ISSN(p): 2146 - 9903
ISSN(e): 2147 - 3056

ARTSÜREM

İDİL

Yıl 13 - Sayı 113 - 2024 - Volume 13 - Issue 113

ARTSÜREM

İmtiyaz Sahibi / Publisher
Sanat ve Dil Araştırmaları Enstitüsü (SADA)

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FROM NEURONS TO CLICKS: COMBINING NEUROSCIENCE INSIGHTS WITH WEB DESIGN

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İşbilen, Damla. "From Neurons to Clicks: Combining Neuroscience Insights With Web Design". idil, 113 (2024): s. 1–6. doi: 10.7816/idil-13-113-01

ABSTRACT

Attention has been a focal point for neuroscientists for decades, and the web provides them with a robust testing ground for pioneering techniques and ideas. The utilization of eye tracking has long been integral for neuroscientists in gauging attention. By analyzing the fixation duration on specific points, researchers can discern the significant elements for users, and designers can improve visual clarity and attract maximum attention. Tracking user behavior, such as touchscreen interactions, provides valuable data to optimize a website's design. Exploring machine learning for interpreting user behavior data could enhance personalized web experiences with valuable contributions from neuroscience. This study informs web designers and developers about leveraging advancements in neuroscience to improve user interaction and capture maximum attention in web design.

Keywords: Neuroscience, Web Design, Eye-Tracking, User Interaction, Visual Perception

Makale Bilgisi:
Geliş: 22 Kasım 2023 *Düzeltme:19 Ocak 2024* *Kabul: 22 Ocak 2024*

The visual system involves a complex pathway from the retina to the thalamus and the visual cortex, where information is analyzed and evaluated for meaning and an appropriate response.

The amygdala plays a crucial role in emotional processing and can influence behavior even before the neocortex has made a decision (Paradiso, 1998:570). Joseph LeDoux's research emphasizes how the amygdala can take control of actions while the neocortex is still in the decision-making process (Dannlowski et al., 2007:418-424).

Most of the message proceeds to the visual cortex, while a small portion goes directly from the thalamus to the amygdala, allowing for a faster but less precise emotional response (Kerschensteiner & Guido, 2017). Additionally, the visual thalamus contributes to attention, awareness, and visually guided actions, presenting a general role for the thalamus in perception and cognition (Saalmann & Kästner, 2011:209-223). The amygdala, a key player in emotional responses, receives a direct signal from the thalamus, allowing for a faster emotional response before the cortical centers fully understand the situation (Méndez-Bértolo et al., 2016:1041-1049).

Consumers' brains generally respond to visual perceptions in two ways: a quick, reactive response that occurs in a short period (emotional) and a slower, analytical response that happens over an extended period (rational). The first response does not allow time for conscious thought about the graphic signature; instead, consumers react to it. In the second response, consumers can think analytically about it.

This dual response is particularly relevant in consumer behavior, as it influences how individuals perceive and respond to various stimuli. The rational response allows consumers to think analytically about the visual stimuli, influencing their cognitive and affective responses (Hwang & Kim, 2021:777-796). The role of visual stimuli in consumer perception has been extensively studied, with research indicating that visual cues significantly influence consumer responses and decision-making processes. Moreover, variations in visual complexity can lead to differences in psychological perception among different consumer groups (Sha & Lin, 2022). This highlights the importance of considering diverse consumer demographics when analyzing visual stimuli and their effects on perception.

Visual metaphors' role in shaping consumer perceptions of brand image and consumption has been studied, emphasizing the significance of visual rhetoric and brand equity in understanding consumer responses to visual stimuli (Batool et al., 2020:145-158). In summary, the interplay between quick, emotional responses and slower, rational responses to visual stimuli significantly impacts consumer perception and decision-making. Understanding the dual nature of these responses is crucial for brands seeking to utilize visual cues to influence user behavior effectively.

Tracking User Interactions in Web Design

Tools such as Google Analytics have the potential to track user behavior, including clicks, and provide valuable data for optimizing a website's visual layout and elements to attract more attention. By tracking website visits, traffic sources, and depth of visit, these tools offer insights into user behavior and provide valuable information for enhancing visual clarity and attracting attention (Smith et al., 2015:480-491). Jansen et al. (2022) and Smith et al. (2015) demonstrate the potential of analytics tools, such as SumoMe's Heat Maps, to track user interactions and provide insights for optimizing website elements to enhance visual clarity and attract attention. SumoMe's Heat Maps shows where visitors click, meaning the designer can move text, buttons, and call-to-actions around to ensure the most visual clarity and attract attention (Jansen et al., 2022). Designers should remember that this only sometimes translates to a positive outcome. Redirecting attention with a captivating graphic may distract users from other essential elements.

Similar to how eye tracking aids designers in positioning text, graphics, and crucial information, there are additional scientific techniques that designers can incorporate to determine the optimal placement of buttons on a page. When using Canva, users come across well-designed buttons on the page that are prominently placed and positioned strategically for easy interaction. The buttons are user-friendly and easily accessible, and their size and placement are unobtrusive. It is worth noting that the buttons adhere to Fitts' Law, an observation made by American psychologist Paul Fitts. The law quantifies rapid, targeted movements precisely when reaching for an online button.

Fitts' Law, a fundamental principle in human-computer interaction, posits that the time taken to move to a target is influenced by the distance and the target's size (MacKenzie,1992: 91-139). This relationship is expressed as a logarithmic function, where movement time is proportional to the distance to the target divided by the target size. The closer or larger the target, the quicker the movement. Fitts' Law has been widely applied and validated in various contexts, such as pointing movements, psychomotor tasks, and brain-computer interfaces (McConnell, 2019:1756-1760; Willett et al., 2017; Gawthrop et al., 2008:412-431). It

has also been used to evaluate the performance of input devices, including mouse and joysticks (Radwin et al., 1990:423-438).

Fitts' Law also underscores the importance of placement. If a designer wants users to move from one button to another quickly, they must position the buttons in close proximity. This is especially important when the user navigates through a sequence, such as clicking a payment or sign-in button and then moving on to the next step. Mobile browsing now constitutes more than 50% of web navigation (Borodin et al., 2007:3), necessitating web designers to craft designs that accommodate cursor and touch interactions. Adapting web content to enable effective web browsing on mobile phones is an attractive challenge to address (Kerbs & Vahidi, 2013:113). The size of human fingers and the lack of sensing precision can make precise touchscreen interactions difficult (Benko et al., 2006:1263-1272). Therefore, web designers need to consider these limitations when crafting designs for mobile browsing.

Understanding users' touch behavior on large mobile touchscreens is crucial for effective design. The potential of touch interactions on mobile devices for estimating the relevance of web search results has been studied (Guo et al., 2013:1821-1826); interactions can have implications for search result ranking and evaluation, further emphasizing the significance of touch interactions in mobile browsing design. A toolkit has been developed to analyze and predict touch-targeting behavior on mobile websites, allowing web developers to collect and analyze touch interactions with their websites (Buschek et al., 2015:54-63), demonstrating the growing emphasis on touch interaction analysis in web design. Understanding touch behavior, analyzing touch interactions, and adapting web content are crucial aspects that web designers must consider when crafting mobile browsing designs.

The use of eye tracking has been vital for neuroscientists to measure attention. By analyzing fixation duration on specific points, researchers can identify significant elements for individuals. Taking this concept further, EyeQuant has developed a predictive algorithm based on eye-tracking data. This innovative approach allows designers to upload their creations to the EyeQuant website, receiving instantaneous insights into how users perceive and focus on their site. EyeQuant employed thousands of participants examining German websites to compile an extensive dataset. This dataset sheds light on what captures attention, how much time individuals allocate to different items on a site, and the features that draw a user's eye. Their findings reveal that color contrast, the number of edges, bolded text, graphic clusters, and faces are pivotal in attracting attention.

The use of eye-tracking data to develop a predictive algorithm for identifying focal points in web page designs and providing feedback on visual elements is supported by research. Djamasbi (2014:37–54) and Silvennoinen and Jokinen (2016) emphasize the significance of visual elements in web design and the need to analyze user interactions to enhance effectiveness.

Eye Tracking in Human-Computer Interaction (HCI) and Usability Research by Jacob & Karn (2003:573–605) discusses eye tracking in HCI and its significance in understanding visual attention on web pages. Bergstrom and Schall (2014) provide insights into eye tracking in UX design and its relevance in understanding visual interactions on web pages. For example, Amazon strategically combines human elements and bold text on a page to captivate the user's attention. Cyr et al. (2009: 539–566) explore the impact of human images in website design, indicating that human elements can significantly influence user engagement. O'Brien and Toms (2008: 938–955) provide a conceptual framework for defining user engagement with technology, emphasizing the importance of attention focus and intrinsic interest. Wang et al. (2014: 582-605) delve into the effect of human images in Business-to-consumer (B2C) website design, shedding light on the context-dependent nature of image appeal, which could be pertinent to Amazon's strategic use of human elements.

Djamasbi (2014: 37–54) discusses the application of eye-tracking in web design and the benefits of utilizing eye-tracking data to enhance web design, emphasizing eye-tracking's potential in identifying visual elements that capture attention. Tangmanee (2016: 49–76) presents an eye-tracking study on YouTube ad banners, highlighting the significance of eye-tracking in understanding visual attention and the effectiveness of visual elements in capturing viewers' attention.

Conclusion

The intersection of neuroscience and visual communication design holds great promise for the future. Neuroscience experiments have demonstrated potential for assessing visual communication effectiveness (Chen & Zhang, 2019:31-36). However, there are limitations in current neuroscience-focused approaches for evaluating design due to the lack of direct visualization of mental activities (Wang et al., 2022:555–573). Despite these limitations, the future of this intersection holds promise, as theoretical developments in

visualization can draw on advances in neuroscience, connecting human-centric processes with machine-centric processes (Chen et al., 2017:103–112). Attention spans are diminishing, and users are making rapid decisions about websites. Users who need help finding the content they seek will quickly navigate away. As technology evolves, understanding and predicting how users interact with touch interfaces can guide developers in creating websites that are not only visually appealing but also seamlessly responsive to diverse user behaviors. Future research may delve into the refinement of eye-tracking algorithms, pushing the boundaries of accuracy and efficiency. Additionally, investigating the interplay between visual attention and emotional responses on the web could unlock new dimensions in user experience enhancement.

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NÖRONLARDAN TIKLAMAYA: NÖROBİLİM İÇGÖRÜLERİNİ WEB TASARIMIYLA BİRLEŞTİRMEK

Damla İşbilen

ÖZ

Dikkat, onlarca yıldır nörobilimciler için bir odak noktası olmuştur. Web sayfaları, nörobilimcilere öncü teknikler ve fikirler için verimli bir test alanı sunmaktadır. Göz takibinin kullanımı, nörobilimciler için dikkati ölçmede uzun süredir önemli bir rol oynamaktadır. Araştırmacılar, belirli noktalardaki sabitleme süresini analiz ederek, kullanıcılar için önemli unsurları ayırt edebilmektedir. Bu değerli veriler ışığında tasarımcılar, görsel netliği artırarak kullanıcıların dikkatini maksimum seviyede çekebilmektedir. Aynı zamanda, dokunmatik ekran etkileşimleri gibi kullanıcı davranışlarını izlemek, bir web sitesinin tasarımını optimize etmek için değerli veriler sağlamaktadır. Kullanıcı davranışı verilerini yorumlamak için makine öğrenimini keşfetmek, nörobilimin değerli katkılarıyla kişiselleştirilmiş web deneyimlerini geliştirebilir. Bu çalışma, web tasarımcıları ve geliştiricilerini, kullanıcı etkileşimini artırmak ve web tasarımında maksimum dikkati çekmek için nörobilim alanındaki gelişmelerden nasıl faydalanacakları konusunda bilgilendirmeyi amaçlamaktadır.

Anahtar Kelimeler: Nörobilim, Web Tasarımı, Göz Takibi, Kullanıcı Etkileşimi, Görsel Algılama