

RESEARCH ARTICLE

The role of attention span in neuromarketing: A social psychological exploration of multi-sensory engagement among generation Z

Sharareh Shahidi Hamedani¹, Liew Cheng Siang¹, Moyyed Abbas Bashir Elnewiri¹, Ghazaleh Babanejaddehaki², Sarfraz Aslam^{3*}

¹ Faculty of Business, UNITAR International University, Petaling Jaya, 47301, Malaysia

² Department of Computer Science and Engineering, York University, Canada

³ Faculty of Education and Humanities, UNITAR International University, Petaling Jaya, 47301, Malaysia

* Corresponding author: Sarfraz Aslam, Sarfraz.aslam@unitar.my

ABSTRACT

Social psychological factors affect neuromarketing engagement, especially among Generation Z. These factors include peer influence, group identity, and social norms. In a digital environment, Generation Z's content is constantly filtered by social networks, likes, shares, and trends. This study examines how Generation Z perceives neuromarketing stimuli on visual, auditory, sensory, and emotional levels and the moderating effect of attention span on these perceptions. A quantitative method was used to conduct a cross-sectional survey of 460 Gen Z individuals as part of the study. The results indicate that visual and sensory stimuli significantly improve customer engagement. Emotional and auditory stimuli have limited effects. Since Gen Z has shorter attention spans, sensory stimuli have only a marginal impact on them. This suggests that neuromarketing strategies targeting Generation Z should prioritize visual and sensory elements while considering their limited attention spans. Tailoring content to align with social norms and peer influence can enhance engagement.

Keywords: Attention Span; digital marketing; Generation Z; customer engagement; neuromarketing; social psychology

1. Introduction

Neuromarketing engagement among Generation Z (Gen Z) is influenced by social psychological factors such as peer influence, group identity, and social norms, which affect their decisions and attitudes^[1]. Social networks constantly filter digital content, likes, shares, trends, and perceived authenticity^[2]. Multi-sensory marketing stimuli and the social signals accompanying them provide a cognitive trigger, influencing the interpretation of and response to marketing messages that integrate multiple senses^[3].

Peer influence can affect attention span both cognitively and socially in this context. Marketers need to understand consumers' behavior to target them and engage them effectively in the marketing process. Innovative approaches play a crucial role in transforming global markets as innovation progresses. A dynamic shift in marketing is reflected in neuromarketing^[4,5].

An interdisciplinary bridge between neuroscience and marketing, neuromarketing combines non-

ARTICLE INFO

Received: 20 May 2025 | Accepted: 5 June 2025 | Available online: 15 June 2025

CITATION

Hamedani SS, Elnewiri BMA, Babanejaddehaki G, et al. The role of attention span in neuromarketing: A social psychological exploration of multi-sensory engagement among generation Z. *Environment and Social Psychology*. 2025; 10(6): 3731. doi:10.59429/esp.v10i6.3731

COPYRIGHT

Copyright © 2025 by author(s). *Environment and Social Psychology* is published by Arts and Science Press Pte. Ltd. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<https://creativecommons.org/licenses/by/4.0/>), permitting distribution and reproduction in any medium, provided the original work is cited.

invasive brain-computer interface technology with marketing research to transform marketing^[6,7]. Consumers' decision-making processes and the brain regions associated with these processes are investigated in neuromarketing^[8]. A further focus of neuromarketing is determining which emotions are significant in shaping people's decisions^[4]. Consumer behavior can be understood better by incorporating neuroscience principles into marketing strategies. Digitally native Gen Z is characterized by a fast-changing attention span and unique engagement patterns, making it especially relevant^[9,10].

Gen Z consumers exhibit unique behaviors and are heavily reliant on the Internet, accessing social networks to find news, entertainment, and communication^[11]. They often ignore traditional brand marketing due to their multitasking abilities and simultaneous media consumption^[12].

Marketers face both positive and adverse situations due to Gen Z's increasing desire for instantaneous experiences^[10]. Compared with previous generations, Gen Z has a shorter attention span^[13]. The average attention span of Gen Z is around eight seconds, according to research by Microsoft^[14]. A successful marketing strategy for this generation must be able to spark and sustain meaningful interest immediately^[15].

Multitasking across multiple screens and a hyper-connected digital environment may contribute to their short attention spans. The attention span of Gen Z is challenging, especially when using traditional advertising methods. To effectively engage Gen Z, marketers must use visual, auditory, and sensory stimuli that capture their attention instantly^[15]. Marketers need to develop innovative marketing techniques to capture and hold their attention.

In this study, we examine the effect of neuromarketing stimuli on Gen Z customer engagement and how low attention spans moderate this effect. Our research seeks strategic insights into how neuromarketing can improve customer engagement when aligned with Gen Z behaviors. Furthermore, examining attention span's moderating role offers theoretical and practical insights into consumer neuroscience and digital marketing.

2. Literature Review

2.1. Gen Z's digital behaviour

The Generation Z group comprises people born between 1997 and 2012, shaped by fast-moving, interactive media in this era^[16]. Traditional advertising fails to reach Gen Zers due to their short attention spans and multitasking across digital platforms^[17]. Multi-sensory, fast-paced, visually engaging content is the key to capturing their attention. Neuromarketing allows consumers to experience visual, auditory, emotional, and sensory stimuli, strengthening their emotional bonds to products^[6]. Colorful visuals, animations, and personalized content are most effective with Gen Z. Brain stimulation improves decision-making and memory retention while activating the reward system^[18].

2.2. Neuromarketing and neuromarketing techniques

A neuromarketing strategy, which uses neuroscience and advertising, develops more innovative advertising campaigns to understand consumer behavior^[19]. Neuromarketing aims to create more powerful advertising campaigns by analyzing brain responses to advertisements, unlike traditional market research that relies solely on self-reported surveys and focus groups^[20]. Based on how these nervous system reactions are analyzed, marketers gain deeper insights into buyer preferences and understand in a deeper, more inconspicuous way how consumers react to the products, advertisements, and brands^[21].

The most widely used neuromarketing techniques are electroencephalogram (EEG), functional magnetic resonance imaging (fMRI), eye tracking, and biometric feedback measurements^[6]. In this case, EEG and fMRI are used to monitor consumer brain activity related to exposure to marketing materials and eye

tracking records where consumers direct their gaze while responding to advertisements or products [19]. Marketers can use these techniques to refine their messaging based on what the brain is responding to. For example, EEG has been reported to record immediate emotional responses to stimuli and to indicate how emotional reactions that ensue after visual or auditory elements generate the decision-making processes[22].

Neuromarketing leans heavily on visual stimuli as they directly command the brain's visual processing systems. Color, imagery, motion, composition, and contrast greatly influence consumers' perception and behavior. Images, bright colors, and compelling motion, all of which have been shown to produce positive emotional responses and promote the memory of marketing messages, have become the norm[23].

Another crucial dimension of neuromarketing is auditory stimuli since the brain's sound processing occurs within 20 milliseconds, which is considerably shorter than visual processing and proceeds rapidly in the brain. Music, jingles, sound effects, and voiceovers can trigger emotional states, help maintain brand associations, and boost customer engagement[24]. Intel's four-note signature sonic logo powerfully showcases how auditory stimuli can help identify brands. This short sound signature has become a recognizable audio brand identifier[25].

Emotions are very important drivers in the process of consumer behavior and decision-making. Emotionally biased advertising appeals to a consumer on an affective level and can compel a buyer to make a purchasing decision. Emotional brand content improves brand recall, increasing loyalty and customer satisfaction[26]. Some parts of the brain, like the limbic system, which helps to process emotions, are inextricably connected to memory formation and decision-making circuits. This makes emotional brand engagement one of the most powerful tools marketers have for developing lasting brand impressions[27].

A sensory marketing strategy involves using multiple senses to create an immersive brand experience and enhance memory retention. Stimuli beyond the visual and auditory can significantly influence consumer perception and behavior. It has been demonstrated that haptic feedback, including vibrations or tactile feedback on mobile applications, can lead to 20% higher emotional engagement [28]. Businesses in physical retail environments that target Generation Z have already used multi-sensory marketing strategies. It has been shown that incorporating ambient aromas (e.g., floral or fresh scents in fashion retailers) in conjunction with various combinations of textural elements (e.g., soft-touch materials in product displays) can greatly increase customer engagement, dwell, etc.[29].

2.3. Attention span and its impact on consumer engagement

Studies have shown that Gen Z's digital upbringing has significantly reduced attention spans, which are often reported to average only eight seconds[30]. Due to their tendency to multitask and attend to multiple media simultaneously, they have a reduced attention span, leading to fragmented attention[31]. As a result, traditional marketing strategies, which often rely on long-form content, have proven ineffective in capturing and retaining the attention of this generation[32]. To engage Gen Z effectively, marketers must create short, impactful, and visually appealing content that quickly captures their attention before it shifts elsewhere[6]. By understanding the relationship between attention span and the stimuli that generate the most engagement, marketers can optimize their campaigns to appeal to Gen Z's cognitive and emotional processing preferences, ensuring that content remains engaging and relevant[33].

Brand authenticity is a key element in attracting Generation Z consumers, as they actively seek brands aligned with their values. Unlike previous generations, Gen Z is discerning in what it considers authentic. Associated with and interested in avoiding brands that seem too commercial or insincere, people prefer those that talk to them and their values and social identities[18]. How can brands understand the influence on consumer engagement based on how authentic the brand is and how it can sell it? Emotional and sensory

cues, when paired with consumers' values, emotional and sensory cues create a strong and particularly powerful emotional connection, thus a powerful connective emotional connection towards things that create brand loyalty and consumer behavior^[34].

The increasing reliance on neuromarketing techniques to enhance consumer engagement has prompted numerous studies on the impact of sensory and emotional stimuli on consumer behavior. However, significant gaps remain in understanding how these techniques impact Gen Z, especially considering their distinct digital behaviors and notably shorter attention spans than previous generations^[35]. While prior research has addressed the role of auditory, visual, mobile, and emotional stimuli in influencing customer participation, there is a lack of studies exploring how these neuromarketing strategies can be fine-tuned to suit Gen Z, particularly under the moderating effect of their attention span^[15].

2.4. Conceptual framework

Neuromarketing stimuli - visual, auditory, sensory, and emotional - are positioned as external factors influencing customer engagement with the S-O-R model (Figure 1). A moderator of engagement is attention span, especially for Generation Z, whose short attention span reduces their effectiveness. The framework addresses a gap in the literature, where sensory marketing strategies often overlook the cognitive limitations of Gen Z, such as reduced attention span ^[36]. In the present study, attention span was incorporated as a moderator, which addresses a gap in the research literature and indicates that sensory marketing strategies often ignore cognitive limitations ^[36]. This framework can be used in practice to design campaigns that are more effective and attention-attracting while also considering the expectations and digital behaviors of Gen Z.

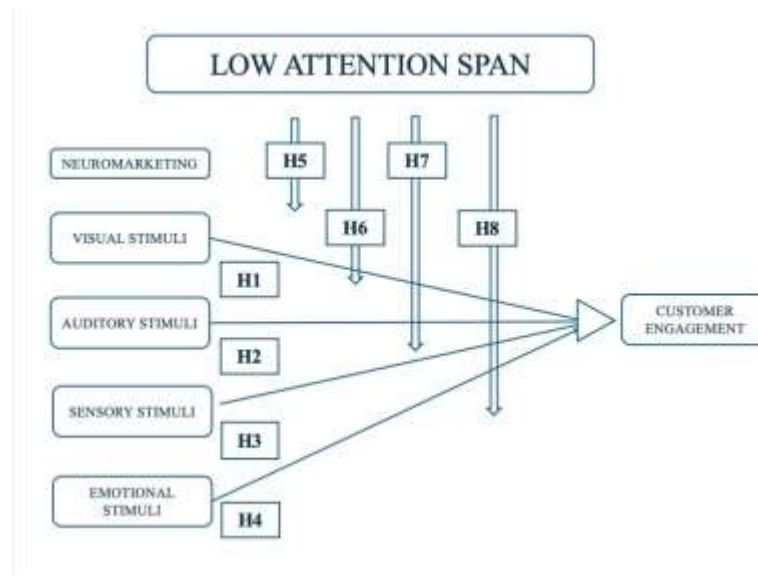


Figure 1. Conceptual framework

3. Research methodology

3.1. Research design

This research employs a correlational design. The design is grounded in the positivism paradigm that embraces the quantification of elements, the evaluation of observed phenomena, and the measurement of the elements.

3.2. Population

This study's targeted population consisted of Generation Z. This age group was chosen because people within this range are the cohort most susceptible to neuromarketing techniques by being highly engaged with digital media and the pattern of behavioral reaction to marketing stimuli ^[10].

3.3. Sampling

There are numerous approaches, encompassing various formulas, for determining sample sizes in categorical data analysis. Krejcie & Morgan's ^[37] table was used to determine the sample size. For a population of approximately 10,000 Generation Z individuals, a sample size of 370 respondents was deemed sufficient for statistical analysis, per Krejcie and Morgan's guidelines. A sample of 460 respondents was chosen for the current study to enhance the robustness of the study's results.

3.4. Instrument

A questionnaire was developed to collect primary data from the respondents. The questionnaire consisted of 28 questions adapted and modified from existing literature ^[36,38] on Neuromarketing and Generation Z's digital engagement. The questionnaire was organized into four sections: **Section A:** Demographic information; **Section B:** Measurement of independent variables (neuromarketing stimuli); **Section C:** The dependent variable (customer engagement); and **Section D:** Moderating variable (short attention span).

3.5. Pilot study

A pilot study was conducted with a small sample (n = 50) of the target population. Reliability (Table 1) tests of the constructs using PLS software illustrated that all constructs had Cronbach's alpha over the threshold minimum value of 0.7. The questionnaire items showed satisfactory internal consistency and reliability.

Table 1. Reliability analysis

Variables	Number of Items	N	Cronbach's Alpha
Visual Stimuli (VS)	5	460	0.851
Auditory Stimuli (AS)	5	460	0.864
Sensory Stimuli (SS)	4	460	0.838
Emotional Stimuli (ES)	4	460	0.852
Low Attention Span (LAS)	6	460	0.580
Customer Engagement (CE)	4	460	0.804

As shown in **Table 1**, the variables included in this study—such as visual stimuli (VS), auditory stimuli (AS), sensory stimuli (SS), emotional stimuli (ES), low attention span (LAS), and customer engagement (CE)—were assessed using a range of items and demonstrated acceptable levels of reliability, with Cronbach's alpha values ranging from 0.580 to 0.864.

3.6. Data collection

Finally, the questionnaire was distributed online via Google Forms on digital platforms like Facebook, Instagram, and WhatsApp. Generation Z uses social media and mobile applications most often. All ethical considerations were addressed; on Google Forms, a consent section was added at the beginning of the questionnaire. Moreover, no personal information was required to be filled out.

4. Findings

4.1. Demographics of participants

Table 2. Respondents' profile

Characteristics	Category	Frequency	Percentage
Age Group	Below 18	54	11.7%
	18-20	126	27.4%
	21-23	173	37.6%
	24-26	93	20.2%
	27-29	14	3.0%
Gender	Male	229	49.8%
	Female	231	50.2%
Educational Level	SPM	65	14.1%
	Level 2	93	20.2%
	Level 3	279	60.7%
	Level 4	22	4.8%
	Level 5	1	0.2%
Occupation	Student	401	87.2%
	Employed	43	9.3%
	Self-Employed	9	2.0%
	Unemployed	7	1.5%

As shown in **Table 2**, the sample's demographic characteristics include age distribution, gender, educational level, and occupation. Most respondents (37.6%) were aged 21 to 23, with a fairly balanced gender distribution (49.8% male and 50.2% female). The participants' educational backgrounds varied, with the largest group (60.7%) having attained Level 3 qualifications. Additionally, the majority of participants were students (87.2%), followed by employed individuals (9.3%), self-employed individuals (2%) and unemployed individuals (1.5%).

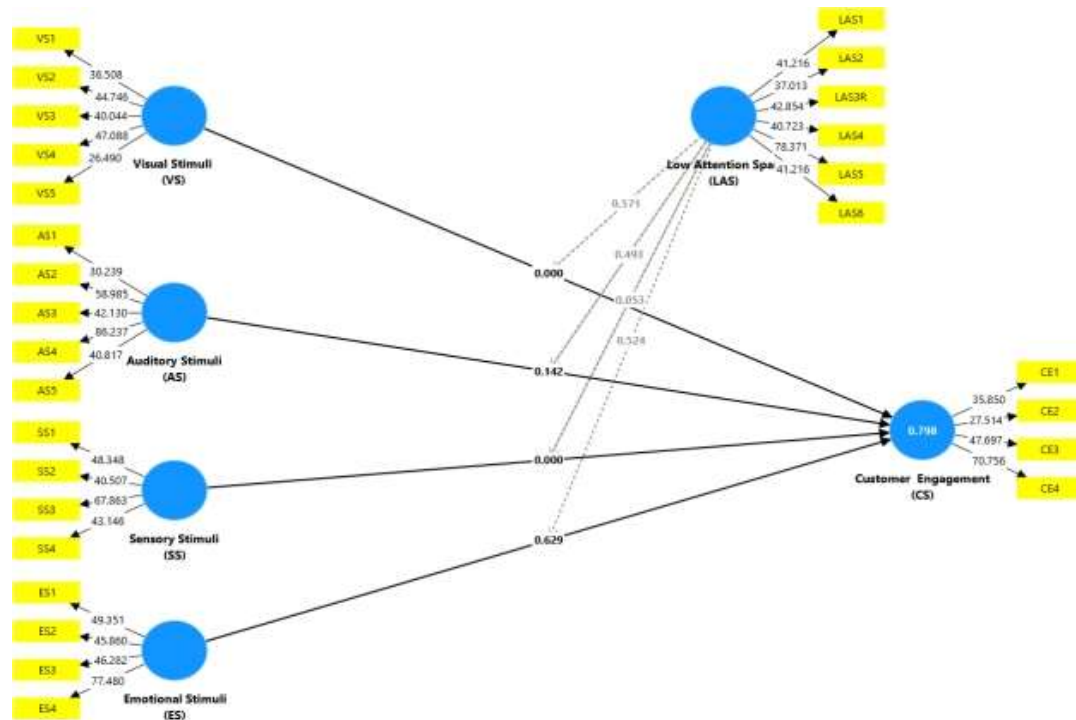


Figure 2. Evaluation of the model quality for PLS-SEM

Figure 2 presents the Structural Equation Model (SEM) used to test the relationships between neuromarketing stimuli (visual, auditory, sensory, and emotional), low attention span (LAS), and customer engagement (CE). The model reveals the direct effects of various stimuli on customer engagement and the moderating role of low attention span. The SEM coefficients indicate that sensory stimuli have the strongest impact on engagement (0.629). At the same time, the moderating effects of LAS are also evident, particularly in the relationship between sensory and emotional stimuli. The first stage involves testing the measurement model (outer model) for validity and reliability, including convergent and discriminant validity assessments using confirmatory factor analysis (CFA). The second stage analyzes the structural model, evaluating R-square, effect size, predictive relevance, and path coefficients through bootstrapping for hypothesis testing.

The study's original model comprises 25 reflective measurement items representing six latent variables, including four independent variables (Visual Stimuli, Auditory Stimuli, Sensory Stimuli, and Emotional Stimuli), one dependent variable (Customer Engagement), and one moderator variable (Low Attention Span). These form eight hypothesized relationships within the model. The R-square value for the endogenous variable (Customer Engagement) is 0.798, indicating that 79.8% of the variance in customer engagement is explained by the predictor variables in the model.

4.2. PLS-SEM measurement model

The evaluation of measurement models in PLS-SEM follows a four-stage process as outlined by [39], encompassing both reliability and validity assessments. This process includes evaluating indicator reliability through loadings of 0.70 or higher, assessing internal consistency reliability via composite reliability of 0.70 or above, measuring convergent validity using Average Variance Extracted (AVE) of 0.50 or greater, and examining discriminant validity by ensuring the square root of AVE for each latent construct exceeds its correlations with other constructs. Reliability, as defined by [40], measures an instrument's consistency in assessing a concept, while validity evaluates how well an instrument measures its intended concept.

Convergent validity assesses the correlation between a construct's measures and alternative measures of the same construct, while discriminant validity examines the extent to which a construct differs from others [41].

Table 3. First-order measurement result for internal consistency, reliability, and convergent validity

Construct	Items	Loadings	Cronbach's Alpha	CR	AVE
Visual Stimuli (VS)	VS1	0.796	0.855	0.896	0.634
	VS2	0.845			
	VS3	0.772			
	VS4	0.837			
	VS5	0.726			
Auditory Stimuli (AS)	AS1	0.715	0.864	0.903	0.651
	AS2	0.850			
	AS3	0.769			
	AS4	0.894			
	AS5	0.796			
Sensory Stimuli (SS)	SS1	0.826	0.841	0.893	0.677
	SS2	0.772			
	SS3	0.844			
	SS4	0.846			
Emotional Stimuli (ES)	ES1	0.852	0.860	0.905	0.705
	ES2	0.787			
	ES3	0.828			
	ES4	0.887			
Low Attention Span (LAS)	LAS1	0.811	0.610	0.840	0.666
	LAS2	0.724			
	LAS3R	-0.817			
	LAS4	0.815			
	LAS5	0.891			
	LAS6	0.828			
Customer Engagement (CE)	CE1	0.801	0.807	0.874	0.637
	CE2	0.668			
	CE3	0.827			
	CE4	0.881			

Table 3. (Continued)

Note: CR = Composite Reliability, AVE = Average Variance Extracted

Table 3 shows factor loadings, Cronbach's alpha, Composite Reliability, and Average Variance Extracted (AVE). Cronbach's alpha values range between 0.610 (Low Attention Span) and 0.905 (Emotional Stimuli), indicating high internal consistency and reliability. The CR values are between 0.840 and 0.903, indicating good reliability. The AVE values are also higher than the recommended threshold of 0.5, indicating sufficient convergent validity^[42].

4.3. Hypothesis Testing Using Bootstrapping Without Moderator

Table 4. Results of hypothesis testing

Hypothesis	Path	Path Coefficient	t-value	p-value	Result
------------	------	------------------	---------	---------	--------

		(β)			
H1	Visual Stimuli (VS) \rightarrow Customer Engagement (CE)	0.320	4.312	0.000*	Supported
H2	Auditory Stimuli (AS) \rightarrow Customer Engagement (CE)	0.129	1.467	0.142	Not Supported
H3	Sensory Stimuli (SS) \rightarrow Customer Engagement (CE)	0.300	4.939	0.000*	Supported
H4	Emotional Stimuli (ES) \rightarrow Customer Engagement (CE)	-0.047	0.483	0.629	Not Supported

Table 4 presents the results of the hypothesis testing for the direct effect of neuromarketing stimuli on customer engagement. Customer engagement is significantly impacted by visual stimuli (H1) and sensory stimuli (H3), respectively, with path coefficients of 0.320 (p-value = 0.000) and 0.300 (p-value = 0.000). The p-values of 0.142 and 0.629 for auditory (H2) and emotional stimuli (H4) showed no significant effect on customer engagement.

Table 5. Results of moderation hypothesis testing

Hypothesis	Path	Path Coefficient (β)	t-value	p-value	Result
H5	LAS \times VS \rightarrow Customer Engagement (CE)	0.048	0.566	0.571	Not Supported
H6	LAS \times AS \rightarrow Customer Engagement (CE)	-0.083	0.686	0.493	Not Supported
H7	LAS \times SS \rightarrow Customer Engagement (CE)	0.168	1.938	0.053*	Marginally Supported
H8	LAS \times ES \rightarrow Customer Engagement (CE)	-0.089	0.638	0.524	Not Supported

Table 5. (Continued)

Table 5 presents the results of the moderation hypothesis testing, which investigates the role of low attention span (LAS) in predicting customer engagement with neuromarketing stimuli. According to the results, low attention span doesn't significantly moderate the effects of visual stimuli (H5), auditory stimuli (H6), or emotional stimuli (H8) on customer engagement. Nevertheless, sensory stimuli (H7) showed a marginally significant moderating effect, with a path coefficient of 0.168 (p-value = 0.053), indicating a potentially moderating effect, although it is weak.

5. Discussion

5.1. Direct effects of neuromarketing stimuli on customer engagement

Hypotheses H1 and H3 are accepted, implying that visual stimuli greatly affect Generation Z's customer engagement ($\beta = 0.320$, $p < 0.001$). This finding supports the previous studies ^[6,43], indicating that Generation Z is highly responsive to visual stimuli like graphics, images, animation, and color spectrum. Generation Z was children who lived in a world steeped in all that was mediated through digital screens. In this world, visual communication is the primary portable means of learning and processing information ^[44]. According to Priporas et al ^[36], this generation's eyes want to perceive information using visual stimuli rather than textual; it seems this generation prefers using visual stimuli for neuromarketing. Moreover, in line with ^[13], processing visual stimuli faster than words is specifically appropriate for engaging Generation Z with the short attention span customary to this generation.

This finding does not support the idea that Generation Z cannot be enticed to view visual content due to their short attention span. This is in tension with the argument ^[45] that Generation Z'ers do not have less

attention but allocate it more readily to content that aligns with their values and interests. From a practical point of view, these findings suggest that marketers should focus on visual branding elements, especially on social media platforms. The key to Generation Z resonating with the brands in front of them is to invest in authentic, relatable visuals since, according to ^[46], they must avoid seeming overproduced or insincere.

Additionally, hypothesis H3 was confirmed ($\beta = 0.300$, $p < 0.001$); that is, there is a strong relationship between sensory stimulus and engagement of customers. It further highlights how much experiential marketing is growing in use, and just as much as Gen Z is looking for it. ^[5] assert that sensory marketing enables brands to go directly past cognitive resistance to engage more deeply emotionally. Zhang & Song ^[47] suggests that sensory experiences, like touch, smell, or immersive events, will directly impact decision-making and result in greater engagement. Sensory marketing is very important for Generation Z because they value authentic and experiential interactions ^[18].

The Over-the-counter brand experience through physical retail environments, pop-up stores, or enhanced reality (AR) platforms is encouraged. It is suggested that marketers invest in this strategy, considering the increase in consumer demand for multi-sensory experiences. This approach is likely to engage Generation Z more effectively, similar to what is endorsed by ^[48].

5.2. Low attention span as a moderating effect

This supported ($\beta = 0.168$, $p = 0.053$) H7, which stated that low attention span would moderate the effect of sensory stimuli on customer engagement, but the effect was less powerful than expected. However, this also implies that Generation Z's attention span is still insufficient, which reduces the effectiveness of sensory stimuli in maintaining. Generation Z does consume content quickly and in multitasking environments ^[49]. Still, most sensory cues seem effective for attracting Generation Z through unconscious processing trials ^[50].

This is evidence that Generation Z is not as undivided as some would believe when it comes to attention span, seeing as attention span becomes lavish when it is allocated to the content you are interested in, they value and engage with digitally relevant content ^[9]. Marketers can overcome attention barriers with sensory stimuli by creating more immersive, multi-sensory experiences.

5.3. Auditory stimuli and emotional stimuli

Generations Z were not impacted by auditory stimuli in support of Hypothesis H2 ($\beta = 0.129$, $p = 0.142$). However, earlier research has disclosed the likelihood of auditory cues like jingles and music facilitating brand recall and emotional connection (Khan, 2025). This study has discovered that auditory cues alone are not sufficient. According to ^[51], Generation Z likes to watch video content without audio, especially on TikTok and Instagram, where it tends to consume video content without audio. The diminished impact of auditory stimuli may also be attributable to multitasking tendencies ^[52].

The result indicates that the auditory stimuli may be better combined with other sensory cues. According to ^[53], the combined power of sound with anything visual or tactile will most effectively strengthen the brand memory. Additionally, Generation Z has been described as sophisticated in dealing with digital media and supposed to receive authentic and relevant auditory content, which might be why generic audio cues are not crucial for their engagement.

Our results did not support hypothesis H4 ($\beta = -0.047$, $p = 0.629$), concluding that emotional stimuli did not significantly affect customer engagement with Generation Z. Emotion is pivotal to decision-making ^[54]. Nevertheless, these findings align with ^[36], who discovered that Generation Z associates a stronger

preference with authentic, honest, and relatable brand communication than too-emotional or dramatic emotional messaging. The results show that the emotional content must be more authentic and associated with a social cause or personal values rather than striving to induce a strong emotional response. Generation Z cares less for content with emotional appeal derived from sentiment and more for content linked to authenticity and social values ^[55].

The present study provides theoretical and practical insight into how neuromarketing stimuli influence Gen Z's customer engagement. Results show that visual and sensory stimuli strongly impact decision-making, whereas auditory and emotional cues fail to do so. As a result, these findings challenge generalized assumptions about stimulus effectiveness and highlight the need for Gen Z-specific strategies aligned with their digital behavior. Despite expectations that attention span would moderate the effects of neuromarketing stimuli, the actual moderating effect was modest. The above finding suggests that audiences with limited attention spans can still engage meaningfully with powerful, well-designed stimuli.

This study identifies that visual and sensory stimuli significantly affect engagement, but no such effect could be devised for auditory and emotional stimuli. This challenges the common notion of marketing strategies and confirms a more focused approach for Generation Z, who tend to be more selective in media consumption. Although worries regarding decreasing attention spans are prevalent, the research indicates attention span doesn't considerably moderate much of neuromarketing effects, signaling that even still, strong stimuli do (and will) create 'real' engagement.

6. Conclusion

The practical approach for marketers is to focus on creating immersive, visual, and sensory-rich experiences rather than simply shortening content. To capture and maintain attention, relevancy, authenticity, and interactivity are critical factors. Ultimately, understanding Generation Z's responses to different types of stimuli allows marketers to design more effective campaigns and create deeper connections with this cognitively selective population. As such, theoretically, our research makes clear which neuromarketing tools have the highest potential to enlighten Gen Z consumers. It also challenges simplistic beliefs that short attention is always detrimental to marketing, one extrapolating from recent consumer behaviors.

From a practical standpoint, the risk for marketers is clear based on the findings – visually engaging content with multi-sensory experiences is readily returned on investment with the most significant levels of engagement. However, the data also suggests no need to oversimplify or shorten content since material engaging by design does not require this. Finally, it is concluded that marketers need to change their strategies and align with Generation Z's preferential views on perception and cognition.

Conflict of interest

The authors declare no conflict of interest.

Acknowledgement

The authors thank UNITAR International University for its support in publishing this research.

References

1. Gupta N, Gaur V, Bhatt A, Gaur S, Parveez S. Psychosocial factors in brand perception among Generation Z (The first " Digital Natives"). *Library of Progress-Library Science, Information Technology & Computer* [Internet]. 2024 [cited 2025 May 14];44(2). Available from: <https://search.ebscohost.com/login.aspx?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=0970105>

- 2&AN=180789456&h=9XGeQraFc8p4Xr4pKLNL3Q6ku%2FQ6uAzqRHN4VM9i8PPhwQ%2BVJ58GyehVOpiq6tF78G8Hr2Y%2FaFp1aRXb04eHow%3D%3D&crl=c
2. Ebulueme J, Vijayakumar V. Authenticity and Influence: Interactions Between Social Media Micro-Influencers and Generation Z on Instagram. 2024 [cited 2025 May 14]; Available from: <https://lup.lub.lu.se/luur/download?func=downloadFile&recordId=9162580&fileId=9162598>
3. Lick E. “Multimodal Sensory Marketing” in retailing: the role of intra- and intermodality transductions. *Consumption Markets & Culture*. 2022 May 4;25(3):252–71.
4. Azrin Ali, Lennora Putit, Azlin Shafinaz Mohamad Arshad, Yasmin Kamall Khan, Heny Hendryati3. Neuromarketing readiness in Malaysia: Where are we now? *JIBE* [Internet]. 2024 Jun 29 [cited 2025 Apr 15];9(1). Available from: <https://ir.uitm.edu.my/id/eprint/101618/1/101618.pdf>
5. Shahidi Hamedani SS, Francis PB, Aslam S. Regulation as a Game-Changer: Factors Driving Cryptocurrency Adoption among Millennials. *International Review of Management and Marketing*. 2025;15(3):415–25.
6. Rawnaque FS, Rahman KM, Anwar SF, Vaidyanathan R, Chau T, Sarker F, et al. Technological advancements and opportunities in Neuromarketing: a systematic review. *Brain Inf*. 2020 Dec;7(1):10.
7. Shahidi Hamedani S, Aslam S, Shahidi Hamedani S. AI in business operations: driving urban growth and societal sustainability. *Frontiers in Artificial Intelligence*. 2025;8:1568210.
8. Kiran JS, Prabhakar R. Neuromarketing in consumer decision making process: Developments and directions for future research. *Empirical Economics Letters* [Internet]. 2021 [cited 2025 May 11];20(2). Available from: https://www.researchgate.net/profile/Jatoth-Sai-Kiran-2/publication/359520371_Neuromarketing_in_Consumer_Decision_Making_Process_Developments_and_Directions_for_Future_Research/links/65ce4c5a476dd15fb33a95fe/Neuromarketing-in-Consumer-Decision-Making-Process-Developments-and-Directions-for-Future-Research.pdf
9. Seemiller C, Grace M, Campagnolo PDB, Alves IMDR, De Borba GS. What makes learning enjoyable? Perspectives of today’s college students in the US and Brazil. *Journal of Pedagogical Research*. 2020;5(1):1–17.
10. Twenge JM. Generations: the real differences between Gen Z, Millennials, Gen X, Boomers, and Silents—and what they mean for America’s future [Internet]. Simon and Schuster; 2023 [cited 2025 Apr 27]. Available from: https://books.google.com/books?hl=en&lr=&id=zsV0EAAQBAJ&oi=fnd&pg=PA1&dq=Twenge,+2023&ots=7pNZ75srrD&sig=rL-CDUFi6Km_4wTTdhvP8Ve2l9U
11. Mardhatilah D, Omar A, Thurasamy R, Juniarti RP. Digital Consumer Engagement: Examining the impact of Audio and visual Stimuli exposure in Social Media. *Information Management and Business Review*. 2023;15(4):94–108.
12. Wiradhany W, Koerts J. Everyday functioning-related cognitive correlates of media multitasking: a mini meta-analysis. *Media Psychology*. 2021 Mar 4;24(2):276–303.
13. Diz MR. Gen Z and Millennials in the workplace: How are leaders adapting to their short attention span and how will they keep them from leaving a qualitative study. 2021 [cited 2025 May 11]; Available from: <https://digitalcommons.fiu.edu/etd/4800/>
14. Roberto T. The first 8 seconds – capturing the attention of Gen Z students [Internet]. 2023 [cited 2025 May 14]. Available from: <https://www.keg.com/news/the-first-8-seconds-capturing-the-attention-of-gen-z-students>
15. Kaur R, Singh R, Gehlot A, Priyadarshi N, Twala B. Marketing strategies 4.0: recent trends and technologies in marketing. *Sustainability*. 2022;14(24):16356.
16. Hammad HS. Teaching the Digital Natives: Examining the Learning Needs and Preferences of Gen Z Learners in Higher Education. *Transcultural Journal of Humanities and Social Sciences*. 2025;6(2):214–42.
17. Hazari S, Sethna BN. A Comparison of Lifestyle Marketing and Brand Influencer Advertising for Generation Z Instagram Users. *Journal of Promotion Management*. 2023 May 19;29(4):491–534.
18. Francis T, Hoefel F. True Gen’: Generation Z and its implications for companies. *McKinsey & Company*. 2018;12(2):1–10.
19. Dutta A. Neuro-marketing and consumer behavior: Exploring the use of neuroscience techniques to understand how consumers make decisions and respond to marketing stimuli. *EPRA International Journal of Economics, Business and Management Studies*. 2023;10(8):29–38.
20. Bajaj R, Ali Syed A, Singh S. Analysing applications of neuromarketing in efficacy of programmatic advertising. *J of Consumer Behaviour*. 2024 Mar;23(2):939–58.
21. Moreno-Escobar JJ, Pérez-Franco V de J, Coria-Páez AL, Morales-Matamoros O, Aguilar-del-Villar EY, Castillo-Pérez MD. Multivariate data analysis of consumer behavior of functional products: a neuroscience and neuromarketing approach to improve decision-making. *Computación y Sistemas*. 2023;27(4):1027–46.
22. Aldayel M, Kharrat A, Al-Nafjan A. Predicting Choices Driven by Emotional Stimuli Using EEG-Based Analysis and Deep Learning. *Applied Sciences*. 2023;13(14):8469.
23. Spence C. On the Ethics of Neuromarketing and Sensory Marketing. In: Martineau JT, Racine E, editors. *Organizational Neuroethics* [Internet]. Cham: Springer International Publishing; 2020 [cited 2025 Apr 27]. p. 9–29. (Advances in Neuroethics). Available from: http://link.springer.com/10.1007/978-3-030-27177-0_3

24. Khondakar MdFK, Sarowar MdH, Chowdhury MH, Majumder S, Hossain MdA, Dewan MAA, et al. A systematic review on EEG-based neuromarketing: recent trends and analyzing techniques. *Brain Inf.* 2024 Dec;11(1):17.
25. Ferrell ML, Beatty A, Dubljevic V. The Ethics of Neuromarketing: A Rapid Review. *Neuroethics.* 2025 Apr;18(1):19.
26. Alshohaib KA. From screens to carts: the role of emotional advertising appeals in shaping consumer intention to repurchase in the era of online shopping in post-pandemic. *Frontiers in Communication.* 2024;9:1370545.
27. Awasthi A, Nneoma NR, Shukla P, Kumari S, Sahil S, Gandhi NK, et al. The role of emotions in consumer brand loyalty: a Neuromarketing Approach. *International Journal of Tourism and Hospitality in Asia Pasific.* 2024;7(1):104–16.
28. Alsharif AH, Mohd Isa S. Revolutionizing consumer insights: the impact of fMRI in neuromarketing research. *Futur Bus J.* 2024 Jul 9;10(1):79.
29. Murwani IA, Rooseno ED, Cakramihardja A, Widjaja JV. The impact of sensory marketing: analysis of its attributes towards online perfum users' behavior. *International Journal of Professional Business Review: Int J Prof Bus Rev.* 2023;8(9):13.
30. McSpadden K. You now have a shorter attention span than a goldfish. *Time Magazine.* 2015;14:11.
31. Subramaniam S, Ern SY. Social Media Marketing Factors that Influence Purchase Intention in India. In: *International Conference on Management and Marketing 2024 (ICMaM2024).* Petaling Jaya Hybrid, Malaysia; 2024. p. 10.
32. Chan CKY, Lee KKW. The AI generation gap: Are Gen Z students more interested in adopting generative AI such as ChatGPT in teaching and learning than their Gen X and millennial generation teachers? *Smart Learn Environ.* 2023 Nov 15;10(1):60.
33. Cardoso L, Chen MM, Araújo A, de Almeida GGF, Dias F, Moutinho L. Accessing neuromarketing scientific performance: Research gaps and emerging topics. *Behavioral sciences.* 2022;12(2):55.
34. Shahid S, Paul J, Gilal FG, Ansari S. The role of sensory marketing and brand experience in building emotional attachment and brand loyalty in luxury retail stores. *Psychology and Marketing.* 2022 Jul;39(7):1398–412.
35. Insights C. Attention spans. Microsoft Canada, Spring [Internet]. 2015 [cited 2025 Apr 27]; Available from: https://www.sergiogridelli.it/wp-content/uploads/2015/07/AttentionSpans_report.pdf
36. Priporas CV, Stylos N, Fotiadis AK. Generation Z consumers' expectations of interactions in smart retailing: A future agenda. *Computers in human behavior.* 2017;77:374–81.
37. Krejcie RV, Morgan DW. Determining sample size for research activities. *Educational and psychological measurement.* 1970;30(3):607–10.
38. Southgate D. The Emergence of Generation Z And Its Impact in Advertising: Long-Term Implications For Media Planning and Creative Development. *Journal of Advertising Research.* 2017 Jun;57(2):227–36.
39. Hair JF, Ringle CM, Sarstedt M. PLS-SEM: Indeed a Silver Bullet. *Journal of Marketing Theory and Practice.* 2011 Apr;19(2):139–52.
40. Sekaran U. Research methods for business: A skill building approach [Internet]. John Wiley & Sons; 2016 [cited 2025 Jan 26]. Available from: <https://so01.tci-thaijo.org/index.php/bkkthon/article/download/33962/28587>
41. Hair Jr JF, Hult GTM, Ringle C, Sarstedt M. A primer on partial least squares structural equation modeling (PLS-SEM). Sage publications; 2016.
42. Hair JF, Matthews LM, Matthews RL, Sarstedt M. PLS-SEM or CB-SEM: updated guidelines on which method to use. *IJMDA.* 2017;1(2):107.
43. Gupta S, Modgil S, Lee CK, Sivarajah U. The future is yesterday: Use of AI-driven facial recognition to enhance value in the travel and tourism industry. *Inf Syst Front.* 2022/04/30 ed. 2023;25(3):1179–95.
44. Kahraman A. The relationship of generation Z with digital technology. *Uluslararası Anadolu Sosyal Bilimler Dergisi.* 2020;4(2):113–34.
45. Anders E. Generation Z and Their Perception Towards the Working Environemnt-Analyzed in Times of Covid-19 [Internet]. Universidade NOVA de Lisboa (Portugal); 2020 [cited 2025 May 11]. Available from: <https://search.proquest.com/openview/f70c8e048025ef3798210387434a870c/1?pq-origsite=gscholar&cbl=2026366&diss=y>
46. Salam KN, Singkeruang AWTF, Husni MF, Baharuddin B, AR DP. Gen-Z marketing strategies: Understanding consumer preferences and building sustainable relationships. *Golden Ratio of Mapping Idea and Literature Format.* 2024;4(1):53–77.
47. Zhang Y, Song Y. The effects of sensory cues on immersive experiences for fostering technology-assisted sustainable behavior: A systematic review. *Behavioral Sciences.* 2022;12(10):361.
48. Hafid H, Baltes A. The Impact of Sustainability and Purpose on Gen Z's Choice of Employer [Internet]. 2023 [cited 2025 May 11]. Available from: <https://www.diva-portal.org/smash/record.jsf?pid=diva2:1782240>
49. Gawda B, Korniluk A. Multitasking among modern digital generations Y and Z. *Journal of Modern Science.* 2022;49(2):421–30.

50. Sutil-Martín DL, Rienda-Gómez JJ. The influence of unconscious perceptual processing on decision-making: A new perspective from cognitive neuroscience applied to generation z. *Frontiers in Psychology*. 2020;11:1728.
51. Djafarova E, Bowes T. 'Instagram made Me buy it': Generation Z impulse purchases in fashion industry. *Journal of retailing and consumer services*. 2021;59:102345.
52. Khan MA. Incongruity in Advertising: A Detailed Examination of Consumer Responses to Background Music in Radio Advertisements and its Effects on Ad-Brand Memorability [Internet] [PhD Thesis]. Manchester Metropolitan University; 2025 [cited 2025 May 11]. Available from: <https://e-space.mmu.ac.uk/638190/>
53. Luthra A, Dixit S, Singh A, Garg S, Khattar S. Sensory Storytelling: Crafting Brand Narratives Through Sight, Sound, Smell, Touch, and Taste. In: *Sensible Selling Through Sensory Neuromarketing* [Internet]. IGI Global; 2024 [cited 2025 May 11]. p. 230–53. Available from: <https://www.igi-global.com/chapter/sensory-storytelling/353593>
54. Zaleskiewicz T, Traczyk J. Emotions and Financial Decision Making. In: Zaleskiewicz T, Traczyk J, editors. *Psychological Perspectives on Financial Decision Making* [Internet]. Cham: Springer International Publishing; 2020 [cited 2025 May 11]. p. 107–33. Available from: https://link.springer.com/10.1007/978-3-030-45500-2_6
55. Putra JE, Sulistyani NW, Ramadhan F, Hidayat H. Effectiveness of Content Marketing in Attracting Generation Z Consumer Loyalty. *Oikonomia: Journal of Management Economics and Accounting*. 2025;2(2):45–58.