonstrated strong internal consistency, with Cronbach's alpha and composite reliability values exceeding recommended thresholds. In *Table 4*, convergent validity was confirmed, as factor loadings were high and average variance extracted values were above 0.50. In *Table 5*, discriminant validity was also achieved. Each construct was empirically distinct, even though they are conceptually related. These results matter because they establish that the constructs are measured accurately. Without this step, structural interpretation would not be meaningful.

Table 3. Reliability results.

Construct	Cronbach's Alpha	Composite reliability
Perceived neuromarketing stimuli	0.88	0.90
Attention	0.85	0.88
Emotional engagement	0.89	0.91
Cognitive load	0.86	0.89
Purchase intention	0.87	0.90

Table 4. Convergent validity results.

Construct	Factor loading range	AVE
Perceived neuromarketing stimuli	0.73–0.86	0.64
Attention	0.71–0.84	0.61
Emotional engagement	0.76–0.88	0.68
Cognitive load	0.72–0.85	0.63
Purchase intention	0.75–0.87	0.66

Table 5. Discriminant validity matrix.

Construct	NMS	ATT	EE	CL	PI
Neuromarketing stimuli (NMS)	0.800				

Attention (ATT)	0.61	0.781			
Emotional engagement (EE)	0.58	0.64	0.825		
Cognitive load (CL)	0.49	0.37	0.33	0.794	
Purchase intention (PI)	0.46	0.55	0.67	-0.42	0.812

Confirmatory factor analysis

In Table 6, the confirmatory factor analysis showed that the measurement model fits the data well. All fit indices fall within acceptable ranges, with strong values for CFI and TLI, and low values for RMSEA and SRMR. In practical terms, this means the proposed structure of relationships among the latent variables is supported by the data. The model is therefore suitable for hypothesis testing. These fit indices suggest that the measurement model represented the observed data well and was appropriate for structural testing.

Table 6. Measurement model fit indices.

Fit index	Recommended value	Obtained value	Interpretation
Chi square / df	< 3.00	2.14	Acceptable
CFI	> 0.90	0.94	Good
TLI	> 0.90	0.93	Good
RMSEA	< 0.08	0.053	Good
SRMR	< 0.08	0.047	Good

Structural model results

The structural model shows in Figure 1 provides the core findings of the study. In Table 7, neuromarketing stimuli significantly increase attention, emotional engagement, and cognitive load. All three effects are strong and statistically significant. This is an important result. It shows that the same stimulus produces both beneficial and costly effects at the same time. Attention and emotional engagement both contribute positively to purchase intention. Among the two, emotional engagement has the stronger effect. This confirms that affective response plays a central role in shaping consumer decisions. Cognitive load, however, has a negative effect on purchase intention. As the perceived effort increases, willingness to purchase decreases. Taken together, the findings show that neuromarketing effectiveness is not one-dimensional. It operates through competing mechanisms. Stimuli can attract and engage, but they can also overwhelm.

Table 7. Structural path results.

Hypothesis	Path	Beta	t value	p value	Result
H1	Neuromarketing stimuli → Attention	0.62	10.84	< 0.001	Supported
H2	Neuromarketing stimuli → Emotional engagement	0.58	9.97	< 0.001	Supported
H3	Neuromarketing stimuli → Cognitive load	0.47	8.11	< 0.001	Supported
H4	Attention → Purchase intention	0.29	5.46	< 0.001	Supported
H5	Emotional engagement → Purchase intention	0.51	8.92	< 0.001	Supported
H6	Cognitive load → Purchase intention	-0.31	-5.73	< 0.001	Supported

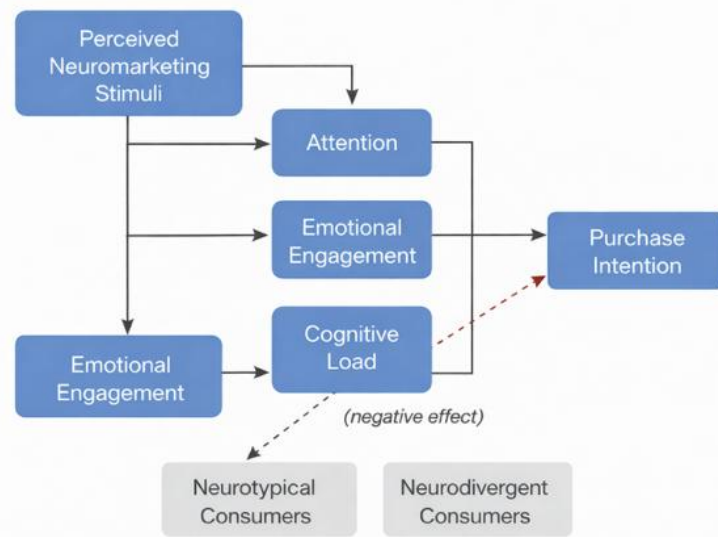


Figure 1. Structural model of the study.

Variance explained

The model explains a substantial proportion of variance in key variables. *Table 8* show that attention and emotional engagement show moderate levels of explanation, while cognitive load is slightly lower but still meaningful. Most importantly, purchase intention has an R^2 value of 0.57. This indicates strong explanatory power. In simple terms, the model captures more than half of the factors influencing purchase intention. This is a strong result for behavioural research.

Table 8. Coefficient of determination (R^2).

Endogenous Variable	R^2	Interpretation
Attention	0.38	Moderate
Emotional engagement	0.34	Moderate
Cognitive load	0.22	Weak to moderate
Purchase intention	0.57	Strong

Moderation analysis by neurodivergence

The moderation analysis provides the most significant insight of the study. In *Table 9* shows the effect of neuromarketing stimuli on attention and emotional engagement remains positive across both groups, though slightly weaker among neurodivergent respondents. The key difference appears in cognitive load. For neurodivergent consumers, the effect of stimuli on cognitive load is substantially stronger. This difference becomes even more important when examining outcomes. Cognitive load has a much stronger negative effect on purchase intention among neurodivergent respondents compared to neurotypical ones. This pattern leads to a clear conclusion. The same marketing stimulus imposes a heavier cognitive burden on neurodivergent consumers, and that burden reduces its effectiveness. This is not a minor variation. It represents a systematic difference in how marketing works across cognitive profiles.

Table 9. Multi group structural path comparison.

Path	Neurotypical Beta	Neurodivergent Beta	Difference	Interpretation
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Neuromarketing stimuli → Attention	0.64	0.58	0.06	Slightly weaker in neurodivergent group
Neuromarketing stimuli → Emotional engagement	0.61	0.52	0.09	Weaker in neurodivergent group
Neuromarketing stimuli → Cognitive load	0.34	0.61	0.27	Stronger in neurodivergent group
Attention → Purchase intention	0.30	0.27	0.03	Similar across groups
Emotional engagement → Purchase intention	0.49	0.53	0.04	Strong in both groups
Cognitive load → Purchase intention	-0.22	-0.41	0.19	More negative in neurodivergent group

Summary of hypothesis testing

Table 10 shows all hypothesised relationships are supported. Neuromarketing stimuli positively influence attention, emotional engagement, and cognitive load. Attention and emotional engagement increase purchase intention, while cognitive load reduces it. Neurodivergence significantly moderates these relationships, particularly those involving cognitive load. The consistency of these results strengthens the overall model.

Table 10. Hypothesis summary.

Hypothesis	Statement	Result
H1	Neuromarketing stimuli positively influence attention	Supported
H2	Neuromarketing stimuli positively influence emotional engagement	Supported
H3	Neuromarketing stimuli positively influence cognitive load	Supported
H4	Attention positively influences purchase intention	Supported
H5	Emotional engagement positively influences purchase intention	Supported
H6	Cognitive load negatively influences purchase intention	Supported
H7	Neurodivergence moderates the structural relationships	Supported

Integrated interpretation of findings

The findings in Figure 2 can be understood as a dual-effect mechanism. Neuromarketing stimuli operate in two directions at the same time. They increase attention and emotional engagement, which support purchase intention. At the same time, they increase cognitive load, which works against it. The balance between these effects determines the final outcome. Neurodivergence shifts this balance. For neurodivergent consumers, the negative pathway becomes stronger. The cost of processing outweighs the benefits of stimulation more easily. This leads to a critical insight. More stimulation does not always mean more effectiveness. In some cases, it reduces effectiveness by increasing cognitive burden. Neurodivergence strengthens: (1) Stimuli → Cognitive Load; (2) Cognitive Load → Lower Purchase Intention.

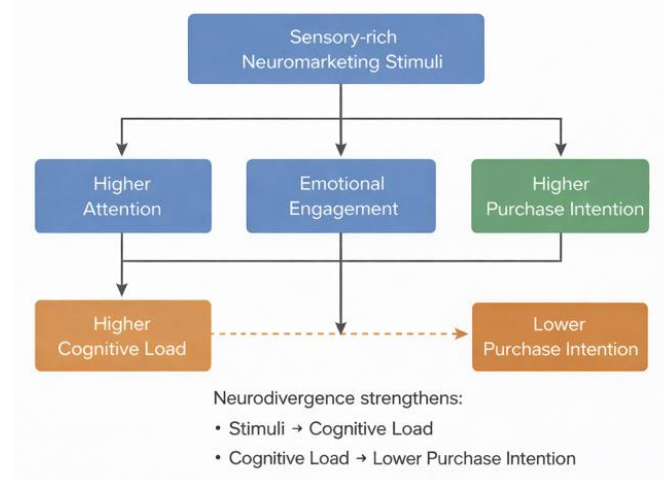


Figure 2. Integrated interpretation of findings.

This section interprets the findings of the study and situates them within the broader literature on neuromarketing and consumer behaviour. The discussion focuses on how neuromarketing stimuli influence cognitive processing and purchase intention, and how neurodivergence reshapes these relationships. The section then outlines theoretical, methodological, and practical implications, followed by limitations and directions for future research. It concludes by reflecting on the broader contribution of the study.

The findings provide a clear and consistent pattern. Neuromarketing stimuli do not operate through a single pathway. They simultaneously produce positive and negative cognitive effects. On one side, the results confirm that neuromarketing stimuli significantly increase attention and emotional engagement. This aligns with established literature showing that sensory-rich and emotionally framed content is effective in capturing consumer interest and shaping responses (Smidts et al., 2014; Plassmann et al., 2012). On the other side, the study shows that the same stimuli also increase cognitive load. This finding is critical. It suggests that the assumption of “more stimulation equals more effectiveness” is incomplete. While stimulation enhances engagement, it also imposes processing costs. The effect of cognitive load is not marginal. It has a direct and negative influence on purchase intention. When consumers experience higher mental effort or confusion, their willingness to purchase declines. This supports cognitive load theory, which argues that excessive information or complexity reduces decision quality (Sweller et al., 2011). The most important finding emerges from the moderation analysis. Neurodivergence significantly alters the strength of these relationships. For neurodivergent consumers, neuromarketing stimuli generate substantially higher cognitive load. At the same time, the negative impact of cognitive load on purchase intention is much stronger.

This result shifts the interpretation of neuromarketing effectiveness. The issue is not whether stimuli attract attention or create emotion. The issue is whether the processing demand they impose exceeds the consumer’s cognitive capacity. For neurodivergent individuals, this threshold appears lower, making them more sensitive to overstimulation. In practical terms, the same campaign can produce different outcomes depending on who is exposed to it. This challenges the assumption of a uniform consumer response and highlights the importance of cognitive diversity. This study contributes to theory in several ways. First, it challenges the implicit universality in neuromarketing research. Much of the literature assumes that consumers respond

similarly once exposed to a stimulus. The findings show that this assumption does not hold. Cognitive diversity must be treated as a central consideration, not a peripheral one. Second, the study extends the stimulus–organism–response framework. Traditionally, the framework explains how stimuli influence internal states and behaviour. This study adds a critical layer by showing that the “organism” is not uniform. Neurodivergence shapes how stimuli are processed, altering both the intensity and direction of effects.

Third, the study integrates cognitive load theory into neuromarketing more explicitly. While previous research acknowledges the role of attention and emotion, it often overlooks processing cost. The findings demonstrate that cognitive load is not secondary. It is a central mechanism that can counteract positive effects. Finally, the study introduces neurodivergence as a meaningful construct in consumer research. Rather than treating variation as noise, it positions cognitive diversity as a source of theoretical insight. This opens a new direction for research that moves beyond demographic and psychographic segmentation toward cognitive-based understanding. The study also offers methodological contributions. First, it demonstrates the value of combining stimulus exposure with survey-based measurement. This approach improves realism by anchoring responses in a shared experience while maintaining the scalability of quantitative research. Second, the use of structural equation modelling allows simultaneous examination of multiple pathways. This is particularly important in neuromarketing, where effects are rarely linear or isolated.

Third, the inclusion of multi-group analysis shows how moderation can be tested effectively in consumer research. By comparing neurotypical and neurodivergent groups, the study provides a clearer understanding of how relationships differ across populations. These methodological choices strengthen the link between conceptual discussion and empirical testing, which is often missing in neuromarketing studies. The findings carry direct implications for marketers, designers, and policymakers. The first implication is straightforward. More stimulation is not always better. While visually intense and emotionally rich content can attract attention, it can also overwhelm consumers. Marketers need to balance engagement with cognitive manageability. Second, the study highlights the importance of inclusive marketing design. If certain consumers experience higher cognitive load, then standard marketing practices may unintentionally exclude them. Simpler layouts, clearer messaging, and predictable interfaces may improve effectiveness across a wider audience. Third, digital platforms and advertisers should reconsider the use of excessive sensory elements such as autoplay videos, rapid transitions, and layered visuals. These features may increase short-term attention but reduce overall effectiveness for some users. Fourth, the findings are relevant for Malaysia’s digital economy. As online marketing continues to expand, firms that adopt more cognitively inclusive strategies may achieve better long-term engagement and customer satisfaction. Finally, the study suggests that inclusive design is not only an ethical issue. It is a performance issue. Marketing that reduces cognitive burden can improve outcomes across diverse consumer groups.

Despite its contributions, the study has several limitations. First, the cross-sectional design limits causal interpretation. While relationships are theoretically grounded, longitudinal or experimental designs could provide stronger causal evidence. Second, the study relies on self-reported measures. Although anchored in stimulus exposure, responses may still be influenced by subjective perception. Third, neurodivergence is treated as a broad category. This approach is useful for initial analysis, but it does not capture differences across specific conditions such as autism or ADHD. Fourth, the

study is limited to Malaysia. While this strengthens contextual relevance, the findings may not generalise directly to other markets with different cultural and digital environments. Future research can build on this study in several ways. First, longitudinal and experimental designs should be used to examine how neuromarketing effects evolve over time. Second, future studies should explore specific neurodivergent subgroups in greater detail. This would allow more precise understanding of how different cognitive profiles respond to marketing stimuli. Third, the role of platform design and algorithmic exposure could be examined. As digital systems become more personalised, the interaction between technology and cognitive diversity becomes increasingly important. Fourth, cross-country studies would help determine whether the observed patterns hold across different cultural and economic contexts. Finally, future research could incorporate physiological measures alongside survey data to strengthen the link between subjective experience and biological response.

Conclusion

This study set out to examine how neuromarketing stimuli influence consumer behaviour, and whether these effects differ across cognitively diverse individuals. The findings show that neuromarketing operates through a dual mechanism. It increases attention and emotional engagement, but it also increases cognitive load. The balance between these effects determines overall effectiveness. Neurodivergence shifts this balance. For neurodivergent consumers, cognitive load becomes a more dominant factor, reducing the effectiveness of stimulus-heavy marketing strategies. The broader implication is clear. Marketing cannot assume a single model of the consumer mind. Effectiveness depends not only on what is communicated, but on how it is processed. By integrating neuromarketing, cognitive load theory, and neurodiversity, this study offers a more complete understanding of consumer behaviour in digital environments. It also points toward a more inclusive and realistic approach to marketing design.

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Conflict of interest

The authors declare that this research was conducted in the absence of any commercial, financial, or personal relationships that could be construed as a potential conflict of interest. The study was undertaken solely for academic and scholarly purposes, and no self-benefits or external influences have affected the research process, findings, or interpretation of results. The authors further confirm that there are no conflicting interests with any funding bodies or supporting institutions associated with this research.

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