Harnessing Eye-Tracking Technology to Analyze Gen Z's Engagement with Digital Marketing

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***Abstract*—In the current highly competitive industry, digital marketers must comprehend consumer behavior and effectively communicate with their intended consumers. Utilizing methods like eye tracking, Electroencephalogram (EEG), and Magnetic Resonance Imaging (MRI), neuromarketing has become a potent instrument for evaluating the effects of advertising across a range of media. This study explores the critical impact that focused visual attention plays in enhancing memory encoding, visual processing, and ultimately, recall of advertisements. The research examines how attention can be focused like a zoom lens, focusing on particular features inside advertisements, using the well-established Zoom Lens Model of Attention. The study examines participant-used visual attention methods and ideal logo placement through careful gaze data analysis. The results highlight the effectiveness of targeted visual attention in improving memory recall. Stronger memory retention showed participants could remember items that attracted concentrated visual attention. Furthermore, the results showed that focused attention-stimulated inputs were processed more effectively, as evidenced by fewer fixations and longer fixation times. This efficiency highlights the cognitive benefits of focused visual attention by implying that people could take in more information from the stimuli in less time. The study emphasizes the practical implications for digital marketers, stressing the significance of strategically putting essential components to draw in and hold viewers' attention long enough to boost advertisement memory.**

Keywords- Digital marketing; eye tracking; neuroscience; human psychology; consumer behavior.

I. INTRODUCTION

Marketers thrive on the ability to understand consumer behavior and translate that knowledge into actionable insights to better cater to their users. In this pursuit, researchers and practitioners alike have embraced neuromarketing techniques. Neuromarketing methods, such as eye tracking, EEG, MRI, and other tools are used to validate advertising effectiveness on digital media [2] [15], social media [4] and other channels. The bias-free nature and high-accuracy findings contribute to the popularity of neuromarketing methods [3].

Eye tracking is a safe and non-invasive methodology that provides insights into visual movement and attention [1]. Eye tracking offers a valuable tool for investigating visual attention strategies employed by users when viewing digital advertisements. The proximity of different elements within the visual field can influence whether users adopt a focused or diffused attentional zoom strategy [24]. The attentional zoom strategy is based on the zoom lens model [17], which suggests that our visual processing resources can be distributed over a wide area or in a focused/narrow area. Their experiments also showed improved visual acuity in areas that receive continuous focused visual attention as opposed to shifting visual attention across the visual field. In [17], the authors also postulated that visual processing resources degrade as the visual attentional field increases, which was also observed by [8].

Previously, in [8], the authors had conducted experiments where participants were presented with two objects, differentiated by color, on conducting subsequent memory tests revealed that participants exhibited strong memory for objects that received focused visual attention compared to objects that were outside the focused visual field of the participant. Numerous other studies have mentioned focused visual attention to improve visual processing, acuity, and memory [5] [7] [21]. The reviewed body of research suggests that employing focused visual attention strategies (while viewing advertisements) can enhance visual processing and memory encoding, potentially leading to improved advertising recall.

The impact of focused visual attention on advertising efficacy is one of the fundamental aspects of consumer behavior that digital marketing aims to understand. This study intends to investigate the function of focused visual attention in improving visual processing, memory encoding, and, eventually, advertising recall. It draws on well-established ideas, such as the Zoom Lens Model of Attention, which suggests that attention may be directed similarly to a zoom lens.

This study aims to investigate the potential benefits of using focused visual attention methods in digital ads by utilizing neuromarketing methodologies and cognitive psychology insights. In particular, the research aims to:

- Examine how focused visual attention and recollection of advertisements are related by using gaze data obtained from eye tracking devices.
- Analyze the best locations for logos and visual attention techniques in ads to enhance visual processing and memory encoding.
- Explore the practical ramifications for marketers, stressing the significance of putting essential components strategically to draw and hold viewers'

attention and increase the recall rate of advertisements.

The rest of the paper is structured as follows. Section 2 presents a literature review, Section 3 details the methodology, Section 4 presents the data analysis, Section 5 discusses the findings, and Section 6 concludes the paper with recommendations for future work.

II. LITERATURE REVIEW

A growing body of research has investigated the factors influencing advertising recall. In [10], the authors employed EEG and eye-tracking methodology to demonstrate that advertisements presented on tablets and paper elicited superior recognition and memorability compared to other media formats. Beyond the delivery platform, the content of the advertisement itself plays a crucial role in recall. In [11], the authors found that including image, text, and price elements within an advertisement significantly enhanced memory performance. In [9], the authors further revealed that the visual gaze of the model in an advertisement can also significantly affect the ad recall value, they observed that when the model shifts their gaze on the product or price, visual attention towards it increases resulting in participants performing well in memory tasks. Other studies have also established that eye-tracking metrics, such as the number of fixations is directly proportional to ad recall value [16].

This study is grounded on the zoom lens model as numerous studies have shown the strength of the model. In [7], the authors observed participants adjust their focal attention around the "salient perceptual objects". The findings suggest that visually salient objects can be surrounded by other elements within the same visual field to improve acuity and processing [7]. Behavioral studies have further supported the zoom lens models, indicating improved visual processing, acuity, and clarity when objects are placed at a focused location [17] [18]. In [6], the authors used electrophysiological methods to show that participants performed better in search tasks during narrowed visual attention due to strong activation of brain regions.

Studies have shown psychological and cognitive bias of visual attention towards the center [12] [16] [22]. In [22], the authors observed an "attentional concentration effect", that showed that visual attention is concentrated at the center even though participants were instructed to equally distribute their attention. In [22], the authors conducted tracking tests and found that participants had higher accuracy rates when tracking towards the center compared to the endpoints of horizontal lines, an "attentional amplification" effect was observed. In [13], the authors tasked the participants to detect the change in luminescence of dots (evenly spaced out). Participants were instructed to spread their attention across, as the change could occur in the center (narrow) or away from the center (broad). Improved detection was observed for dots in the center, implying the strength of narrowed visual attention and our bias. The effects above elucidate our uneven distribution of visual attentional resources and our bias to focus our visual attention toward the center of our visual field.

A. Eye tracking framework

Eye tracking is a great research methodology to observe users' visual attention and gather insights to improve advertising effectiveness in digital media [15]. Using eye tracking, numerous studies have provided evidence that employing focal attention by way of placing ad elements in close spatial proximity has improved advertising effectiveness. Due to low spatial proximity between ad elements, the saccadic amplitude is low. In [20], the authors described focal attention as having longer fixations and shorter saccadic amplitude whereas ambient attention has shorter fixations and longer saccadic amplitude. Data on focal attention (short saccadic amplitude) concluded that participants performed better in a recognition task and were more confident about their performance [20]. In [19], the authors conducted experiments to understand the effects of price labels on adverts with human models (vs mannequins), the authors deduced that placing elements close to an "attention magnet", i.e., human models increase the saliency of the elements placed near the "attention magnet". The conclusion was drawn due to neuroimaging studies validating that attention is deployed to specific spatial areas [19]. Converging evidence from other studies suggests that visual elements positioned closer to the focus of attention within the visual field are processed more efficiently compared to those located further away [23]. Marketers can leverage the increased visual attention of an ad element, i.e., product image or model to other ad elements like price, logo, and other information since increased visual attention relates to increased memory [14] [25]. In [21], the authors conducted a series of experiments to identify the best placement of a logo in an online advertising format to optimize for visual search and found that the logo element should be placed in the middle, parallel to the picture element. Placing the logo element in close proximity, not overlapping, to the picture element also improved memory [21].

III. METHODOLOGY

The viewing time for each advert stimulus will be 5 seconds, as previous studies employed the same duration for stimuli viewing [26]. In [28], the authors conducted a pilot study which revealed that 5 seconds was the average duration participants spent viewing banner ads on social media. Participants viewed four stimuli, each presented for 5 seconds, totaling 20 seconds of viewing time. After a 5-minute interval following the final stimulus, they completed a memory test to assess recall and recognition.

A. Participants

Gen Z participants are the study's primary focus since they are the most digitally native generation and play a major role in shaping online consumer trends and interaction patterns [16]. Our study aimed to have a minimum of 40 participants, as recommended in [26]. In [26], the authors recommended 15 - 50 participants for eye-tracking studies to be valid. We recruited 48 female students from Zayed University, Dubai, UAE, as our study focused on understanding consumer

behavior among Gen Z female users, who represent a key demographic segment in digital marketing research.

B. Stimuli

The stimuli were developed according to the frameworks constructed as in [27]. The manipulated stimuli are of high quality and resemble real advertisements. Certain stimuli consisted of familiar brands and resembled real-life adverts of the brand, and other stimuli consisted of hypothetical brand names and logos to mitigate any familiarity bias [27]. The design employed a combination of image, text, and price elements within the stimuli, which are commonly associated with enhanced advertisement memorability [11].

Advert stimuli were also manipulated as per the findings of [21]. The research found that the advertiser should first try to place the logo element in the right middle position parallel to the picture element because the commodity logo in this matching mode can get the longest average time of consumers' attention, and the duration of attention is the most [21].

The findings in [29] were also applied to design the stimuli. In [29], the authors pointed out that perfume product image located in the lower part of the advertisement can attract consumers' attention the most. The product image was in the lower part of the advertisement for every stimulus. The logo was placed above the product image as suggested by [21].

Previous research has demonstrated the influence of brand recognition and price on product preference [30]. To mitigate these potential biases in our study, stimuli were designed to incorporate fictitious brand names and maintain a consistent price range (see Figures 1 and 2).

IV. Data Analysis and Results

Figures 3(a) and 3(b) are cluster visualizations. A cluster is an area with high gaze data points [31]. An Area of Interest (AOI) [34] is a particular area or component of a digital interface (such as an email, landing page, website, or advertisement) that marketers monitor or examine to learn more about user behavior.

Figure 3(a) has only 1 cluster with 100% of participants contributing to the gaze data. Figure 3b has 2 clusters, and cluster 2 (upper right) ha89% participant contribution. Almost 11% of participants did not have significant eye gaze data in cluster 2 consisting of the brand name and logo. The results revealed optimal logo placement to be centered and aligned parallel to the picture element, consistent with findings reported by [21] in the context of focal attention stimuli. Placing ad elements within close proximity of the 'attention magnet' (food image), improved visual acuity and processing of all the elements within that narrowed visual field which aligns with the zoom lens model.

Figure 1. Stimuli for narrowed/focal visual attention and its AOIs.

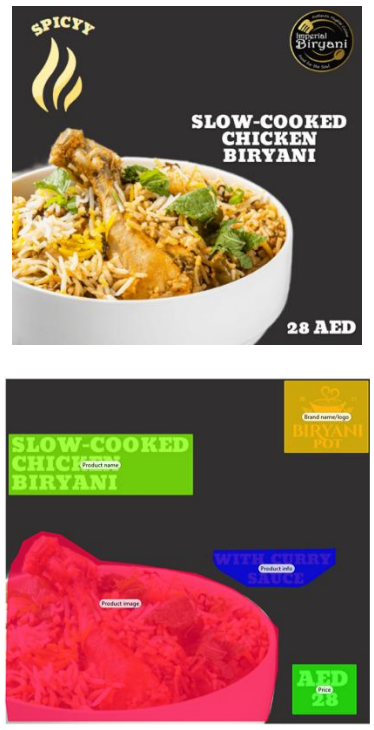

Figure 2. Stimuli for diffused/broad visual attention and its AOIs.

(a)

(b)

Figure 3. (a) and (b): Cluster analysis for stimuli having focal visual attention and ambient visual attention.

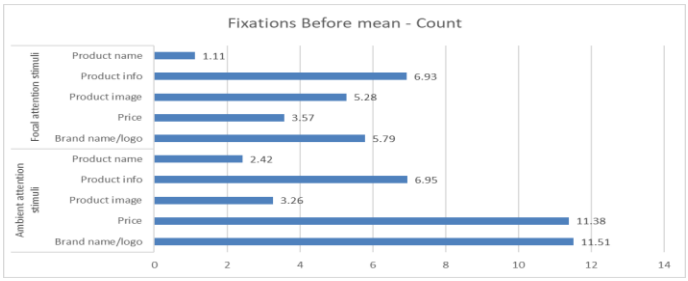

Figure 4. Fixations before mean - count for each AOI in both focal and ambient attention stimuli.

Fixation Count - count										
	Ambient attention stimuli					Focal attention stimuli				
	Brand name/logo	Price	Product image	Product info	Product name	Brand name/logo	Price	Product image	Product info	Product name
Total no.of fixations	67	58	267	119	218	51	121	150	77	279
Percentage	9.190672154	7.956104252	36.6255144	16.32373114	29.90397805	7.522123894	17.84660767	22.12389381	11.35693215	41.15044248

Figure 5. Number of Fixations (AOIs).

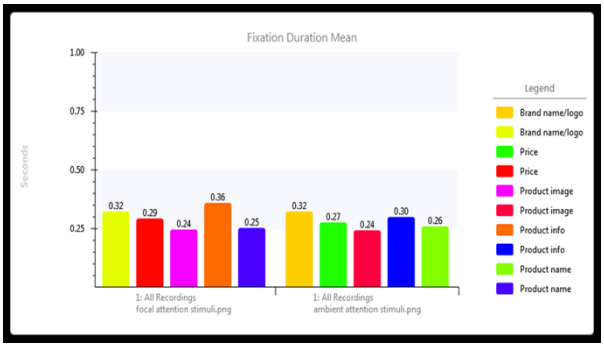

Figure 6. Mean fixation duration across AOIs in focal attention stimuli and ambient attention stimuli.

Figure 4 shows the number of fixations before fixating on an AOI [31]. The results reveal a significantly lower mean number of fixations prior to fixating on each AOI in the focal attention stimuli compared to the ambient attention stimuli. This finding suggests that participants, under conditions promoting focused visual attention, were able to rapidly direct their gaze towards the AOIs upon stimulus presentation. A lower fixation count is often associated with enhanced processing efficiency, potentially allowing participants to extract more information from the stimuli within a shorter time frame. Figure 5 gives the fixation count of stimuli.

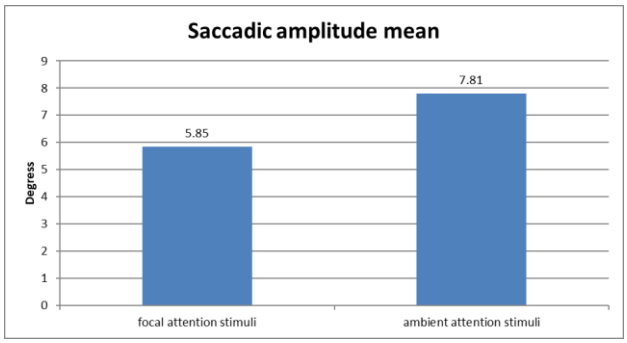

Figure 7. Mean saccadic amplitude (degrees).

Figures 6 and Figure 7 show the mean fixation duration and mean saccadic amplitude, respectively. Saccadic amplitude, the angular distance between eye fixations during a saccade, reveals visual attention allocation, with shorter amplitudes indicating focused scanning and longer amplitudes indicating broader scanning [20].

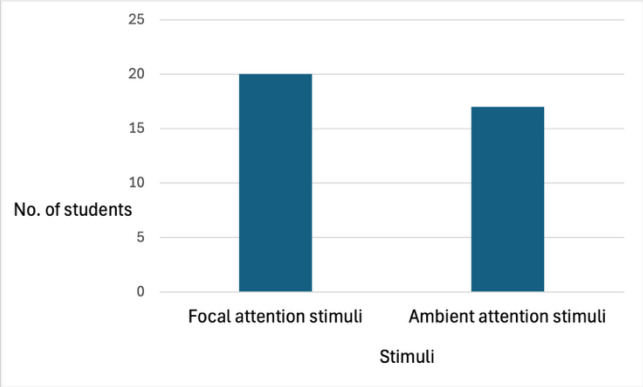

Figure 8. Number of participants who succeeded the memory test.

Focal attention stimuli had longer fixation durations and shorter saccadic amplitudes. Therefore, participants employed focal visual attention. In contrast, ambient attention stimuli had shorter fixation durations and longer saccadic amplitudes, implying that participants employed an ambient visual attention [32] [33]. Figure 8 shows that more participants were able to recall the stimuli that had focal visual attention.

V. DISCUSSION

The results of this study expand on previous research on the benefits of focused visual attention for improving memory encoding, visual processing, and eventually, recall of advertisements. This study investigated the theory that using focused visual attention tactics within advertisements can increase visual processing and memory encoding. It was based on the well-known Zoom Lens Model of Attention, which suggests that attention can be focused like a zoom lens. The gaze data analysis results support the hypothesis by showing individuals who received focused visual attention were better able to recall the stimuli than those who were exposed to ambient attention. The best logo location, as shown by the cluster visualizations, was centered, and positioned parallel to the image element, supporting findings from prior studies. This is consistent with the idea that positioning important components adjacent to an attention-grabbing object, such a focal picture, might improve visual processing and precision in a smaller visual field.

The findings pertaining to the number of fixations prior to fixating on AOIs further suggests that individuals in environments that facilitate concentrated visual attention had the ability to quickly focus their gaze on the AOIs upon presentation of the stimulus. This may indicate increased processing efficiency, allowing individuals to process the stimuli more quickly and retain more information. On the other hand, a less effective processing strategy was indicated by a higher mean number of fixations in response to ambient attention inputs. The differences between focused and ambient visual attention are further supported by the results pertaining to mean fixation length and saccadic amplitude. Longer fixation times and smaller saccadic amplitudes were induced by focal attention stimuli, indicating intentional and focused visual processing. Alternatively, greater saccadic amplitudes and shorter fixation durations were induced by ambient attention cues, indicating a more diffused and passive visual attentional approach.

Significantly, the study's findings show that ads that are intended to draw in focused visual attention have a distinct advantage, as seen by the participants' greater memory rates when exposed to these kinds of stimuli. This emphasizes the useful implications for marketers looking to maximize campaign effectiveness. Through the strategic placement of essential features in advertisements, advertisers can improve visual processing, memory encoding, and ultimately, advertising recall by drawing and holding viewers' attention.

VI. CONCLUSION

The empirical results obtained from neuromarketing approaches and the insights obtained from cognitive psychology in this study demonstrate the essential role that focused visual attention plays in improving the effectiveness of advertising. Gaze data analysis indicates that, in contrast to stimuli exposed to ambient attention, those intended to elicit focused attention produce greater memory recall and facilitate more effective processing. Interestingly, the best arrangement of essential components in ads about attentional foci is critical for improving visual processing and memory encoding. The practical ramifications of these findings for advertisers are highlighted, as they highlight the need to carefully place items to draw in and hold the attention of viewers, increasing the impact and memory rates of advertisements. Future studies should focus more on examining the subtleties of different focal cues and stimuli qualities to provide advertising professionals with more direction as they work to maximize the effectiveness of their campaigns and produce memorable, long-lasting brand experiences.

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