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FAKULTETA ZA MATEMATIKO, NARAVOSLOVJE IN
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ZAKLJUČNA NALOGA
(FINAL PROJECT PAPER)

NEVROZNANOST POTROŠNIŠTVA: POTREBA PO URAVNOTEŽENJU NEVROMARKETINGA, ZNANSTVENIH INTERPRETACIJ IN NEVROETIKE

(CONSUMER NEUROSCIENCE: THE NEED FOR A WELL-BALANCED WEB OF NEUROMARKETING, SCIENTIFIC INTERPRETATION, AND NEUROETHICS)

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Zaključna naloga
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Nevroznanost potrošništva: potreba po uravnoteženju nevromarketinga, znanstvenih interpretacij in nevroetike

(Consumer neuroscience: the need for a well-balanced web of neuromarketing, scientific interpretation, and neuroethics)

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Izvleček:
Nevroznanost potrošništva je novejše znanstveno področje, ki z uporabo nevroznanstvenih metod raziskuje vprašanja povezana s potrošništvom in marketingom. V primerjavi s tradicionalni marketingškimi raziskavami ponuja nekaj metodoloških prednosti in vpogled v nevrološko podlago sklepanja odločitev, preferenc, ekonomskih preračunavanj in odziva na promocijske strategije. Nevromarketinška dognanja lahko pripomorejo tudi k razumevanju motenj, kot je zasvojenost z igrami na srečo in nakupovanjem. Ta zaključna naloga ponuja pregled nad področjem nevroznanosti potrošništva, izbranimi raziskavami iz nevromarketinga, diskusijo problematik povezanih z etičnostjo tovrstnih raziskav in izpostavi potrebo po regulacijskih smernicah.

Key words documentation

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Abstract:

Consumer neuroscience is an emerging study field, which investigates problems of consumption and marketing through neuroscientific methods. It offers several methodological advantages over traditional marketing research techniques and provides insight into human decision-making process, preferences, willingness to pay calculation and neurological responses to marketing stimuli. Neuromarketing findings can also contribute to the understanding of consumption-related disorders like pathological gambling and compulsive shopping. Through discussions of the aforementioned topics this project paper provides a coherent overview of the field, while presenting and explaining the findings of selected neuromarketing studies. It finalizes by discussing the issues regarding the ethics of consumer neuroscience research, and exposes the need for regulatory guidelines.

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1 INTRODUCTION

In recent years, scientific and technical development has contributed to innovative and multidisciplinary research approach in several scientific fields. Several fields of science have started employing neuroscientific methods in order to gain insight into human behaviour through a different perspective. The general interest and hype around neuroscience has generated new disciplines within social sciences and humanities, such as neuroeconomics, neurotheology, neuroeducation and neuroaesthetics. Despite the complexity of neuroscientific research and its findings, neuroscience has been progressively influencing our daily lives, social practises and public's understanding of personal identity, decision making, conscientiousness and causation. The influence of neuroscience goes far beyond laboratories and we are witnessing the rise of the so called 'neuroculture' (Frazzetto & Anker 2009).

Even though many critics worry that the influence of neurobiology is leading to an overly reductionistic approach of human mental states and actions, other argue that neuroscientific research merely helps us understand the role of non-conscious neural processes in our decisions and actions (Rose & Abi-Rached 2013). Neurobiological explanations of human behaviour can co-exist with the premises of social sciences about choice, responsibility, and consciousness that are the foundation of contemporary advanced liberal societies. It is not radical to suggest that humans are influenced by biological forces, not just their consciousness. Recognition of these neurobiological factors offers an innovative research perspective and insight, which can generate empirical data crucial for further understanding of human psychology and behaviour.

The goals of this thesis are:
First to define consumer neuroscience and related fields, such as neuroeconomics, neuromarketing (1.1 and 2.1).

Then will be presented the main neuromarketing research techniques and approaches such as psychophysiological measurements, electroencephalography, functional magnetic resonance imaging, magnetoencephalography, positron emission tomography, transcranial magnetic stimulation (2.2).

Some discussion is introduced to compare the effectiveness of neuromarketing techniques and classical marketing research methods such as surveys, focus groups, personal interviews, observation and field trials (2.1.2).

Another objective is to explain how combining two or even more methods may improve the validity of the research findings, and to identify the importance and potential contributions to neuromarketing research (2.3). Interesting and innovative findings from neuromarketing research will be presented and explained, with an additional key goal: to objectively interpret the results.

A further objective is to show that consumer neuroscience research can potentially contribute to the better understanding of decision making processes and certain psychological disorders (2.4). A last objective will be to investigate the role of neuroethics, by discussing as well the negative aspects and limitations of neuromarketing (2.5).

1.1 Neuroeconomics

Economics and organisational sciences have always been interested in questions derived from psychology, particularly decision making and information processing. Advancements in neuroscientifc methodology and technologies like magnetoencephalography (MEG) and functional magnetic resonance imaging (fMRI) have made it possible to observe those functional processes occurring in the in vivo brain. Indeed, economics was one of the first social sciences to start implementing neuroimaging techniques into its research, which led to the development of neuroeconomics.

Neuroeconomics is defined as the application of neuroscientific methods to analyse and understand economically relevant behaviour (Kenning and Plassmann, 2005), or as an emerging transdisciplinary field that uses neuroscientific measurement techniques to determine the neural linked to economic decisions (Zak, 2004). In this case, economics should be interpreted in a broader sense: any decision process made by evaluating alternatives. The key advantage of this new discipline is in the interaction between mathematical models of decision making and empirical neurobiological experiments on decision making. This eventually results in a richer understanding of choice formation, than economics or neuroscience could achieve alone (Braeutigam, 2005).

Standard economic models of human decision-making usually minimize or ignore the influence of emotions on people’s decision-making behaviour. However, utilising neuroimaging techniques have identified additional psychological and emotional factors that influence economic decision-making (Glimcher, 2009). The ultimatum game, a commonly used decision-making game for observing peoples decision-making processes, was used by neuroeconomists in behavioural economics studies, with the primary goal of explaining reasons for rejections of unfair offers (Houser & McCabe, 2009). Participants can either accept or reject an offer made by the other participant, who decides how to split

the money between the two options. Using functional magnetic resonance imaging or fMRI, a neuroimaging technique I will present in a later chapter, Sanfey et al. (2003) investigated the neural bases of decision-making process during the game. According to the standard utility theory, the participant being offered money accepts any offer, since some monetary gain is better than none. However, when the responder considered the proposer's offer to be unfair (such as a split of 80/20), the chance of the offer being rejected was significant, even though this could be considered non-optimal economic behaviour. The neuroeconomic approach revealed that unfair offers activated parts of the brain associated with emotion and cognition, with equal intensity. Activity in the anterior insula (associated with emotion) increased even more when the participant rejected the unfair offer, which suggests the crucial role of human emotion in choice and decision-making (Braeutigam, 2005).

The field of neuroeconomics has been rapidly growing and has produced a lot of evidence on decision-making in various real world contexts. For example, recent research has been able to locate desirability in the human and animal brain. It is computed and represented in the brain as a neural signal that can be tested, measured and represented and therefore exist as a concrete object, rather than just a theoretical construct (Glimcher & Rustichini, 2004). Commonly used objects and consumer products are used to study concepts like sensory processing, choice, evaluation of loss and reward, trust etc. Still, these studies are not conducted with a goal of practical application of its findings, as neuroeconomics is mainly an academic discipline.

However, to an opportunistic mind, the progression from the academic world to implementing neuroeconomic findings with real business issues seems only natural.

2 NEUROMARKETING & CONSUMER NEUROSCIENCE

2.1 Theoretical frame of references

2.1.1 Beginnings of neuromarketing

Even though a lot of research questions dealing with consumers and marketing are often similar to those of neuroeconomics, application of neuroimaging methods to marketing research has been perceived as controversial, ethically questionable and potentially harmful from the its very start (Ruskin, 2003).

The first institute offering neuroscientific research to corporal clients in the USA was the *BrightHouse Institute for Thought Sciences*. It was established in 2002 from the neuroscience wing at Atlanta's Emory University Hospital. The term "neuromarketing" was first used in the *BrightHouse*'s press release on 22nd June, 2002, and promised to bridge the gap between business and sciences by providing clients with unprecedented insight into their consumers' minds. The institute's goal was to forever change the world of marketing by using brain imaging to identify patterns of brain activity that would reveal how a consumer is actually evaluating a product, object or advertisement (Paul, 2002). Their further services included marketing analytics and guidelines to help clients' marketers to create better products and services, and to design more effective marketing campaigns.

The firm was soon targeted by criticism of the public, and their activity was labelled as "a quest to find a "buy button" inside the brain and to test products, packaging and advertising for their ability to activate it" (Wells, 2003). The anti-advertising civil group *Commercial Alert* demanded investigation of *BrightHouse*'s research by the Office of Human Research Protections (USA). *Commercial Alert* accused *BrightHouse* them of developing tools of behaviour control and behaviour modification. These tools can be bought by corporate clients, in order to amplify dangerous marketing related trends such as over-consumption, epidemics of obesity, type 2 diabetes, alcoholism, smoking, gambling and other addictions (Ruskin, 2003). After the accusation, *BrightHouse*'s website was removed in order for the institute to fade from the public attention.

2.1.2 Methodological advantage of neuromarketing

In spite of public's negative perception of marketing and consumer science, the main purpose of marketing research is to understand, explain and predict individual, group and organisational behaviour relevant to markets (Lee et al., 2007). This includes a wide and complex range of research questions, not simply trying to persuade consumers into mindless shopping. By providing companies with information about consumers' needs and wishes, products emerging on the marketplace are more compatible with consumer preferences, and effective marketing facilitates the process of choice for the consumer (Ariely & Berns, 2010). Marketing research deals with product policy (optimal design of products according to the real preferences of consumers), price policy (what is the optimal price for a products for companies and consumers' satisfaction), communication policy (consumer specific advertising and its effectiveness), distribution policy (optimal distribution of goods between manufacturer and retailer) and brand research (influence of brand information on decision making) (Kenning & Linzmajer, 2011).

Like other social sciences, consumer science uses a wide range of research techniques, from focus groups, individual surveys, in-depth interviews to actual market tests. However, all of these techniques depend on the participants' willingness and capability of self-assessment. Since the origins and reasons for certain behaviours, thoughts and feelings are often complex and subconscious, it can be difficult for both individual subjects and researchers to correctly identify them (Hubert & Kenning, 2008). Moreover, if the topic is very sensitive or the participants feel the need for social acceptance, they are also likely to provide incorrect information, which is then even further filtered by the interviewee's consciousness before being reported (Hubert & Kenning, 2008). Consumers and their decisions are also affected by human biology, and incorporation of this perspective into consumer research could help provide more objective results, and explain the increased variance (Kenning & Linzmajer, 2011). Methods of self-assessment are influenced by participants' cognitive filter, but brain activity measurements can not be modified by strategic behaviour or social desirability (Camerer et al., 2005). With brain imaging technology, it is also possible to capture the response to the stimuli at the same time as the information is being percepted, and processed with the subject (Lee et al., 2007). This way, it is also not necessary to rely on how well the subject recalls thoughts and emotions while being exposed to stimuli. Neuroscientific approach allows investigation of biological foundations of consumer behaviour which allows testing of existing theories from a different perspective (Kenning & Linzmajer, 2011).

Application of neuroscientific methods, like fMRI in case of the *BrightHouse Institute*, provides new research opportunities and methodological advantages. The various brain

imaging techniques offer a unique possibility to record information about the brain at the moment of perception, processing, and decision-making (Lee et al. 2007). This methodological approach also enables testing of existing theories that are based on different neural mechanisms and has the potential to detect additional neural processes that are associated with consumer behaviour (Hubert & Kenning, 2008).

2.1.3 Defining neuromarketing

The analysed literature sources revealed several conceptions, namings and definitions of the neuromarketing research approach. Some authors, define "neuromarketing" as a field of study that uses neuroscientific methods in order to analyse and understand human behaviour in relation to markets and marketing exchanges (Lee et all, 2007). According to Lee and colleagues, neuromarketing research goes beyond simply analysing consumer behaviour for commercial interest and also includes other areas such as inter and intra-organisational research. Others define the scientific proceedings of this research approach as "consumer neuroscience", and the practical application of its findings within managerial practice as "neuromarketing" (Hubert and Kenning 2008). Despite these slightly conflicting definitions and categorizations most authors associate the term neuromarketing with the application of neuroscientifc techniques with the purpose of identifying the individuals' brain processes responsible for consumer' behaviour (Fortunato et all, 2014).
Since it is obvious that these definitions are inter-related, in this thesis the terminology "consumer neuroscience" and "neuromarketing" will be used interchangeably.

2.2 Neuromarketing research techniques

The primary objective of neuromarketing is to obtain brain activity data associated to consumer behaviour using research methodology and technologies. Three types of neuromarketing techniques can be distinguished, categorized according to the of signals being measured: (1) metabolic activity in the brain; (2) electrical activity in the brain; (3) physiological body changes (so not in the brain).

Due to the complicated nature of the physical technology and machinery used to measure relevant signals, only a brief description of the main neuromarketing technologies will be presented here. However, it is evident that each of the techniques has advantages and disadvantages, so to achieve satisfactory results with measurements it is advantageous and beneficial to combine several techniques. Measuring different variables with different techniques can serve for better understanding of a marketing problem. For example while participants in the study perform mental tasks, observe or try out products, neuromarketing

techniques measure their response to the particular marketing stimuli (Fortunato et al., 2014).

2.2.1 Neuroimaging methods

• Functional magnetic resonance imaging (fMRI):

While MRI provides detailed brain structures, and provides anatomical maps of the brain functional magnetic resonance imaging, or fMRI, is a non-invasive technique for studying brain activity. It can be used to produce activation maps that show what parts of the brain are involved in a particular mental process. An MRI scanner tracks tissue perfusion, blood-volume changes, or changes in the concentration of oxygen (Nikos & Logothetis, 2008). Sensory stimulation causes changes in neural activity in certain brain regions. When a cortical region is more active it consumes more oxygen, which increases blood flow to the region. More oxygenated blood has different magnetic properties than deoxygenated blood. Most fMRI studies exploit this magnetic difference, by measuring the so called BOLD or blood oxygen level – dependent contrast (Lieberman, 2010)

Compared to other neuroimaging technologies, fMRI is best for resolving small structures, rather than those that are deep in the brain. It has several other advantages such as excellent spatial resolution, it is does not involve radiation, and it is not too complicated to use for experimenters (Fortunato et al., 2014). fMRI is the most popular technique for measuring brain activity. However, the negative aspect of this technology is the fact that it is not portable, the equipment is rather bulky, fills several rooms, therefore is rather expensive and it is limited in conducting certain experiments. One of the disadvantages is also the fact, that this technique requires a delay of 6 to 10 seconds to record the processing of neurons (Ariely & Berns, 2010). Magnetic fields are not associated with any adverse health effects, but very powerful magnets (that provide better resolution) can cause temporary dizziness and a metallic taste in the mouth. Magnets of higher strength also increase the noise associated with signal detection, which can be unpleasant for research subjects. Besides, audio noise is present, and the participants are also required to stay motionless during the experimental period (Zak, 2004).

• Electroencephalography (EEG):

This technique measures changes in the electrical fields predominantly of the regions directly under the scalp using conducting electrodes. The number of electrodes can vary from only a few, to hundreds in high-density arrays. The number of electrodes (usually in a form of bands or a helmet) affects the spatial resolution. The EEG can detect changes in

electrical activity up to 10,000 times per second (Morin, 2011). Abnormalities in the patterns of activity can be detected already from brief neuronal events (Illes, 2006). However, EEG has poor sensitivity for deep brain structures, and thus it is optimal for recording of more superficial electrical signals, because the skull disperses the electrical field. In contrast to fMRI, electroencephalography has high temporal and low spatial resolution (Ariely & Berns, 2010).
EEG is non-invasive, safe and a relatively low-cost neuronal activity recording method. It is portable, and easily synchronised with the stimuli. Its weakness is the difficulty in measuring activity in deeper brain structures (Illes, 2006).

• Positron emission tomography (PET):

Positron Emission Tomography (PET) uses small amounts of short-lived radioactive particles, "radiotracers", that are injected into the bloodstream and have to circulate and partition to the tissues and organs being studied. When the material undergoes radioactive decay, a positron is emitted and recorded by a PET scanner. Areas of high radioactivity are associated with huger brain activity (Ackerman, 2006). Even though this technique has spatial resolution similar to that of fMRI, it is highly invasive because radioactive particles (positrons) must pass through the body, which has some disadvantages for a persons's health, and these consequences need to be considered in neuromarketing research.

• Magnetoencephalography (MEG):

Magnetoencephalography (MEG) is similar to EEG, but produces more advanced neuronal activity recording images. Unlike EEG, the electrodes on the scalp measure magnetic fields produced by electrical currents in the brain. This provides more accurate and useful results because the skull and the tissue surrounding the brain affect the magnetic fields electrical impulses measured by EEG. It is very helpful to combine MEG and magnetic resonance imaging (MRI), to obtain even better images, in order to more easily identify relevant brain areas (Kuzniecky, Sirven 2013). It has excellent temporal resolution, but is not optimal for measurements of deeper, subcortical areas of the brain. However, its spatial resolution is better than that of EEG (Morin, 2011), while for now it still is a very expensive method.

• Transcranial magnetic stimulation (TMS)

Transcranial magnetic stimulation (TMS) is a method that stimulates the brain by sending electromagnetic impulses through the skull. An iron core wrapped in electrical wire is programmed to generate a magnetic field, and when placed on the subject's skull, it induces electrical currents in the underlying neurons. The activation of nerve cells

temporarily disrupts brain function in this area by inhibiting synaptic transmission. TMS is used to study the role of specific brain regions for certain functions, by observing cognitive and behavioural changes resulting from the temporary inhibition of influenced cortical area (Camerer et al. 2005; Lee et al. 2007; Ariely & Berns 2010). Since this technique alone is not optimal for providing detailed insight into cortical activity, it is often used in conjunction with other methods such as fMRI and MEG. Neuroimaging techniques (fMRI, EEG, or MEG) are generally used to locate the most optimal position for the TMS coil, and to determine which behavioural measures are going to be used as variables (Camerer et al. 2005). TMS has several disadvantages: it is limited to brain areas close to the skull and its effects are not limited only to the stimulated region (because of the closeness of brain structures), which makes interpretation more difficult. Moreover, some evidence suggests that TMS potentially causes longer-lasting effects on neural tissue (Kenning & Linzmajer, 2011). The radiation this technology produces also causes headaches or even seizures in some patients (Heckman & Happel 2006).

2.2.2 Psychophysiological measurements

Measurements of psychophysiological indicators like heart rate, blood pressure, galvanic skin response, facial electromyography and eye-tracking are often used along neuroimaging techniques. The technology used to obtain psychophysiological indicators is mostly portable, inexpensive, fast and non-invasive. However, such measurements can be influenced by many factors, such as body movements, or different sets of emotions leading to a similar psychophysiological output (Camerer et al. 2005).

• Eye tracking

During the eye tracking technique, a subject's attention and focus can be observed by measuring the pattern of gazing, visual fixations and pupil dilation. Near-infrared light is directed toward the centre of the eyes (pupil) and tracked by a camera or some other optical sensor. Currently, the used eye trackers are either remote, screen/desktop based systems that can track eyes only within certain limits, but still sufficiently large for some particular research questions, or mobile, using a head-mounted device. Mobile eye trackers (usually in a form of "glasses") allow the subject to move freely and are therefore very well suited for study designs that require task performance in a natural environment.

This technology is used to analyse consumers visual attention to advertising (TV and print), evaluation of products and packaging design, in-store testing of the optimal product placement and path to purchase, and for user experience design for information technologies solutions (websites, applications, games). It provides researchers with data in

a form of gaze points (a calculation of time spent focused on an object). If there is a series of gaze points measured close in time and range, they form a so-called fixation point. Data from eye tracking can also be used to create heat maps, which are dynamic representations of gaze points and fixations, revealing the distribution of visual attention in an easy to interpret color-coded scheme. Eye-tracking devices also record patterns of fixation, revealing which elements stand out to the respondents. Nevertheless, direct interpretations of eye tracking data are not possible, since eye tracking measures what the subjects sees, but not which cognitive processes and emotional states drive those particular eye movements.

Therefore, eye tracking is usually combined with another biometric technique (Imotions, 2015b). For measuring complex cognitive processes, eye tracking can be used along with the already presented neuroimaging technique electroencephalography (EEG), to analyse brain arousal and other metrics, associated with stimulus processing, action preparation, and execution (Imotions, 2015b).

• Galvanic Skin Response (GSR)

GSR also known as Electrodermal Activity (EDA) or Skin Conductance (SC), monitors objective arousal in response to emotionally-relevant stimuli. While the main purpose of sweating is thermoregulation, sweat glands on hands and feet are also activated whenever emotionally aroused. GSR measures electric conductivity of the skin, which depends on its hydration level. Conductivity data are transmitted to a computer through an amplifier (Groeppel-Klein, 2005). Results on the left and right hand vary, depending on the type of stimulus, which is suspected to be related to the lateralization of the social functions in the brain. Positive emotions were found to produce a stronger response on the left hand, and negative on the right hand (Banks et al., 2012). The GSR can be used for evaluating consumer preferences by tracking emotional arousal by actual physical objects, videos, images, sounds, odours, food probes and other sensory stimuli, as well as thought experiments, and mental images (Imotions, 2015a).

• Facial electromyography (fEMG)

Electromyographic sensors monitor the electric energy generated by body movements with electrodes attached to the skin surface. With facial EMG it is possible to measure muscle activity even in response to weakly evocative emotional stimuli, when no facial changes were observed with other methods such as Facial Action Coding System (FACTS) (Ekman & Friesen, 1978). Morover, even if participants are instructed to hide or mask their emotions, facial EMG can still register the correct response. Activity of the muscles

responsible for lowering the eyebrows was found to vary, depending on the emotional valence of presented stimuli and reports of mood states. Activity of muscles that control smiling was found to be positively linked with positive emotional stimuli and positive emotional states (Cacioppo et al., 1986). EMG can be used to measure muscular responses to any type of stimuli, and records everything from consciously controlled movements, to subtle activation patterns. It is inexpensive and portable, but it is very sensitive to movements and often requires several repetitive measurements (Cacioppo et al., 1986).

• Cardiovascular parameters:

Electrocardiography (ECG) detects the electrical discharges when the heart muscles contract. The heart rate response is used to measure pleasantness of external stimuli and attention, as heart rate plays a role in psychophysiological attention mechanism (Wang & Minor 2008). Cardiovascular analysis inspects the vascular activity, and records the changes in blood pressure, blood volume or pulse. Vascular activity was used to measure arousal, and previous research demonstrated high correlation with the skin conductance. However, vascular activity changes can be a result of other psychophysiological processes, for example memories (Wang & Minor 2008).

2.3 Overview of selected relevant neuromarketing studies

Even though it seems very promising, consumer neuroscience is still considered to be in its "infancy", and should be seen as a complementing advancement for consumer behaviour, rather than a challenge to traditional marketing (Kenning & Linzmajer, 2011).

With the purpose of demonstrating the interrelatedness of traditional marketing research and neuromarketing, in order to market their products, companies need to create a successful mixture of policies (Business Case Studies, 2016):

- the right product (product policies)
- sold at the right price (price policies)
- in the right place (distribution policies)
- using the most suitable promotion (communication policies)

Which will be explained in more detail below, with the exception of distribution policy, as it is concerned with optimal distribution of goods between producer and retailer.

2.3.1 Product policies

Product policies are broad guidelines formulated with regard to product planning and development. Marketing research plays a key role in determining what kind of products would be right for which consumers. Understanding of consumers' needs and preferences in regard to appearance and function of the products is crucial (Business Case Studies, 2016). Neuromarketing can offer insight into the consumers' true perception of the product.

One of the first studies revealing the underlying mechanisms of product preference was conducted 15 years ago (Erk et al., 2002). Based on how in human societies, social dominance can be signalled by the demonstration of one's wealth, it was hypothesized that cultural objects that signal prestige (in this case sports cars), will act as social reinforcer, and activate reward related brain areas. While being fMRI scanned, the subjects viewed photographs of sports cars, limousines and small cars. Later, they had to evaluate the attractiveness of the cars. The goal was to investigate the neural correlations of social reinforcement by comparing responses to different photos. Comparison of fMRI measurements revealed significantly higher activation in brain regions associated with reward and reinforcement. It was shown that the activation of the ventral striatum and orbitofrontal cortex was the lowest for small cars and highest for sports cars, with limousines in between, corresponding with the same scaling of perceived attractiveness. This confirms that the degree of perceived attractiveness of stimuli reflects the level of activation of above mentioned regions. The authors of the study note that this result corresponds to results of the study that demonstrated that passive viewing of attractive female faces caused activation in reward circuitry (especially in ventral striatum) of heterosexual males (Aharon et al., 2001) and that anticipation of reward also leads to increased activation of ventral striatum (Knutson et al. 2001b). Erk et. al. (2002) concluded that it is possible that attractive cars could function in a similar way as the perception of attractive faces: as a potentially rewarding stimulus. In case of sports cars that is due to social conditioning which makes cars perceived as a signal of social dominance, which is associated with potential reward (Erk et al., 2002).

For consumer neuroscience, these studies reveal that the activation in the ventral striatum can be an indicator of how attractive a visual stimulus is perceived by the subject. Perception of a product as a potentially rewarding stimulus depends on various factors such as cultural conditioning, its availability, etc. However, activity changes in the ventral striatum can be an indicator of possible costumer purchasing behaviour, assuming there is a relation between product preference and subsequent purchasing behaviour (Kenning & Linzmajer, 2011).
Considering the fact that studies have found that two-thirds of all supermarket purchase decisions occur, once the person is already at the store (Schoormans and Robben, 1997),

companies put a lot of effort (money) into optimising the product packaging to fulfil its functions: protect the content, supply information, and distinguish the product from other brands. Another study investigated the neural correlates of product perception, focused on package design, and focused on perceived attractiveness of the packaging design (Stoll et al., 2008). Volunteers were instructed to judge whether the packaging was attractive or not, while being fMRI scanned. It was shown that attractive and unattractive packaging triggers different neural activation patterns. Significant activity changes were recorded in the medial prefrontal cortex (MPFC), a crucial brain region for human decision making, based on assessment of reward and punishment and evaluation of sensory stimuli (O'Doherty et al., 2001). This cortical region is also associated with generation of emotion and emotional evaluation (Breiter et al., 2001). The increased activation of MPFC could therefore represent stronger emotional response to attractive packaging (compared to less appealing alternatives). Stoll et al. (2008) further concluded that more appealing packaging designs work better at triggering attention, visual processing and integration of incoming information with background knowledge. On the other hand, neural activity changes recorded during evaluation of less attractive packaging lead to the assumption that subjects associated those products with uncertainty and negative emotions.

This means neuromarketing research is potentially well suited for early product design stages as it offers insight into the perception of the product (Ariely & Berns, 2010). Its application seems very promising for so called "user design" where consumers are involved in the product development in order for the companies to create products that people would want to purchase and find useful. Neuromarketing could offer insight into what consumers express while purchasing (which is now possible through traditional marketing research methodology like questionnaires etc.), as well as how they are actually coming to that decision, their reasoning (Ariely & Berns, 2010). This could contribute to a more human-compatible design of products and to a lower rate of failed introduction of new products to the market.

2.3.2 Price policies

Smart price policy is of obvious importance for the companies' sales revenue and profit. Optimally, the price is set according to how valuable the consumers perceive the product to be. Researching consumers' responses to prices, demonstrated that similar prices can be perceived in different ways, depending on the category of the product. Higher prices can be perceived as an indicator of higher quality or they can trigger feelings of loss, if the price is perceived by being unfairly high (Lichtenstein, 1993). Due to previously discussed methodological limitations of traditional marketing research (section 2.1.2),

neuromarketing offers an interesting insight into the neural representation of price perception.

A cortical structure called the nucleus accumbens correlates with positive arousal and the medial prefrontal cortex (MPFC) gets activated by the perception of gain outcomes (Knutson et al., 2001a). The activation of the insulary cortex was found to correlate with self-reported negative arousal and anticipation of physical pain and was hypothesized to play a crucial role in the prediction of loss (Paulus & Stein, 2006). Activation of these circuits may influence the subsequent decision-making.

The goal of a study by Knutson et al. (2007) was to find out how neural circuits respond to product preference, and how to excessive prices. Subjects were scanned with an fMRI scanner while engaging in a task where they could choose either to purchase the product presented in an image, or not. However, the images were shown in a way that the participant first saw just the product (measurement of preference), then the price (measurement of response to price), and then to decide to purchase the product after. It was found that activation in areas linked to the anticipation of gain and positive arousal (nucleus accumbens), correlated with product preference (first picture measurement). And the insula, linked to the anticipation of loss, was significantly activated by excessive prices. Activation of MPFC, implicated in integration of gains and losses, correlated with reduced prices. These findings demonstrated that activation of the nucleus accumbens mirrored a subjects' response to the merchandise, while subsequently, the MPFC and insula activations showed subjects' reaction to the cost of the product. Nucleus accumbens activation works as predictor of purchase decision during the product evaluation period, and MPFC and insula do that during the price evaluation period (Knutson et al., 2007). So basically, it was demonstrated that product preference can lead to purchasing, but that only happens if the price is right and perceived as a fair cost and benefit trade off by the consumer. Together, these findings show that, contrary to macroeconomic theory, purchasing decisions are not only driven by consumer preference and price, but also by immediate emotional response to potential gain and loss. This information can be useful for scheduling price limits, or the price that brings satisfaction to the consumer and profit to the company.

Similarly, a 2007 study by Plassmann, O'Doherty and Rangel investigated the neural foundation of the willingness-to-pay (WTP) calculation, or the highest price that the person is willing to pay for the object. Participants assign the WTP to an item according to its benefits. In the study, hungry participants were asked to place real bids on different foods, while the researchers fMRI scanned their brain activity. Two kinds of trials were used. In free-bid trials, participants were free to select the amount of their bid, so they had to make

a willingness-to-pay computation. In forced-bid trials they were told how much they should bid ($0, $1, $2, or $3), so they did not need to think about their WTP.

The experimental research design was based on the hypothesis that the brain only performs the WTP calculations during free trials. However, the scans from forced bid trials did not show the desired correlations to prove this hypothesis. It is difficult to find the neural basis of the WTP since many other variables might be correlated. The brain may be stimulated by the anticipation of taste, or it may asses the food's caloric content. It is possible that the brain either analyses the size of the forced bid, or the brain areas are activated by the disagreement between the subject's WTP and the forced bid. The visible contrasts of the scans show the WTP activity, but also other correlated variables. Experimenters tried to distinguish between areas that showed activation by the WTP during free trials, and the areas that were also significantly more active in comparison to forced trials. It was found that the medial orbitofrontal cortex (mOFC) satisfied these conditions, which confirms their hypothesis. The OFC is active in representing the reward value of gustatory, olfactory, auditory and somatosensory stimuli. This area is involved in abstract reinforcements such as winning or losing money, or positive and negative verbal feedback (O'Doherty, 2003b). The mOFC is involved in representing stimulus-reward, and the computated value at the time of decision making is a measure of the stimuli. Findings of Plassmann's et al. study suggest that the mOFC plays a critical role in goal directed behaviour by calculating economic value (Plassmann et al., 2007).

Comparison of these findings to Knutson's et al. (2007) study of neural foundation of preference versus price calculation, reveals some differences in the measured neural activation (see the paragraph above). It is likely that even though both experiments involved decision-making tasks, small but important differences in the computations were needed for decision-making, involved in different neural circuits. In Knutson's et al. (2007) study, prices were revealed after a certain time period and the activation of nucleus accumbens can be attributed to anticipation of reward. It was suggested that further research will be needed to understand how brain evaluates potential outcomes, and how other cognitive and emotional processes affect the computation of economic value.

Being able to understand how consumers make calculations such as the WTP is important for products' success on the market. As the presented studies demonstrate, various factors influence the consumers' economic decision-making - product preference, perception of cost vs. benefit trade off etc. Often, people are willing to pay more than the set market price for an item, if the product's value to the consumer exceeds the market price. Being able to have some objective insight into the WTP with the help of neuroimaging method could help marketers test whether other marketing instruments such as branding, design

and presentation are able to increase the recognized value of the product with the consumer. Indeed, it has been scientifically demonstrated that marketing actions can regulate the cognitive and emotional experience of products on neural bases (de Araujo et al., 2005; Plassmann et al., 2008). Therefore, setting the right price is essential.

Effect of pricing goes beyond the purchasing designs, it can modulate neural representations of experienced pleasantness (Plassmann et al., 2008). This was demonstrated in a fMRI study, where participants tasted wines. They were told the wines were all different and sold at different prices, even though there were only three versions of the wine, two of them administered twice - once under a high price label, once at a low price. The results proved that the increase of the price also increased the volunteer's report of flavour pleasantness and increased the BOLD signal (a sign of increased activity) in the mOFC (encoding experience of pleasantness) due to expectancy of better quality (Plassmann et al., 2008). The price change did not affect the primary taste areas, which lead the authors to conclude that cognitive processes of flavour expectancy in the mOFC modified the experienced pleasantness of flavour.

It is very possible that any marketing action influencing the expectation of products quality or utility, might lead to such comparable effects. This suggests the need for well researched, product and consumer-type-specific promotional and branding strategies, which are more related to the category of Communication policies.

2.3.3 Communication policies

Communication with consumers is done primarily through promotion. Its aim is to provide information that will help customers decide which products and services to purchase. The costs of advertising is usually substantial, however successful promotion strategies can increase sales and can therefore be very cost-effective (Business Case Studies, 2016).

Advertising campaigns with a consistent theme are importantly involved in the process of branding. Branding represents the aim to create a recognisable and differentiated presence of the brand in the market, and is important for consumers' perception of the company's products in the desired way (Business Dictionary, 2016).

In 2004, a very interesting study conducted by McClure et al. demonstrated the power of branding in preference and decision making, from a neural basis perspective. For modern humans, behavioural preference for foods and drinks (and possibly non-edible items) do not solely depend on the sensory experience. Behavioural evidence demonstrate that social, cognitive and cultural predispositions influence our perception and preference. The

objective of the study was to investigate the influence of the brand image (like Coca-Cola and Pepsi) on behavioural decisions and brain responses (measured with fMRI). These two soda Coke drinks have nearly identical chemical composition, however people usually express strong preference for one or the other. The study first investigated the behavioural and neural response to these drinks without participants being informed about brand information, and showed that the participants split equally their preference for Coca-Cola and Pepsi. The behavioural reports and fMRI results showed corresponding results. Increased activation was showed in ventro medial region of the prefrontal cortex (VMPFC), which is involved in the appetitive aspects of reward, and the presumed reward value based solely on sensory information (Knutson et al., 2001b; O'Doherty et al., 2003a). In the second part of the study, the participants were provided with the brand information, and no significant impact of this information in the case of Pepsi drink was found (compared to the anonymous taste test). However, there was a very strong effect on subjects' behavioural preferences for Coca-Cola, when the cups were labelled with the brand name. In spite the fact that all the cups contained Coke during this part of the experiment, subjects preferred to drink the labelled cups. This was also evident in the neuroimaging part of the experiment. When a photo of Coca-Cola followed sampling of this drink, the dorsolateral prefrontal cortex (DLPFC), hippocampus and midbrain showed significantly larger activity then when there was no brand information. It is believed that the DLPFC is important for integrating emotional information (Watanabe, 1996), and along with the hippocampus, it has been associated with behavioural modification on grounds of emotion and effect. No such results were obtained with the Pepsi delivery. The hippocampal activation in this experiment suggests its role in the recall of cultural information that consequently contributes to bias preference judgments (through DLPFC). The VMPFC activity (indicator of stimuli preference) was not affected by the brand knowledge, which suggests that branding and advertising have a very significant influence on consumers' behavioural preferences, despite the absence of and actual chemical difference between the products.

Different neural processing due to brand perception was also demonstrated in a study where subjects viewed logos of car brands that were either well known in their culture or not sold and advertised where they lived, and therefore unfamiliar (Schaefre et al., 2006). While being scanned with an fMRI scanner, they were shown pictures of logos and asked to imagine themselves driving the car that belonged to that brand. Increased activation of the mPFC was recorded for the culturally familiar car brand symbols (logos). This cortical area is involved in self-reflection and self-relevant processing. It is possible that the subjects' imagination of using culturally familiar cars lead to self-relevant thoughts (Schaefre et al., 2006). These findings suggest that brand familiarity could play a role in

how intensely, and in what way a person processes information about a product related to a familiar and respected brand, compared to the non-branded product of the same type.

Such findings raise a question of how successful branding could be achieved. As mentioned, advertising plays a crucial role. Consumer neuroscience can offer some insight into how advertising works. A successful advertisement is supposed to modify the audience's neural response to some degree, otherwise it cannot be effective. Advertising productivity could be greatly improved through understanding of how advertisements are received, processed and stored in the brain, and how they influence brand choices.

One study demonstrated that emotional advertisements are more likely to be remembered than reason-engaging, cognitive advertisements, and besides, that they are processed differently (Ambler, Ioannides & Rose, 2000). To test memorability, beta-blocker propranolol (used to suppress emotions) was administered to some subjects, while others received a placebo. Significantly stronger content and message recall and recognition was observed for control and the placebo group, compared to the propranolol group. In a separate part of the study, subjects were watching TV commercials, while patterns of cortical activity were recorded with magnetoencephalography (MEG). Although the sample size was too small to make generalized conclusions, distinct differences in cortical signalling was recorded during affective and cognitive advertisements. Larger activation was observed in the ventromedial frontal lobe, which is linked to decision-making and social sensitivity.

Similarly, a 2001 study by Rossiter et al. set out to investigate which video scenes from commercials will be more memorable. They used a neuroimaging technology called steady-state probe topography (an innovative version of electroencephalography or EEG). Participants watched TV commercials placed in between TV programmes, and were tested for visual recognition a week later. This study also offered some insight into how short-term memory is transferred into long-term memory. Contrary to what was previously believed, pictorial stimuli are predominantly encoded by the left hemisphere (Rossiter et al., 2001). This study offered some direct guidelines for making TV advertisements more memorable. It showed that the commercial frames with video frames longer than 2 seconds were more memorable. Therefore, the key visual information should be held for at least that 2 seconds period. Also, abstract visual scenes showed to be less memorable. Interestingly, higher engagement during commercial viewing did not predict better memorability. Authors of the study also note that the activity patterns of the left-hemisphere in the pre-frontal cortical areas can be assessed, and used as motivating potential of the advertisement.

Such findings are valuable for visual content testing, either in terms of advertisements or testing of movies and TV series during editing processes. A study already demonstrated that typical enlarged neural responses to a movie were similar and stereotypical across subjects (Hasson, 2008). Hence, brain activation patterns could be recorded for very successful movies and editing of sequences to yield a new section could be tested and achieved similar effects. Even though neural responses to watching movies are complex, it may not be necessary to be able to interpret them, if the goal is to improve editing to make the movie more engaging and entertaining. Several neuromarketing firms have already worked with the entertainment industry, but since most of such work has not been published, it is not possible to evaluate the potential of neuromarketing in this context (Ariely & Berns, 2010).

2.4 Contributions of consumer neuroscience to neurology

A lot of neuromarketing investigates questions related to the neurology of the reward system. Behavioural disorders associated with neurological diseases such as pathological gambling and compulsive buying are believed to be related to abnormalities in reward system functions (Javor et al. 2013.). Behavioural neurologists could learn more about the underlying pathophysiology by employing similar research strategies as neuroeconomics (decision-making games etc.) and consumer neuroscience. Observing how neural responses vary between healthy subjects and subjects suffering from compulsive buying disorder, would probably show different activation patterns in reward and loss/pain avoidance neural systems. This kind of interdisciplinary research could help provide valuable knowledge about this still relatively unexplored disorder. Some findings also suggest that the form of payment could play a role in how frivolously consumers spend their money. It is possible that more abstract forms of payment such as credit cards (and probably online shopping) "anaesthetize" consumers against the pain of paying, and therefore they do not go through similar cost-gain calculations as with other forms of economic transactions (Prelec & Loewenstein, 1998).

In the case of pathological gambling, fMRI research already confirmed reduced activation of the mesolimbic reward system (Reuter et al., 2005). Neuroeconomics research could demonstrate how patients with this psychiatric disorder make decisions, and which cortical activations are responsible for their loss of control over gambling and rational processing.

Neuroeconomics and neuromarketing (in case of brands and advertising) also investigate mechanisms of trust. An individual is required to perform a number of evaluations and decisions in order to trust an unknown person. Medical research has demonstrated the importance of trust in patient-physician relationship. Recovery outcomes of certain

diseases have been shown to (partly) depend on patient's trust (Nguyen et al., 2009; Thom et al., 2004). The reward system is part of the cortical trust network, which suggests that diseases where reward circuits are affected could lead to lower trust in medical personnel. As suggested by Javor et al. (2013), further research could help design guidelines for better communication and increased trust in patients.

2.5 Neuroethics of neuromarketing

Topics related to marketing often trigger discussions about the fundamentals of marketing from an ethical point of view. Media coverage of neuromarketing has been mostly very negative, as the general public fears that scientists are trying to find the so called "buy button in the brain" and mind-read and manipulate the consumers (Ruskin, 2003). Such concerns originate from the lack of scientific knowledge, and some of the current marketing practices such as consumer data transactions, data mining and analytics are probably far more manipulative and privacy intrusive (Singer,, 2012). Nontheless, integration of ethical guidelines for beneficial and non-harmful use of research techniques to the field of neurmarketing would be a very important preventive measure. Neuroethics deals with ethical issues unique to the field of neurobiology and the utilisation of neuroimaging technology (Murphy et al., 2008). Scientists have moral and legal obligation to inform consent and protect the privacy of research participants. However, such protective measures are not obligatory when the study is carried out for marketing purpose (Tovino, 2005). Even though at the moment invasion of privacy of thought, through neuroimaging is not possible, it is important to consider how society might use such information if technological advances would ever made that possible. Therefore it would be ethically correct to at least apply the same legal standards for neuromaketing research, as for regular academic neurobiology research. A lot of neuromarketing research is conducted by commercial research enterprises (Emsense, FKF Applied Research, Lucid Systems, Neurofocus, Neuroco, Neurosense Limited, OTOInsights, Sales Brain, Sands Research, and Thought Sciences etc.), and is never published as peer-reviewed scientific articles. General ethical guidelines should also protect the subjects of such experiments. Another concern related to neuromarketing is over-interpretation of fMRI data and advertising of neuromarketing research as a possibility to understand the consumers mind. Such misinterpretations and false advertising of neuromarketing companies causes mistrust in the public eye and fear of neuroimaging research. Responsible communication and honest representation of what neuroimaging can do is crucial for the maintenance of the public's positive perception of brain sciences, and consequently, governmental funding of research and technology advancement. Guidelines for internal and externally validity in the commercialization of neurotechnology should therefore be established (Murphy et al., 2008).

Financial incentives offered to participants by the private companies should be regulated, in order to protect subjects for participating in research out of financial need, and to exclude biased voluntariness and research results. Overall, policies for responsible management of research findings, subject protection and non-harmful and beneficial uses of neurotechnology at all stages of neurmarketing protocols should be designed.

3 CONCLUSION

Neuromarketing or consumer neuroscience is a relatively new scientific field. Its potential is not yet clear, but due to steady improvement of neurotechnology, it is very possible that neuroimaging will be used advantageously in various domains of marketing and consumer research. Currently available studies were mainly investigating basic research questions related to consumer behaviour and decision making process in economic contexts. However, they have already provided some valuable insight, such as the role of emotions in decision-making, effects of branding and neural response to different products, advertisements, prices etc. Still, validity of some of these studies could be called into question, due to very low number of participants and small sample sizes, all because of very high costs of neuroimaging research (Hubert & Kenning, 2008). Moreover, the utilised research methods are (currently) not able to measure small variations in brain activity and even if neuroimaging studies can reveal some underlying neural effects of, for example advertisements, it is not possible to directly suggest that activity in that brain area will result in increase of sales, which is often how commercial neuromarketing firms advertise themselves. It is therefore important to introduce some guidelines and regulations of how neuromarketing/consumer neuroscience is defined and presented in academic circles, commercial settings and general public.

Interdisciplinary collaboration of academics from various fields and marketers would be advisable in order to provide high quality standards of correctly regulated research. Exchange of knowledge between various (private) organizations could help build a solid theoretical foundation of consumer neuroscience and its findings could be beneficial to society in general, not only to companies trying to improve their products and increase profit. Scientific evidence of how advertisements affect us could push for introductions of laws that would forbid advertising of harmful products such as cigarettes and alcohol and perhaps encourage introduction of other consumer protective policies. Moreover, consumer neuroscience could help in understanding of how to encourage behaviours and lifestyle decisions that would benefit individuals and society. Many issues that modern societies are facing today, such as obesity, substance abuse, lack of physical activity, behaviour that is contributing to pollution etc. could perhaps be researched from the neuroeconomics point of view. Alteration of behaviour requires energy, and the cost-benefit evaluation that is observed in neuroimagnig studies of neuroeconomics and neuromarketing, could perhaps be similar to a thought process that follows an initiative for change. Additionally, neuromarketing findings could be employed in creation of campaigns encouraging behavioural change for previously mentioned societal issues. For now, these are just possible directions for the future. At the moment, neuromarketing should be viewed as research of cortical processes that govern people’s daily activities related to products,

services and marketing (Ariely & Berns, 2010). It has the potential of becoming an interesting and important research field, and it can simultaneously provide useful information for marketers. However, ethical regulations and policies should be introduced.

4 POVZETEK NALOGE V SLOVENSKEM JEZIKU

Nevroznanost potrošništva je novo znanstveno področje, ki raziskuje vprašanje potrošništva in marketinga s pomočjo nevroznanstvenih metod (Kenning, Linzmajer, 2011).

Uporaba tehnologij možganskega slikanja (fMRI, EEG, PET, MEG, TMS) in psihofizioloških tehnik (sledenje očem, elektrodermalna aktivacija, obrazna elektromiografija, kardiovaskularne meritve) za raziskovanje učinkovitega marketinga in testiranje potrošnikovega odziva je v zadnjem desetletju pridobila na priljubljenosti (Ariely in Berns, 2010). Klasične marketinške raziskovalne tehnike, kot so vprašalniki, intervjuji ipd. pogosto ne dajejo dovolj objektivnih rezultatov, saj so v veliki meri odvisni od potrošnikove pripravljenosti za sodelovanje in njegove sposobnosti, da objektivno opiše svoje misli, odzive, čustva in občutke v zvezi z raziskovalnim vprašanjem (Morin, 2011).

Uporaba tehnologij možganskega slikanja ima potencial, da raziskovalcem razkrije skrite informacije o tem, kako potrošniki sklepajo odločitve in kako se odzivajo na različne dražljaje, ki jih oglaševalci uporabijo v marketinške namene (Ariely, Berns, 2010). Nevromarketing že od samega začetka spremlja precej buren odziv medijev in javnosti, saj v ljudeh zbuja strah, da se znanstveniki trudijo odkriti način, da bi potrošnika pripravili do tega, da se ni zmožen upreti nakupu (Wells, 2003). Avtorji literature o nevromarketingu v večini podarjajo, da tehnologija (za enkrat) česa takega nikakor ne omogoča in da nevroznanost potrošništva ni namenjena manipulaciji potrošnikov. Ključno je razumevanje, da so potrošnja in ekonomske odločitve velik del življenja človeka v zahodnem svetu, zato je raziskovanje s tem povezanih nevroloških procesov koristno tako za napredek znanosti, kot za razvoj človeku bolj kompatibilnih in všečnih izdelkov, razumevanje motenj kot sta na primer zasvojenost z igrami na srečo in nakupovanjem, ter nenazadnje za bolj učinkovit marketing (Lee idr., 2013).

Nevromarketinške raziskave so že privedle do številnih zanimivih dognanj, kot je nevrološki odziv na prestižne izdelke, ki je skladen z odzivom ob pričakovanju nagrade (Erk idr., 2002), povečan čustven odziv na izdelke s privlačno embalažo (Stoll idr., 2008), nevrološki odziv ob odločanju o nakupu, ki je demonstriral, da potrošnik nakup lahko dojema kot pozitivno investicijo ali kot izgubo v primeru previsoke cene (Knutson idr., 2007), dejstvo, da marketing lahko vpliva na zaznavo okusov (McClure idr., 2004), da morajo biti ključni podatki v TV oglasih prikazani vsaj dve sekundi, da so zapomnjeni (Rossiter idr., 2001) in da se ljudje bolj pozitivno odzivamo na privlačne oglase s čustveno vsebino (Ambler, Ioannides, Rose, 2000). Ker so raziskovalne tehnike, ki jih uporablja nevroznanost potrošništva večinoma želo drage, tovrstne raziskave pogosto nimajo

velikega števila udeležencev, kar zmanjša njihovo kredibilnost. Vendar tehnološki napredek obeta vedno večjo dostopnost tehnologij za možgansko slikanje in s tem lažjo izvedbo nevromarketinških raziskav. Zaenkrat je smiselna uporaba tovrstnih tehnik predvsem v fazi razvoja izdelkov. Opazovanje potrošnikovega nevrološkega odziva, poleg meritev vedenjskih odzivov, vprašalnikov ipd., omogoča prilagoditev funkcionalnosti, izgleda, cene in oglaševanja izdelka, še preden je ta lansiran na trg (Lee idr., 2013). Cena nevromarketinškega testiranja je namreč nižja od zgrešenih marketinških strategij in neuspeha izdelka na trgu.

Kljub temu, da je strah pred odkritjem "gumba za nakup" odveč (Kenning, Linzmajer, 2011), je področje nevroznanosti potrošništva neustrezno regulirano, kar se tiče zaščite udeležencev raziskav in etičnih smernic. Klinične študije, ki uporabljajo tehnike možganskega slikanja, morajo slediti zakonsko predpisanemu protokolu, ki vključuje natančno informiranje udeležencev o poteku eksperimenta in možnih posledicah, podpis dokumenta o prostovoljni privolitvi itd. Vse te regulacije za nevromarketing zaenkrat ne veljajo (Murphy, 2008). Preventivno bi morali oblikovati tudi etične smernice nevromarketinga, ki bi raziskovalce zavezovale k družbeno koristni in neškodljivi uporabi nevrotehnologij.

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