

# Emerging Methods as a Tool for Obtaining Subconscious Feedback in E-commerce and Marketplace

J. Berčík, A. Mravcová, A. Rusková, P. Jurčíšin, R. Virágh

**Abstract**—The online world is changing every day. With this comes the emergence and development of new business models. One of them is the sale of several types of products in one place. This type of sales in the form of online marketplaces has undergone a positive development in recent years and represents a kind of alternative to brick-and-mortar shopping centers. The main philosophy is to buy several products under one roof. Examples of popular e-commerce marketplaces are Amazon, eBay or Allegro. Their share of total e-commerce turnover is expected to even double in the coming years. The paper highlights possibilities for testing web applications and online marketplace using emerging methods like stationary eye camera (Eye tracking) and facial analysis (FaceReading).

**Keywords**—Emerging methods, consumer neuroscience, e-commerce, marketplace, user experience, user interface.

## I. INTRODUCTION

THE online world is changing every day. With this, the emergence and development of new business models is also related. One of them is the sale of several types of products in one place. The idea of buying several products under one virtual roof aligns with the convenience and efficiency that online marketplaces offer. These platforms bring together a wide range of sellers and products, allowing consumers to browse and purchase items from various categories in one place. This contrasts with the traditional shopping centers model, where consumers would need to visit multiple stores physically to find a variety of products.

In e-commerce, a marketplace refers to a platform or website on which multiple sellers or third-party sellers can offer and sell their products or services to customers. The marketplace operator provides the infrastructure, technology and customer support, while the sellers are responsible for creating and managing their offers, setting prices and fulfilling orders. Sellers interested in growing their business sustainably are no longer passing by these platforms unnoticed.

The main purpose of an e-marketplace is to provide a platform where buyers and sellers can meet and transact. The aim is to facilitate the transaction process, allowing buyers to find and buy products or services from different sellers, while giving sellers access to a large number of potential customers. The marketplace operator may generate revenue by charging

fees or commissions on sales made through the platform. Ultimately, the goal of the marketplace is to create a mutually beneficial ecosystem that enables both buyers and sellers to achieve their goals efficiently and effectively.

Examples of popular e-commerce marketplaces are Amazon, Alibaba, eBay or Allegro. In the coming years, it is expected that their growth will even double their share of the total e-commerce turnover. Therefore, they are considered to have a great potential to be examined with various effective modern methods to even make their potential contribution for all sides higher. The article therefore demonstrates the use of new methods such as stationary eye camera and facial analysis for the purpose of testing web applications and online marketplaces.

## II. THEORETICAL BACKGROUND

In our study, we find it essential to concentrate mainly on three key areas central to our research: electronic marketplaces, developing techniques in neuromarketing, and e-commerce.

### *E-Business*

Generally, electronic business (e-business) can be defined as the utilization of the internet for connecting and enhancing business processes, electronic commerce, organizational communication, and collaboration within a company, as well as with its customers, suppliers, and other stakeholders [1]. Pilinkiene et al. [2] define e-business as a comprehensive system of processes and tools leveraging internet-based information technologies for both internal and external business operations. This approach encompasses the utilization of the internet, intranets, extranets, and diverse networks to facilitate commercial activities, as supported by various studies [1], [3], [4].

Electronic commerce, commonly referred to as e-commerce, specifically involves the online buying, selling, marketing, and servicing of products and services across computer networks. As e-business involves interactions with suppliers and customers, there exists a significant overlap in functions with e-commerce. Despite the frequent interchangeable use of the terms "e-business" and "e-commerce" [5], [6], the distinction between them lies in the broader scope of processes within e-

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business, which includes internal transactions within an organization. These internal transactions encompass activities related to procurement, logistics, supply chain management, payments, inventory control, and order tracking [3]-[5]. E-commerce can be best understood as a subset of e-business, with the primary overlap occurring in the realm of buying and selling products and services [1].

Aichele and Schönberger [7] describe e-business as one of the most significant applications of new digital information and communication technologies (ICT). In this context, the internet is considered as a universal technological platform that offers opportunities to enhance the capabilities of individuals and organizations [4]. It is used for buying and selling both physical and digital goods and services, deepening international connections, and managing business processes [3].

As society transitions from an industrial society to an information society, the importance of information has grown in comparison to production. As the information society advances, the economic structures associated with it are also changing. Many companies have shifted their business processes to the internet, enabling comprehensive electronic transactions based on modern ICT, leading to the concept of e-business [7].

The activities of e-business can be categorized into the subfields of e-commerce, e-communication, e-education, and e-information, or e-entertainment. One of the foremost challenges in the realm of e-business pertains to its substantial development costs. Achieving proficiency in e-business necessitates a significant financial outlay. Given the inherent complexity of e-business applications, an organization may find it imperative to undertake a comprehensive overhaul of its existing systems [8], [4]. This involves the acquisition of new hardware and software, along with the recruitment and training of new personnel. Embracing an e-business solution carries with it a heightened risk of failure. Another problem is the issue of business security, primarily due to the escalating threat of hacker attacks [8]. This concern becomes particularly salient since all information is exposed over the internet through e-business applications. E-business also offers a multitude of advantages for businesses.

Čiarnienė and Stankevičiūtė [3] outline two primary categories of drivers: Cost/efficiency drivers and Competitiveness drivers. The two key means by which these benefits can be realized are as follows: the potential for increased revenue through expanded reach to a larger customer base and fostering loyalty among existing customers, and cost reduction achieved by electronically delivering services.

When examining these advantages, two types of benefits become evident: tangible benefits and intangible benefits (see also [9]). Tangible benefits are associated with increased sales and the reduction of administrative, marketing, and supply chain costs. Intangible benefits arise from improved customer service, more rapid and responsive marketing communications, better information management, faster product development life cycles, and, consequently, quicker responses to customer needs [3], [6]. The adoption of e-business contributes to enhancing customer satisfaction, operational efficiency, cost

minimization, profitability, and, in turn, bolsters the company's competitiveness [10].

#### *Electronic Marketplaces*

Soh et al. [11] describe electronic marketplaces (EMP) as autonomous IT-powered intermediaries that link numerous purchasing organizations to multiple selling entities. An e-marketplace represents social structures, satisfies an economic market concept and relies upon the application of information communication technology [12]. These platforms essentially create a virtual marketplace where goods or services can be transacted over the internet. EMPs can vary in size, focus, and features, but they all share the overarching objective of facilitating online commerce.

EMPs have long piqued interest due to their potential to enhance market efficiency and drive down product prices, all while promoting greater price transparency. To achieve increased price transparency and reduced product costs, two essential conditions must be met. Firstly, the EMP must incorporate IT-enabled mechanisms that enhance price transparency. Examples of such mechanisms include electronic catalogues displaying posted prices, electronic forward or reverse auctions, or electronic price negotiation tools. Secondly, the EMP must achieve success, meaning both buyers and sellers actively participate in its ecosystem [11], [13].

Buyers engage by making purchases through the EMP, while sellers contribute by providing their product information on the platform. Electronic marketplaces occupy a crucial position within numerous industries. Their significance lies in their potential to enhance economic efficiency through the reduction of price-cost margins and the acceleration of business transactions. These platforms offer services that not only broaden the purchasing and selling capabilities of many companies but also imbue prices with greater dynamism, allowing them to respond more effectively to shifts in economic conditions [14], [13].

In addition, it should be noted that electronic marketplaces are well suited to complex business operations and even small changes in engagement protocols can have a major impact on the attractiveness and profitability of a marketplace. Wang and Archer [15] classify electronic marketplaces into distinct categories, which include aggregators, exchanges, auction sites, and collaboration platforms. Here, we recognize also aggregation marketplaces. These platforms serve as aggregators, bringing together numerous buyers or sellers along with their respective product catalogues. Pricing models in aggregator marketplaces can be either static or subject to negotiation, and prices may be determined offline or through eRFPs (Request for Proposals) [15]-[17].

Exchange marketplaces operate in real time, where prices are established through dynamic bid and ask interactions. Auction Sites facilitate session-based competitive bidding upon request. Participants engage in competitive bidding to determine prices. Collaboration platforms, on the other hand, primarily focus on facilitating pre-negotiated transaction execution rather than negotiation or price setting. These platforms are designed to streamline and support interactions in a collaborative manner.

It is important to note that auctions typically require at least a few participants on the bidding side, while collaboration platforms are structured to facilitate interactions between two parties (dyadic relations) [15], [12].

E-Marketplaces have transformative impact of on the world of commerce. These platforms have revolutionized the way business is conducted, offering sellers increased convenience, accessibility, and access to a broader customer base. Simultaneously, they provide consumers with an extensive array of choices and the convenience of shopping from the comfort of their homes. Prominent marketplaces like Amazon, eBay, Alibaba, Etsy, Airbnb, and Upwork have adapted their platforms over time to better align with the evolving needs of both buyers and sellers. Each of these platforms serves a specific niche or industry, catering to a diverse range of buyers and sellers [5], [18]-[20].

Electronic marketplaces effectively categorize and differentiate between various types of participants, including B2B, B2C, C2C, C2B, B2A, and C2A interactions. In recent years, there has been a noticeable surge in online shopping, with the percentage of customers opting for this mode of commerce steadily increasing over time [21]. This trend has brought significant benefits to customers, organizations and society. In contrast to traditional marketing systems, where customers expended considerable time and effort commuting to physical stores for their shopping needs, EMPs offer an enjoyable and efficient alternative for both customers and merchants [20]. It is a win-win situation where both parties derive substantial benefits from this evolving landscape.

#### *Neuromarketing and Emerging Methods*

According to Cosic [24], emerging marketing techniques fall under the umbrella of neuromarketing research methods, which have significantly advanced conventional marketing research. These methods shed light on how unconscious responses and emotions influence consumers' perceptions and decision-making processes.

Neuromarketing operates at the intersection of behavioral psychology, economics, and consumer neuroscience, delving into the cerebral mechanisms to gain insights into consumer behavior and enhance marketing strategies. These emerging methods involve various brain scanning techniques such as fMRI and EEG, along with eye tracking and physiological measurements like heart rate, breathing rate, and galvanic skin reaction. These tools help uncover the subconscious drivers behind choices and preferences [25]-[31]. Importantly, these drivers are not within the conscious awareness of consumers and, therefore, cannot be detected through traditional methods such as focus groups, interviews, and questionnaires [32], [33]. These emerging methods do not replace traditional market research approaches; instead, they complement them [34], [35]. The synergy between these approaches is poised to be a pivotal factor in the future success of marketing strategies [36].

Neuroscientific methodologies encompass the utilization of instruments and approaches designed to measure, map, and document brain and neural activity while individuals engage in various behaviors [37]-[39]. By doing so, these methods

generate neurological representations of such activity, enabling a deeper understanding of specific brain and nervous system responses resulting from exposure to stimuli [38], [40]. These techniques, which enable real-time observation of neural processes during behavior, can be categorized to neuroscientific tools and techniques for recording neural activity both within (electromagnetic and metabolic) and outside the brain, as well as neuroscientific methods for manipulating neural activity [25], [26].

An alternative perspective on neuromarketing tools, categorizing them into three distinct groups are presented by Alsharif et al. [25]. The first category involves the recording of metabolic activity in the brain, with Functional Magnetic Resonance Imaging (fMRI) being a commonly employed technique. This tool relies on monitoring blood flow within brain vessels to measure an individual's brain activity, rendering it highly potent due to its exceptional spatial accuracy. The second group of tools revolves around the recording of electric activity in the brain, predominantly featuring Electroencephalography (EEG). EEG, while being a cost-effective option, falls short in terms of spatial accuracy for measuring distal brain activity. Nonetheless, it excels in temporal accuracy, capturing brain activity in milliseconds. The third category encompasses the recording of non-brain activity, which includes tools like Eye-Tracking (ET), Facial Electromyography (FEMG), Galvanic Skin Response (GSR), and facial coding, among others [25], [26], [28], [30].

Eye Tracker, a contemporary neurophysiological tool, is widely used in experimental psychology and neurological research, primarily due to its ability to track visual attention and eye movements. It records eye movements, fixations, and pupil dilation, offering insights into various cognitive processes related to stimuli and providing valuable information on consumer behavior in response to marketing stimuli such as brands and advertisements. GSR, or Galvanic Skin Response, measures changes in the skin's electrical conductivity, reflecting increased activity in sweat glands. This technique is a convenient means of assessing emotional arousal dimensions and changes in skin conductance. GSR is particularly well-suited for studying consumer decision-making. Furthermore, combining EEG with tools like ECG and GSR allows for a more comprehensive understanding of cognitive and emotional responses [25], [26], [28], [30].

Stanton et al. [33] present a significant critique of neuromarketing, which pertains to the potential risks associated with harm and infringements on human rights. This criticism highlights two distinct categories of harm that may be brought about by neuromarketing: 1) Immediate effects on individual customers: These encompass the immediate impacts on individual consumers who engage with neuromarketing techniques. 2) Long-term effects on society: These refer to the broader, societal-level consequences that may result from the widespread adoption of neuromarketing practices [33]. While some of the ethical concerns and the ensuing consumer apprehension surrounding neuromarketing are well-founded, the authors also underscore that certain fears are unfounded and thus inconsequential. They argue that the application of

neuromarketing tools must be underpinned by a framework of bioethical considerations, in addition to adhering to fundamental business ethics standards. This is because both human dignity and integrity are potentially at risk due to the implications of this technology [33].

### III. MATERIAL AND METHODS

The main aim of the paper was to investigate the user experience (UX) and interface perception (UI) with selected parts of the *kaufland.sk* website, which is an online marketplace. There were two parts under investigation:

- the homepage interface of the site displayed in the computer interface
- product categories (search/filtering for specific types of goods).

Thirty participants (52% male and 48% female online electronics shoppers aged 18-40 years) took part in the testing. The task was set as follows: 'Imagine you want to buy a powerful laptop. Visit *www.kaufland.sk* on your computer device and search for a powerful laptop.' The data were collected using a Tobii X2-30 mobile Eye tracking camera and FaceReader 7. After the test, a short interview was conducted with the respondents. The survey was conducted on July 28 and 29, 2023 in the Laboratory of Consumer Studies (LSS), FEM SUA in Nitra (Fig. 1).



Fig. 1 Testing of the website in LSS FEM SPU in Nitra

The entire testing process was guided by the Code of Ethics of the "Laboratory of Consumer Studies" of the Faculty of Economics and Management of the Slovak University of Agriculture in Nitra [41] and the Neuromarketing Science and Business Association [42]. The principles set out in the ICC/ESOMAR Code of Ethics (2020) were also accepted. Each respondent was informed about the experimental procedure, received a short training on the methods used (Eye tracking and Face reading) and completed two GDPR compliance forms, namely consent to biometric testing, processing and storage of personal data and acknowledgement of the short training.

The primary data were processed through the Observer XT synchronization software.

### IV. RESULT AND DISCUSSION

In terms of the results shown in Fig. 2, it is possible to see the heat maps of the visual attention of the respondents. The heat map gives the ratio of the most time spent looking and the most viewed parts. Based on the heat map, it can be seen that the respondents immediately move to the menu or the search box when they come to the home page without performing any interaction with other parts of this page. It can also be seen that in addition to the menu and search box, respondents also viewed the icons (login, shopping cart, *kaufland* card) displayed on the right side of the page, as well as the image of the first banner 'hundreds of good deals'. These findings suggest that ET can significantly complement the information about respondents' real visual attention while browsing the site also in the computer interface, which is often obtained through online analytics.

Fig. 3 shows the search process for the product category that was part of the respondent assignment. Within the segmentation of the product categories, it can be seen that the most visual attention is concentrated in the left part of the interface, where, in addition to the categories of the online marketplace, sections such as "store offer, *kaufland* card" are located. The higher level of visual attention concentrated in this section may indicate a certain level of uncertainty in terms of clarity. The page is designed in such a way that the rest of the page is darkened when searched (emphasis on product categories) nevertheless, the heat maps show that some respondents also noticed the darkened content. This may also be due to the assignment as in the next steps the visual attention was focused on the electronics category and then the computers subcategory. Within the selected product category, customers had the opportunity to further scroll which was also the subject of testing and can be seen in these screenshots. The marketplace within a given product category offers a quick selection of the product subcategory on the left side of the page, which was also viewed to a significant extent by the respondents. The filters in the middle section of the site (screen size, brand) attracted the highest level of visual attention within this interface, which is evident from the heat map obtained through Eye tracking. An interesting finding is the relatively high level of visual attention at this stage of product filtering also focused on the main menu and central search window.

After prescrolling down within a product category, we are able to evaluate the interaction with individual products, but also with filters (manufacturer, price, screen size), as presented by ET results via heat maps. Also in this step we can see a relatively high degree of visual attention focusing on the filters in the left part of the web interface. Within the products themselves, the price was a significant element of visual attention, but also the technical specifications of the laptops (see Figs. 4 and 5).

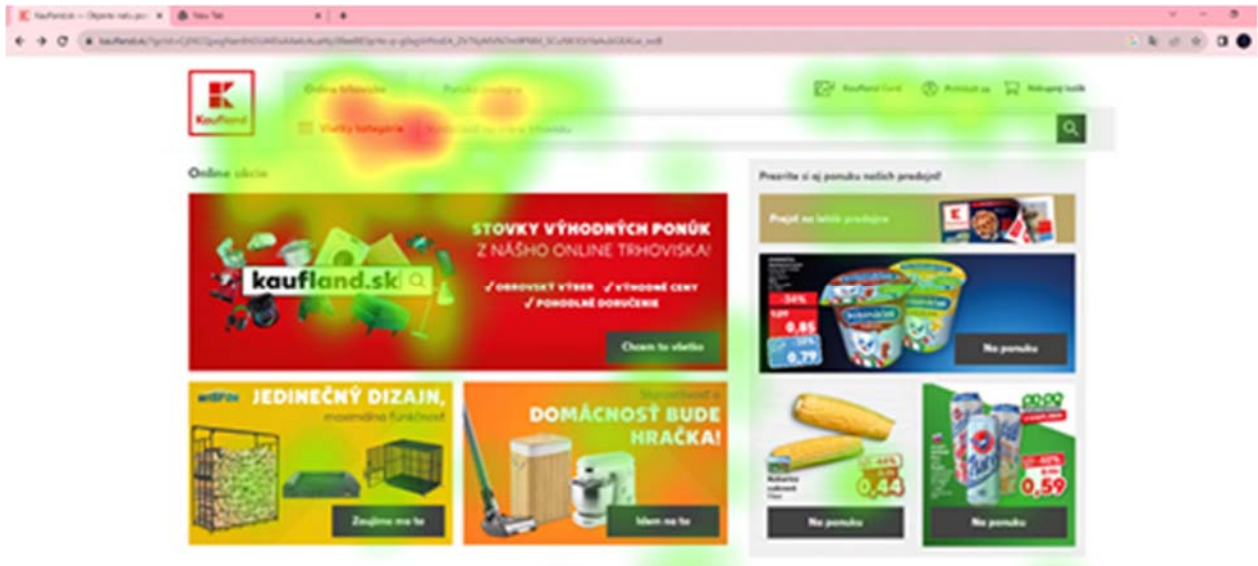


Fig. 2 Heat map of the kaufland.sk marketplace homepage

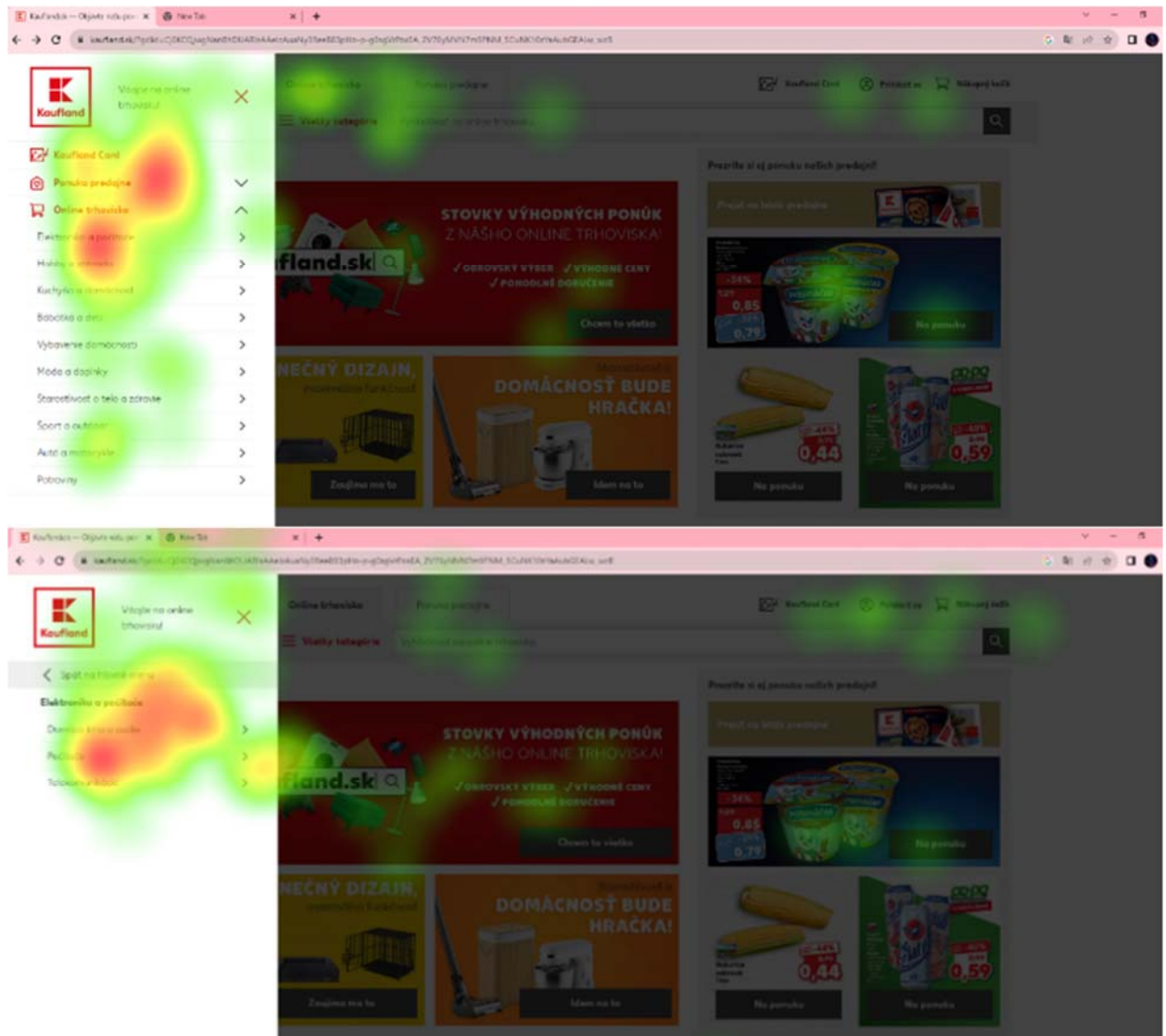


Fig. 3 Heat maps of the search process in product categories and subcategories I

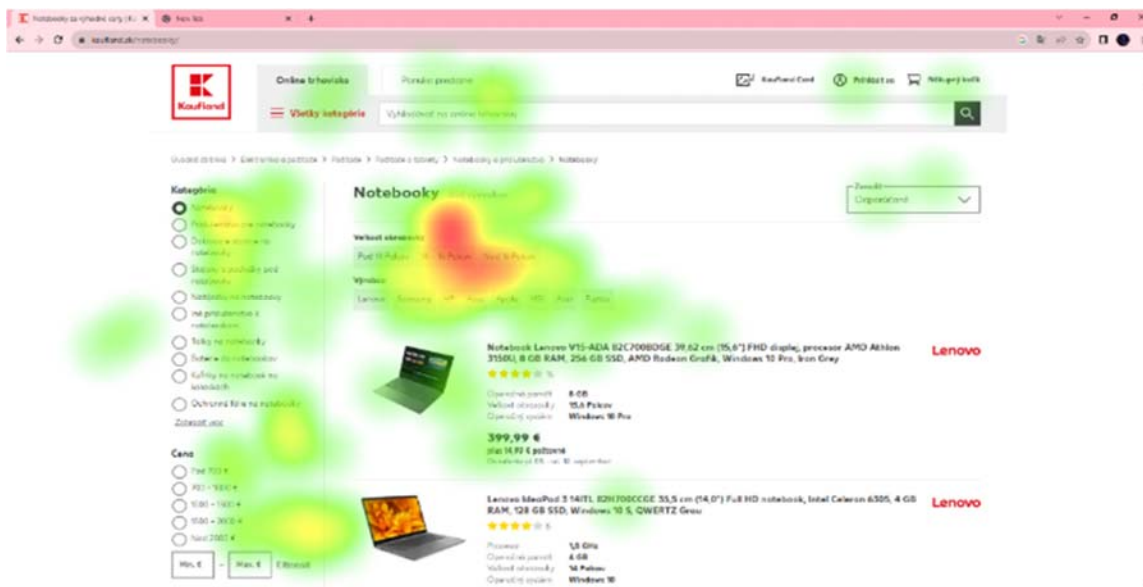


Fig. 4 Heat map of the product filtration process II



Fig. 5 Heat map of the search process in product categories III

In addition to visual attention, emotional attention was also tested under laboratory conditions. This was recorded using Face Reading. Based on the monitoring of emotional attention, the aspects with the highest level of attention were identified. Based on the monitoring of emotional attention (brown sections), it can be seen that respondents focused most on the main menu of the site, which includes the online marketplace, the search box, the stores and the product categories, within the

introduction section. In the context of searching for a specific product, the emotional attention monitoring identified the places with the highest attention within the filters in the left and middle parts of the web interface. The higher level of attention may be related to the assignment, but it may also indicate a certain level of uncertainty in terms of the UX design of the marketplace (see Fig. 6).

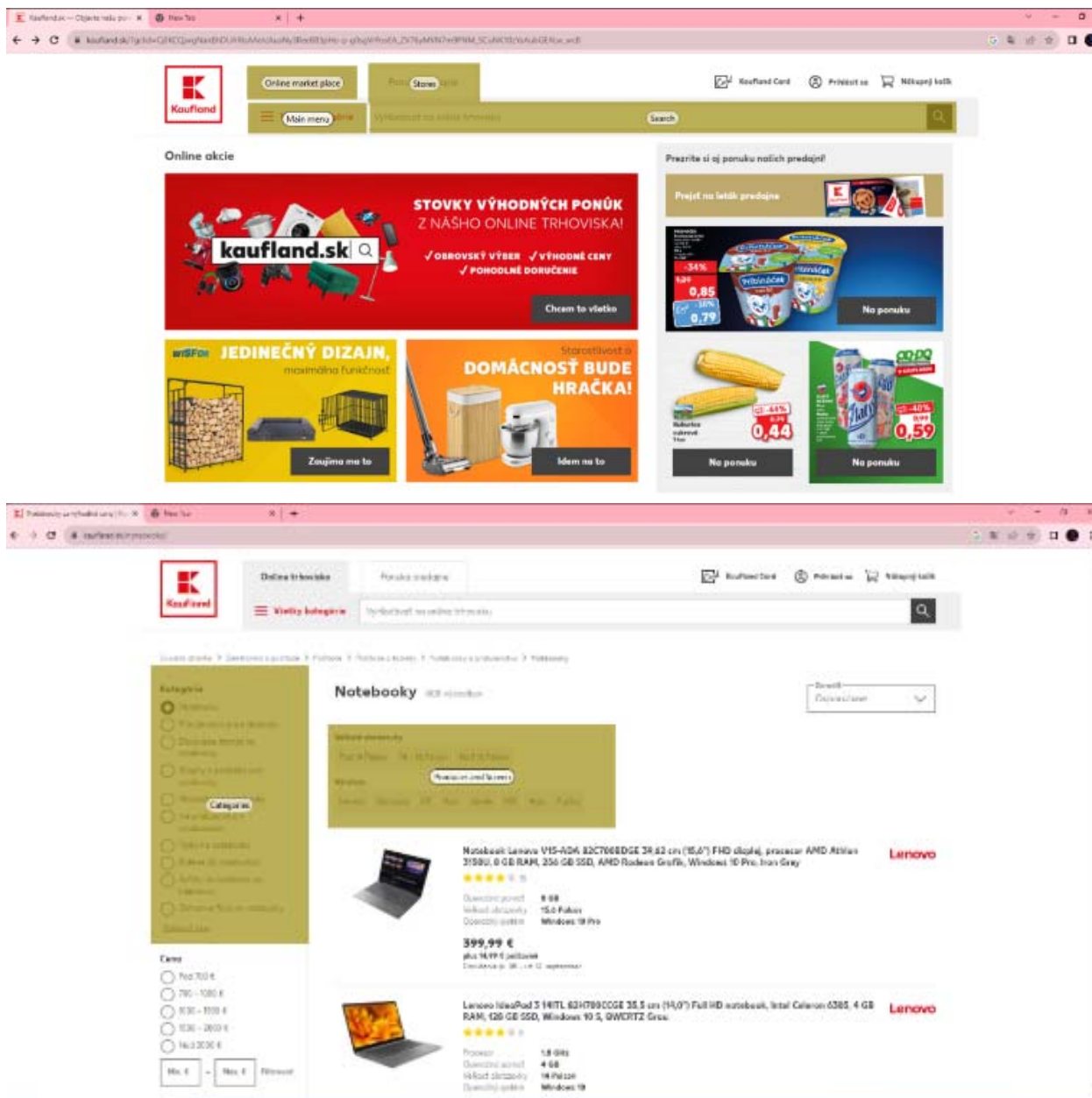


Fig. 6 Attention level – selected parts of the kaufland.sk website

After the test, an interview was conducted with the respondents. The result of the question whether there was anything they did not like about the web interface can be seen in Fig. 7. After the test, an interview was conducted with the respondents. The result of the question whether there was anything they did not like about the web interface can be seen

in Fig. 7. In the post-test interview, the majority of respondents (17) stated that there was nothing they did not like about the online marketplace computer interface, five respondents mentioned a problem with the direct search and three, the placement of filters, which is related to the process of searching for specific products, four respondents were not comfortable

with the overall layout of the site, and one respondent was not comfortable with the design of the site.

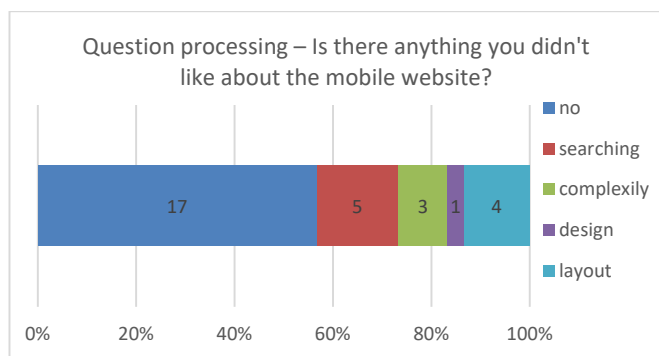


Fig. 7 Question processing – Is there anything you didn't like about the mobile website?

#### V. CONCLUSION

We conducted a study that brings a new perspective on the use of neuromarketing tools in testing and improving UX and UI design of a website. While online analytics on mobile devices offer a detailed view of where consumers are clicking the most, heat maps reveal the areas that actually capture their visual attention. Aspects of the main kaufland.sk site that distracted respondents' visual attention were identified e.g. icons (login, shopping cart, Kaufland card). Within the segmentation of product categories, it can be seen that a significant level of visual attention is concentrated in the left part of the interface, where, in addition to the online marketplace categories, sections such as 'store offer, Kaufland card' are located, and the higher level of visual attention concentrated in this part may indicate a certain level of uncertainty in terms of clarity. We recommend Kaufland to change the way the website is displayed when searching for products, as respondents also spend time looking at darkened areas. A significant finding is the relatively high level of visual attention in the product filtering stage also focused on the main menu and the central search window, which may be due to the awkward placement of the filters. In addition to visual attention, emotional attention was also focused on the search filters which may also indicate a degree of uncertainty in terms of the UX design part of the marketplace website. The suggested improvements could contribute to increased customer satisfaction and higher conversion rates.

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