IBIMA Publishing
Journal of Marketing Research and Case Studies
http://ibimapublishing.com/articles/JMRCS/2024/404100/
Vol. 2024 (2024), Article ID 404100, 8 pages, ISSN: 2165-7009
https://doi.org/10.5171/2024.404100

Research Article

Utilizing Eye-Tracking in Advertising: Preliminary Findings

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Received date: 28 March 2024; Accepted date:11 June 2024; Published date: 22 July 2024

Academic Editor: Ewa Koreleska

Abstract

Eye-tracking research is steadily increasing, with emerging hypotheses about the connection between eye movements and cognitive processes in advertising contexts. This study aimed to utilize eye-tracking technology to explore how consumers perceive advertising appeals, particularly in distinguishing between the promoted product and the accompanying elements within an advertisement. The research sample included 35 students aged 19 to 23 years, comprising 18 women (51%) and 17 men (49%). The eye-tracker used in our study was the Smart Eye AI-X model from iMotions. We hypothesized that respondents would predominantly focus their gaze on the image of the child. The heat map revealed that the most viewed areas were the advertising text, the child's face, and the car's registration number section. The factors examined in this study significantly impact data quality, and we argue that our findings are valuable for anyone seeking to capture high-quality data in psychological and neurological research.

Keywords: eye- tracking, eye- movements, advertisement, neuromarketing

Introduction

In the field of neuromarketing, there is a rapid technological development associated with eye-tracking technology. Eye-tracking has broad applications in various scientific disciplines such as marketing research, usability research, and, notably, psychological research. Although numerous eye-tracking studies have been conducted, most of them are based on the analysis of eye movements with static stimuli such as images, web pages, and presentations (Viniegra, Núñez-Gómez & Tur-Viñes, 2020). Carter and Luke (2020) point out the enormous potential of eye-tracking given the plethora of publications on this topic in the last decade. There is limited research on the application of eye-tracking technology in dynamic stimuli such as videos, games, and interactive applications (Zhang et al., 2018). Brecht and Ogilby emphasize the importance of video lectures, which students find attractive and perceive as effective learning aids.

Cite this Article as: Ivana ONDRIJOVA, Anna TOMKOVA and Tatiana PETHÖ (2024), "Utilizing Eye-Tracking in Advertising: Preliminary Findings ", Journal of Marketing Research and Case Studies, Vol. 2024 (2024), Article ID 404100, DOI: https://doi.org/10.5171/2024.404100

The penetration of the Internet into everyday life leads to the expectation that the user experience of a website should be positive. Poor user experience is not usually tolerated by users, and they simply decide to leave the website. Based on this, the demand for website usability analysis is thriving, and it is increasingly common to include eye tracking as one of the techniques used for this purpose (Ehmke & Wilson, 2007).

Eye- tracking movements

According to Carter and Luke (2020), the origins of eye-tracking can be traced back to Charles Bell, who first described the control of eye movement and brain, classifying eye movements and describing their influence on visual orientation. Through this, the physiological connection between the eyes and the nervous system was defined. Eye-tracking technology monitors eye movements in real-time, providing details about respondents' cognitive functions. Specifically, it provides unique information about perceptual and cognitive processes, which are important foundations for learning (Schmidt-Weigand, Kohnert & Glowalla, 2010). From a learning process perspective, it is important to apply multimedia learning, which, through eye-tracking technology, allows the analysis of eye movements and a better understanding of the behavior of eye-tracking participants (Zhang et al., 2018).

Eye tracking involves recording the position of a person's eyes as they look at a visual aspect. The eye position is recorded several times per second and subsequently overlaid with the stimulus recording. The premise of eye tracking is the direct correlation between where a person looks with their eyes and where their attention is directed. By tracking eye movements, we can gather information about the processes of attention and subsequently learn more about what interests them, what their priorities are, and what may be misconfigured (Bojko, 2005).

Interest in eye tracking research is increasingly growing, and we also encounter hypotheses regarding the linkage between the eye and the mind. This follows the principle set by Just & Carpenter (Poole & Ball, 2005), assuming that what a person looks at indicates what they are thinking about.

Within neurophysiological methods that deal with processes in the human brain, eye tracking holds a special place. By examining eye position, gaze, eye movement sequences, and visual adaptation during cognitive activities, eye tracking is an important tool for psychology and neurological research. Eye tracking conducts an analysis of gaze direction, which is necessary for understanding human behavior and perceptual decision-making. It is often used to assess spatial attention orientation, performance in visual tasks, reactions to information on websites, customer responses to advertisements, and the impact of various stimuli on the brain (Popa, et al. 2015).

Technological advancement provides opportunities to improve research methods. Traditional studies typically rely on self-report surveys, which are subject to subjective bias and data validity issues. However, eye tracking technology offers an alternative objective research method for studying processes related to visual attention. The application of eye tracking methods can expand understanding of attention and perception. In this article, we provide an overview of eye tracking methods, their theoretical basis, advantages and disadvantages, data collection, and analysis procedures. We highlight gaps in knowledge and areas for future research.

Eye- tracking technology

Internet users and visitors of various websites demand quick and easy orientation. This emphasizes the constant need for improving efficiency and user satisfaction (Bargas-Avila et. al., 2009). Faster visual elements within web objects ensure easier orientation for Internet users (Leuthold et al., 2011). Users also rely on their mental model of the system, influencing their expectations of how a website functions and looks (Foulsham & Underwood, 2008). By effectively arranging web objects based on users' mental models, website orientation can be simplified, thus enhancing the quality of interaction (Bargas-Avila et al., 2009). Eye-tracking is significantly associated with cognitive processes such as perception, memory, language, and decision-making. The connection between the eyes and the mind is not absolute, but, generally, it can be said that the eyes reflect the mental processing of whatever we are currently looking at (Carter & Luke, 2020). According to Clarke et al. (2017), eye movements are largely beyond conscious control.

Individuals can choose where to look, but finer details are largely reflexive, meaning participants do not precisely remember where they looked. Based on this, it can be stated that eye tracking can be used in unconscious processing. Fixation is the time during which the eyes are focused on a target, with perception remaining stable over time, and during which the eyes receive necessary visual information. A single fixation cannot gather quality information from the entire visual field, so it is necessary for the eyes to move frequently. Therefore, most fixations are relatively short, and eye fixations vary in length depending on several factors such as the nature of visual stimuli, the purpose and complexity of the task, individual skill, and attention (Rayner, 2009).

Methods

The aim of the study is to use eye-tracking technology to investigate how consumers perceive advertising appeals in terms of distinguishing between the promoted product and accompanying elements in the advertisement.

We hypothesize that respondents are more focused on emotionally charged elements of the advertising stimulus than on the promoted product itself.

Participants

The research sample consisted of 35 students aged 19 to 23 years, of whom 18 were women (51%) and 17 were men (49%). Data collection took place from October to November 2023 at the Neuromarketing Laboratory at the Faculty of Management and Business, University of Prešov, Slovakia. Each respondent was briefed on the procedure of biometric testing and signed an Informed Consent to participate in the biometric study.

Apparatus

The eye-tracker used for research in our study was from the company iMotions, model Smart Eye AI-X (Table 1), which is recommended for studies within marketing, UX, media, and psychology.

Table 1: Technical Specifications of eye-tracker

Sampling Rate	60 Hz
Headbox (Freedom of Head Movement)	35 x 30 cm at 65 cm distance
Operating Distance	45 – 85 cm
Accuracy	0.5 degrees (typ.)
Precision	0.1 degrees (typ.)
Output Data	Gaze point, pupil diameter, time stamp
Blink Recovery Time	1 frame (immediate)
Gaze Recovery Time	1 frame (immediate)
Latency	25 ms from camera exposure
Eye Tracking Principle	Dark pupil and corneal reflection
Maximum Screen Size	24" (16:9 aspect ratio)
Operating Environment	Indoor (all illumination conditions)
Size	280 x 13 x 32 mm (width x height x depth)
Weight	147 g
Cable Lengths	2 m
Camera Interface	USB 3.0
Mount Type	On-scree (with mounting plate)
Operating System	Windows 10

Source: iMotions, 2024

The software evaluates 48 metrics divided into five areas: Information, Gaze-based metrics, Fixation-based metrics, Saccade-based metrics and Mouse-based metrics. For the purposes of our study, we selected 5 metrics that we used in the analysis. Specifically, these are (iMotions, 2024):

- TTFF (Time to First Fixation)(ms) - Average time that passed since the AOI's start time until the first fixation was detected on the AOI.
- Dwell Time (ms) - Average of how long the respondents gazed at the AOI.
- Respondent ratio (%) - Percentage of respondents who gazed at the AOI.
- Fixation count - Average amount of fixations detected inside the AOI.
- Revisit count - Average of how often the respondents looked back and fixated at the AOI after the first dwell.

The result of the measurements also included a heat map. A heat map is a visual representation of data where values are depicted as colors on a two-dimensional surface, such as a map or grid. Areas where users fixate their gaze more frequently or for longer durations are represented by warmer colors such as red or orange, indicating high attention. Conversely, areas with fewer fixations or shorter durations are depicted with cooler colors like blue or green, representing lower attention.

Material

The stimulus presented to the respondents was an advertising poster for a Škoda car in Slovak language. This poster was chosen because it depicts a car model with a background of a child. The image of the child is intended to serve as a "background figure," but, due to its size and prominence, we assumed that it would "overshadow" the main focus of the poster, which should be the car itself. The image of a smiling child generally evokes emotions, which contrasts with the image of the car. Slightly above the center of the poster, the advertising text is prominently displayed in large font, translated like: „Reality is most beautiful when it's not virtual. Charge up your life with the new fully electric Škoda Enyaq iV SUV“.

Results

To verify the assumption that respondents are more focused on emotionally charged elements of the advertising stimulus than on the promoted product itself, we evaluated the heat map of the tested advertising poster and selected indicators from eye-tracking data.

Picture 1: Areas of interest and heat map

Source: Authors' own processing

In Picture 1, the first part depicts the Areas of Interest (AOIs) that we considered important in terms of respondent attention and subsequently tested. The second part of the picture shows an aggregated heat map, illustrating areas with the highest incidence of respondent gaze. From the heat map, we can see that respondents looked most at the advertising text (ad copy) and the child's face. According to the colors on the map, respondents looked less at the car brand logo and the car itself. The small text at the bottom of the poster was only started by most respondents, but according to the heat map, almost nobody finished reading it.

More detailed results are provided by the labeled Areas of Interest (AOIs), which we present in Table 2.

Table 2: Areas of Interest

AOI	TTFF (ms)	Dwell Time (ms)	Ratio (%)	Fixation (count)	Revisits (count)
Logo	4 586.6	313.9	23.8	1.3	0.0
Brand name	2 442.7	587.7	46.2	2.3	0.8
Ad copy	340.2	3 613.9	100.0	16.4	2.7
Footer text	6 531.5	841.8	50.0	3.2	0.2
Car	1 951.8	1 555.5	88.5	5.8	1.6
Child´s face	3 146.1	883.4	76.9	2.9	0.6
Child´s smile	3 205.2	812.3	38.5	1.9	0.6

Source: Authors' own processing

The TTFF indicator was shortest for the Ad copy (340.2 ms), indicating that respondents focused on this area first. Subsequently, they looked at the Car, then at the Brand name, followed by the Child's face and smile. The last thing they gazed was the Logo and Footer text (after 6,531.5 ms). According to the Dwell Time indicator, we see that respondents spent the longest time gazing the Ad copy area (3,613.9 ms), likely because it is positioned in the center of the poster and written in large font. The second area with the longest viewing time was the Car. This was followed by the Child's face and smile, and the least observed were the Brand name and Logo (313.9 ms). All respondents looked at the Ad copy (Ratio = 100%). More than 50% of the respondents looked at the Car and the Child's face. Conversely, less than 50% of the respondents focused on the Brand name, Child's smile, and Logo (Ratio = 23.8%). To determine the number of eye fixations in the selected area, we used the Fixation indicator. According to it, our poster received significantly the highest number of fixations in the Ad copy area (16.4 counts). Respondents looked at the other areas much fewer times, with the least being on the Logo (1.3 count). The number of times respondents returned their gaze to previously viewed areas is indicated by Revisits, which is highest in the Ad copy (2.7 counts) and lowest in the Logo area (0 counts), where none of the respondents returned to it.

Our assumption was that the majority of the respondents would focus their gaze most on the image of the child. The heat map indicates that the most viewed areas were the advertising text, the child's face, and the car in the registration number section. Indicators from eye-tracking measurements show that the area that respondents were most interested in was the advertising text (ad copy) area, and the least interesting area was the footer text. Our assumption was therefore not confirmed because the child's face did not prove to be the most viewed area.

Conclusion and Discussion

The emotional state of an individual is a factor that modifies perception and attention to some extent. The impact of affective advertisements on attention has been mainly studied by Buodo, Sarlo, and Palomba (2002) and Schimmack and Derryberry (2005). Further research by Fenske and Eastwood (2003) and Fox and Russo (2005)

has shown that stimuli with negative elements are quickly detected, and visual attention is subsequently directed towards their placement. It is assumed that positive stimuli aim to explore new information, while negative emotions primarily affect focus (narrowing) of attention and cognition. The results suggest that positive valence, in terms of mood, provides an expansion of attentional scope, whereas negative valence narrows distribution, or the scope of attentional focus. The effects of broad and narrow attention are termed ambient and focal attention in eye-tracking literature. Ambient attention is characterized by short fixations, whereas focal attention is characterized by long fixations (Krejtz et al., 2017). Eye movements when viewing advertising posters are influenced by several factors, including size, color (Lohse & Wu, 2001), visual clutter (Janiszewski, 1998), and social cues (Hutton & Nolte, 2011). Creative or original advertisements are more memorable than typical ones and are also more popular and considered more interesting (Higgins et al., 2014). Eye tracking quantifies attention paid to advertising elements. Brand attention is a crucial component of advertising effectiveness. An advertisement that generally captures attention and pleasure may not necessarily translate attention to the brand and associate with the brand (Pieters et al., 2002). Quantifying visual attention to advertising elements is an important and sought-after measurement. It serves as a suitable test case for determining whether eye-tracking solutions have the necessary sensitivity and specificity to measure attention in advertising (Plassmann et al., 2012).

Studying eye movements and advertisements provides general theoretical insights (Wedel & Pieters, 2008), examining the relationships between eye movements and higher-level phenomena such as memory and preferences. It helps understand how we integrate advertising text and images within our visual environment. Advertisements are thus often complex stimuli. Eye tracking is useful for those designing advertisements or various announcements or warnings in advertisements. Eye movements offer insight into the rapid and detailed dynamics of visual attention, which are not as readily accessible through verbal reports (Pieters & Wedel, 2008). Eye tracking is conducted in real-time during advertisement viewing without interfering with the process (Glaholt & Reingold, 2011). The technique is less prone to response bias. Eye tracking is an effective means to determine specific features of advertisements contributing to their success or failure in attracting viewers' attention (Treistman & Gregg, 1979). When eye tracking is used in conjunction with other approaches, including subject interviews, testing their memory of products or brands, and monitoring their selection, this technique can significantly contribute to applied advertising research.

In this contribution, we provide basic information regarding eye movement characteristics, as well as their patterns during reading, scene perception, and visual search. Advertisements often contain text as well as information resembling various scenes, as well as a search component for specific information. We provide an overview of key findings related to eye tracking during advertisement viewing. The factors we have examined in this contribution have a significant impact on data quality, and we argue that the presented results are beneficial for anyone aiming to capture high-quality data in psychological and neurological investigations. We are, of course, open to further research corresponding to these findings across a broader range of eye trackers and advertisements.

Acknowledgement

This work was supported by the grant 1/0428/23 VEGA Research on Customers´ Subconscious Reactions Using Eye-Tracking and Other Neuromarketing Tools.

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