

## ADVANCED MAPPING AND EVALUATION OF CONSUMER PERCEPTION AND PREFERENCES ON THE CAR MARKET BASED ON EYE-TRACKING

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**Abstract:** The paper explores the place and position of consumer neuroscience in marketing management while it points out its role in understanding consumer behaviour. The current competitive environment is associated with the re-evaluation of traditional methods and processes on the one hand, and the application of new sources of information for the report manager's decision on all levels, not only in manufacturing companies, service companies as well as commercial companies. The aim of this study was to point out the relatively new ways of marketing research through interdisciplinary field called consumer neuroscience for effective marketing management realization in a car selling enterprise. From the results we were able to analyse feedback about visual attention in buying decisions and so realize effective marketing management in form of proper strategic decisions.

**Key words:** consumer neuroscience, marketing management, brands, visual attention

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### Introduction

Managers must carry out one of the very important tasks that relates to their customers, and that is to know their needs and wants, and to deliver their products and services to the market in a better and faster way than the competitors. Gallo, (2010) defines marketing management as a process, which involves the planning and implementation of concepts, pricing, promotion and distribution of ideas or goods and services, the aim of which is the exchange that satisfies individuals or organizations. General management comes and is claimed mainly from the material production. According to Kotler et al. (2007) marketing management is defined as a science or art, in which target markets are selected and profitable relationships are built with them. Thus, managing demand and further managing customer relations includes marketing management. Bartošová and Krajníková (2011) state that we can speak about marketing management as a continuous process, which involves analysis, planning, decision-making, implementation and monitoring, which creates and maintains long-term relationships with target customers and

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allows achieving set goals Kubicová and Kádeková, (2017). Consumer behaviour investigates the thought processes and actions of consumers – ultimate end users (rather than business buyers or organizational consumers). Consumers choose how to allocate their available resources of money, time, and energy to select, purchase, consume (use), and dispose of products – goods, services, ideas, or anything else that satisfies customers' personal needs or desires or that solves personal marketplace problems. (Lantos, 2015) It is necessary to understand the basic behaviour patterns of consumers. These behaviour patterns are quite different in the current world market as opposed to two decades ago. Some of these behaviour patterns can be identified readily. But, when attempts are made to identify consumer behaviour patterns, the general tendency is often to concentrate on the similarities and to combine markets based on certain generalities. (Samli, 2012) Neuroscience is aimed at uncovering the mechanisms behind behaviour, which may include emotion, but is not limited to it. It can be seen as a branch of biology or psychology, but it is truly an interdisciplinary approach combining the fields of chemistry, computer science, engineering, linguistics, mathematics, medicine, genetics, philosophy, and physics. Applied consumer neuroscience can be described as a combination of neuroscientific, psychological, and traditional market research methodologies to better understand consumer behaviour and nonconscious interactions with consumer products. More popular methodologies include a range of technologies from biometrics or autonomic nervous system measures (heart rate variability – HR, galvanic skin response – GSR, facial electromyography – fEMG to brain imaging (functional magnetic resonance imaging – fMRI. (Borges, 2016) Consumer neuroscience is a sub-area of neuroeconomics that addresses marketing and consumer behaviour relevant problems with methods and insights from brain research. The term “neuromarketing” is often used to identify this development as well, but the label may be a misnomer. (Wells and Foxall, 2012) The evolution of Consumer Neuroscience is based on the evolution of customers and consumer behaviour research, which is connected with economics and marketing. (Kenning, 2014) Consumer neuroscience (Hubert and Kenning, 2008) and neuromarketing are dealing with the influence of marketing stimuli on consumer and consumer reactions (Klucharev et al., 2008; Plassmann et al., 2012). Consumer's decisions are made on its five senses. The most important is the visual attention of the product or brand. Visual attention is one of many properties of human and animal vision allowing them to extract important information from abundant visual inputs. (Zhang and Lin, 2013)

Recognition reflects familiarity gained from past exposure. Recognition does not necessarily involve remembering where the brand was encountered before, why it differs from other brands, or even what the brand's product class is. It is simply remembering that there was a past exposure to the brand. Research in psychology has shown that recognition alone can result in more positive feelings toward nearly anything, whether it be music, people, words, or brands. Studies have demonstrated

that, even with nonsense words (like “postryňa” vs. “potastin” for example), consumers instinctively prefer an item they have previously seen to one that is new to them. Thus, when a brand choice is made – even when the decision involves products like computers or advertising agencies – the familiar brand will have an edge. (Aaker, 2012) We can think of visual attention as producing a constant stream of stimulus-based inputs from the outside world that compete against and influence an inner stream of conscious contents. (Friedenberg, 2013) Visual attention refers to the processes by which some visual information in a scene is selected, in particular, information that is most relevant to ongoing behaviour. (Kimchi et al., 2016) Brand is connected with a product and many consumers’ associate products with the well-known brand and their experience. Each fully integrated brand will boast its own identity, one that’s expressed in its every message, shape, symbol, ritual and tradition. Evoking something is only one objective of the next generation of products and advertising. In order to survive, brands will have to incorporate a brand “platform” (meaning a set of associations a consumer makes with a product or company) that fully unites the five senses. (Lindstrom, 2010) Brand experience is conceptualized as sensations, feelings, cognitions, and behavioural responses evoked by brand-related stimuli that are part of a brand’s design and identity, packaging, communications, and environments. In short, brand experience equals the sum of all points of contact with a brand. This includes both empirical evidence (how well the product performs) and peer assessments (how our friends and colleagues feel about the brand). To produce a good experience, the brand must have personality. (Fessler, 2012) For some brands (mostly consumer packed goods brands such as Coca-Cola), consumers find it hard to distinguish between different competing products in blind (unbranded) tests. In these cases, brand communications have a more central role, supported by great products and excellent distribution. After 30 years of total quality management (TQM), customer relationship management (CRM) and other such management prescriptions, there is still a huge gap between promise and delivery for most brands, especially service brands. In today’s increasingly digital world, consumers are more and more active and interconnected, so failure to deliver the brand promise is likely to be punished by the market faster and more toughly than ever. (Clifton, 2010) Customer brand engagement is the level of a customer’s motivational, brand-related and context-dependent state of mind characterized by specific levels of cognitive, emotional and behavioural activity in brand interactions. (Brodie et al., 2013) Researches also dealing with the topic of consumer behaviour are Prokeínová and Palúchová (2014) and Kubicová and Kádekóvá (2011).

### **Material and Methods**

The research was conducted in the showroom of N-motor in Nitra. N-motor company specializes in the sale of cars Mazda and Ford. Mazda's showroom features a modern, timeless design in accordance with the unified visual concept of the company's premises while car sales of Ford are in original condition with the

absence of more significant design elements. The objects of investigation is visual attention at the showroom premises Mazda and Ford, namely when examining two issues, a Mazda 6 from Mazda showroom and Ford Mondeo from Ford showroom. In order to identify actual consumer visual preferences, respondents were addressed to undergo consumer neuroscience research (monitoring eye movements) and fill out a short questionnaire.



**Figure 1. Preparation of tested space** (Own photo documentation)



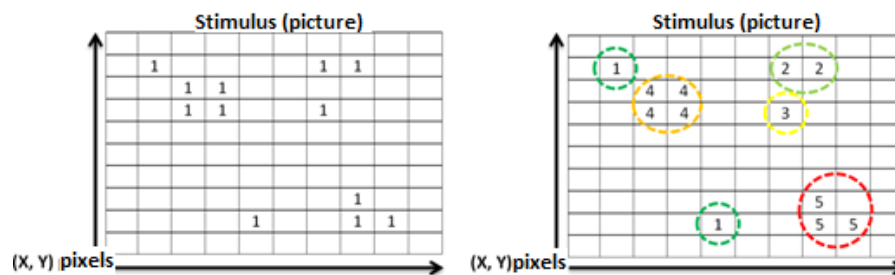
**Figure 2. Calibration of gadgets - Eye tracker** (Own photo documentation)

Practical research was performed using mobile Eye camera (Eye Tracker Glasses 2) with a dark pupil tracking technology from the Swedish company Tobii with an accuracy of 0.5 to 1 degree angle, the update rate of 100 Hz, automatically calibrated at one point. For software Tobii Glasses Analyzer (version 1.27.14446) that records the progress of eye-tracking allows you to create and outputs, such as heat maps or maps fixing points. In the research take part 10 respondents with age more than 18 years (gender: 7 males, 3 females). In the field of consumer neuroscience there does not exist a term such as a typical size of the research sample which fulfils the condition of representativeness because selection and number always are related to the main goal and the demandingness of research. In consumer studies with the use of biometric and neuroimagine methods does not

exist such a term as “standard study”. Every type of research in this field is unique in its own way and takes into consideration the needs of defined research presumptions. In some cases these institutions dealing with the research in the area of consumer neuroscience work only with 6 respondents due to time and finances consumption. For example neuromarketing companies like Neurensics, Neuromarketing Labs; University of Bonn (Life&Brain GmbH), Copenhagen Business School (Neurons Inc.) deal with smaller research samples like 10-20 respondents (Nagel, 2014).

#### Heat maps

Heat maps are two-dimensional graphic representations of data where the values of a variable are depicted in colours. The first step in heat map creation is the division of looks based on stimuli. This is executed via all fixations from all selected records one by one following completion of their values in the fixation which shares the same  $X$  and  $Y$  pixel location as the others. When we choose a number, we add the number of fixations in the same position. In the case of the absolute time of duration, the length of every fixation is added. Along with the relative time duration, first the length of every fixation is divided according to the display time of the presented media (video, picture), and after that it is added (Wilson et al., 2008).



**Figure 3. The creation of heat maps** (Individual processing by the author based on the Tobii software manual)

Immediately after all the fixation values are assigned, colour values are assigned to all places with the warmest colour representing the highest values.

#### Fixation points

Visualisation of the fixation points represents the successive position of views (circles) on a static or dynamic medium. The size of the circle indicates the length of the view and the number within it means the order and average duration of a view. This visualisation is suitable for use with a smaller number of participants over a short time interval (Tobii, 2013).

## Results and Discussion

In order to discover the impact of car brands communication to customer visual attention we have conducted consumer neuroscience investigation within which we monitored the eye movements of respondents. In order to easier processing of the results we tested areas (showroom Mazda and Ford) placed brand position from which respondents looked at the issue of cars. Based on the heat map in Fig. 4 can be seen that the largest concentration of visual attention of the respondents in the event of exposure to the Mazda 6 went to the area of the information board, material informing about the 10% discount, front parking sensors, as well as the interior. Research participants also took a dominant character in front of the vehicle and the type itself. Based on the output in Fig. 4 can be noted that the sample of respondents paid considerable attention to the exhibition facility next to a vehicle with car information (promo panel) and to price discount on the vehicle's windscreen. This finding results in important information which can have benefit for marketing management when selling cars. Particularly in terms of the importance of using traditional POP and POS funds at the point of sale. Within the car itself, the respondents mostly noticed unconventional elements such as light and rain sensor, on-board projector displaying information of driving on the windscreen and the front sensor next to the Mazda symbol.



**Figure 4. Heat map views of consumers in view of Mazda 6** (Own processing based on research)

As can be seen in the map of the fixing points in Fig. 5 initial customer insights pointing to the car itself. First of all test participants saw the brand and model of the car and to subsequently design elements. Second on the look at a leaflet informing about the 10% discount. In most cases, respondents drew their views on the information board up as the last in the order. Based on the size of the fixing points it can be said that most of the time spent by participants viewing the interior of the vehicle and also the information board. Based on results, it can be assumed that there are differences in visual attention in each sector. According to a similar study which was carried out under real conditions of a grocery store in the candy department, people, as in this case, were also primarily looking at the product.

Unlike the showroom where the second view of the majority of respondents was on “discount located on the windscreen” in case of candy the view was heading for the price tag (Berčík and Horská, 2016), while the price of a car, along with information of the equipment and technical parameters of the vehicle, was noticeable in most cases as the last.



**Figure 5. Points respondents visual attention when viewing the Mazda 6** (Own processing based on research)

To compare the results of the eye camera after completion of testing, we also conducted a questionnaire survey in which respondents were asked to arrange the order of attributes (price, car, discount, information) depending on how the exposure in Mazda 6 was attentive to the issue. These show as seen in the Table. 1, the first in the order, the respondents viewed the car, and then what the price is, however, contrary to the findings by the eye of the camera. Respondents also reported that a 10% discount attentive to the issue as the last in the sequence but based on the results of the eye cameras they were looking at this point as the second.

**Table 1. The order of perspectives on the basis of a questionnaire when viewing a Mazda 6** (Own processing based on research)

	price	information	car	discount
<b>MIN</b>	2	1	1	2
<b>25% quantile</b>	2	2	1	2,25
<b>50% quantile</b>	3	3	1	3
<b>75% quantile</b>	3	4	1	4
<b>MAX</b>	4	4	3	4
<b>Order</b>	2.	3.	1.	4.

When we are talking about exposure to the car Ford Mondeo in Fig. 6 can be seen that the largest concentration of visual attention of respondents on the heat map also directed in this case the location of the brand (Ford), the information board, and the interior of the vehicle. The object of attention was largely the type of the vehicle itself. Even, in this case, people, besides the vehicle itself (interior, brand, vehicle type), paid considerable attention to the information on the exhibition equipment next to the car. This fact can be important part of management decisions about investment in modern digital kiosks which can improve the performance of classic/traditional presentation devices.



**Figure 6. Heat map of consumer views when viewing Ford Mondeo** (Own processing based on research)

Images of fixing points on the Fig. 7 demonstrates the initial views of respondents for cars Ford Mondeo. Also in this case, the test participants initially looked at the brand and model of car, and only then take note of the other elements. Information panels have been looking in most cases as the last in the order by respondents. Customers watched the information and price even in this case as the last one which could have meant that they were not genuine customers (unlike to food they are more limited by means of money).





**Figure 7. Fixing points of visual attention in view of respondents on Ford Mondeo**  
(Own processing based on research)

Even in this case we ranked consumers views compared with the findings from the responses from the questionnaire survey. In this case, the respondents answered that they first noticed the car, then the price and then discount and finally information about issuing car see Tab.2 What is, however, contrary to the findings based on results from the eye of the camera.

**Table 2. The order of perspectives on the basis of a questionnaire when viewing Ford Mondeo** (Own processing based on research)

	price	information	car	discount
<b>MIN</b>	1	2	1	1
<b>25% quantile</b>	2	2,25	1	3
<b>50% quantile</b>	2	3	1	3
<b>75% quantile</b>	3,75	4	1,75	4
<b>MAX</b>	4	4	2	4
<b>Order</b>	<b>2.</b>	<b>4.</b>	<b>1.</b>	<b>3.</b>

### Conclusion

This article was focused on monitoring the visual attention of participants which was detected through biometric somatic eye tracking method. This method represents a credible tool revealing the real visual attention of tested subjects (it records the movement of eyes every millisecond). However, it does not provide information about attention (emotional engagement) of research participants. In simple terms we know what are the potential customers looking at in the showroom, but we do not know if or how much they are interested in the product. One of the limitations is the fact that people can influence their visual preferences, mostly in the first phases of testing, because they are aware of that their view is recorded. Even though shortcomings differences in results were detected when

comparing traditional and innovative research. There may be several reasons but the fact is that the human brain accepts every millisecond many stimuli which are filtered and therefore a human is not able to evaluate their attention (Wiedmann et al., 2012). Because human decision making lasts from 300 milliseconds from exposure/view of the stimulus (Philiastides and Sajda, 2007), it is important to have information not only from traditional research tools but also from innovative ones for marketing management and strategy creation.

Based on the results of traditional and innovative research, we propose to obtain relevant information to combine these forms of research in the future. Consumer neuroscience research tools can be an effective tool (as stated by the authors Kucharski and Kot, 2017) for marketing management for more accurate information acquisition, when making key decisions on the car market and obtaining feedback on the car market. By monitoring eye movements, we have identified key aspects of visual attention, which may constitute a significant element in the choice of the individual elements of in-store communication.

In the future we plan to repeat this research with the use of a neuroimaging method – mobile electroencephalograph. This method can give us information about the engagement of the test persons. Besides that, we focus on comparison of different perception of each showroom due to different environmental factors (lighting, sound, air quality) and fatigue of respondents (beginning and end of the week).

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## ZAAWANSOWANE ODWZOROWANIE I OCENA PERCEPCJI I PREFERENCJI KONSUMENTÓW NA RYNKU SAMOCHODOWYM W OPARCIU O ŚLEDZENIE WZROKU

**Streszczenie:** Artykuł omawia miejsce i pozycję neuronauki konsumentkiej w zarządzaniu marketingowym, jednocześnie wskazuje na jego rolę w zrozumieniu zachowań konsumentów. Obecne otoczenie konkurencyjne wiąże się z ponowną oceną tradycyjnych metod i procesów z jednej strony oraz z zastosowaniem nowych źródeł informacji dla decyzji kierownika raportu na wszystkich poziomach, nie tylko w przedsiębiorstwach produkcyjnych, usługowych, ale również komercyjnych. Celem tego badania było zwrócenie uwagi na stosunkowo nowe sposoby badań marketingowych poprzez interdyscyplinarną dziedzinę zwaną neuronauką konsumentką w celu skutecznej realizacji zarządzania marketingowego w przedsiębiorstwie sprzedającym samochody.

Dzięki uzyskanym wynikom można było poddać analizie opinie na temat uwagi wizualnej przy podejmowaniu decyzji zakupowych, a tym samym realizować skuteczne zarządzanie marketingowe w formie właściwych decyzji strategicznych.

**Słowa kluczowe:** neuronauka konsumentka, zarządzanie marketingowe, marki, uwaga wizualna

### 基於眼動追蹤的汽車消費者感知與偏好高級製圖與評價

**摘要:** 本文探討了消費者神經科學在營銷管理中的地位 and 位置, 同時指出了其在理解消費者行為中的作用。目前的競爭環境一方面與傳統方法和流程的重新評估有關, 另一方面是報告管理者各級決策的新信息來源的應用, 不僅在製造企業, 服務公司和商業公司。本研究的目的是通過消費者神經科學這個跨學科領域指出相對較新的營銷研究方法, 以便在汽車銷售企業中實現有效的營銷管理。

正確決定的前提是大多數反映現實的信息, 因此除了傳統的研究方法之外, 還使用了生物識別方法(來自Tobii公司的移動眼睛跟踪器眼鏡)用於十個響應者在汽車的授權經銷商處識別和描述他們的視覺注意力。這項研究是在尼特拉的一個N電機上進行的, 該電機銷售馬自達和福特汽車。為了獲得關於受訪者的視覺注意的信息, 我們在查看店內通信的選定元素時已經測量了眼睛的移動。從結果中, 我們能夠分析對購買決策的視覺關注的反饋, 從而以適當的戰略決策的形式實現有效的營銷管理。**關鍵詞:** 消費者神經科學, 營銷管理, 品牌, 視覺注意