European Journal of Science and Theology, December 2017, Vol.13, No.6, 145-155

ELECTROENCEPHALOGRAPHY AS A TOOL OF ADVERTISING RESEARCH IN THE CONTEXT OF MAC MODEL

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(Received 19 July 2017, revised 3 August 2017)

Abstract

This paper is dedicated to the application of electroencephalography (EEG) as a brain research tool into the domain of audio-visual advertising effects as a future possible direction of marketing research in Slovakia. After a brief introduction to this rarely used and challenging method of a new field examining consumer perception and decision making called neuromarketing, we are presenting a research of ten audio-visual commercials carried out in 2016 by the means of electroencephalography and questionnaire based on MAC model as a model of memory, affect and cognition introduced by T. Ambler and T. Burne (1999).

Keywords: advertising, electroencephalography, EEG, neuromarketing, MAC model

1. Introduction

1.1. EEG

Today, electroencephalography (EEG) is one (alongside fMRI) of the most commonly used methods of neuromarketing. Neuromarketing as a scientific field born from Neuroscience is in a way a reaction to recent knowledge concerning decision making process as more automatic and based on unconscious forces and brain considered to be more emotional than rational as opposed to what was previously believed (e.g. philosopher René Descartes later criticised for his emphasis on rationality by neurologist Antonio Damasio in his famous book Descartes´ error or representatives of Rational Choice Theory) [1, 2]. It can be best defined as "*the application of neuroimaging techniques mediated by a specific cortical response in order to analyze and understand human behavior in relation to markets and marketing exchange*" [M. Tolon et al., *Testing cognitive dissonance theory: consumer´s attitudes and behaviors*

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about neuromarketing, https://www.scribd.com/document/232508966/Testing-Cognitive-Dissonance-Theory-Consumers-Attitudes-and-Behaviors-About-Neuromarketing]. As a field it is limited by our understanding of human brain and its regions. Some consider it controversial with ongoing discussion about its ethics seeing an insight into human brain as an infraction of privacy [3]. At the same time, the scientification of human soul raises questions beyond this field.

EEG is a method of clinical practice that started to be used in 1935 and is crucial for example in epileptology and sleep research [4]. It is so called 'passive' technology operating on the principle of registering electric potentials from the surface of the head that are produced by brain activity usually by sensors built in a cap [5]. These extremely small potentials caused by neurological activity are recorded 2000 times per second for each sensor. The more sensors to work with (optimally at least 64), the more precise results we can obtain. However, the high sensitivity of EEG sensors causes that unwanted noise which is sometimes recorded as well (e.g. from muscle activity, eye blink) [6]. As any other method, EEG has its advantages and disadvantages. It has a high temporal resolution meaning it can register fast changes with virtually no time delay. It enables to compare left and right hemisphere. Space resolution depends on the number of electrodes, but EEG is not able to register changes in deeper and older brain structures (e.g. in reward centre, limbic system linked to emotions) [7]. Moreover, it is said that the majority of our brain activity is used to maintain a baseline activity making it hard to determine brain waves (changes) caused solely by advertising stimuli [8].

EEG research of marketing stimuli as a part of neuromarketing research is not that new, but due to its financial and interpretational demandingness it is, at least in our country (note: Slovakia), relatively rare. Neuromarketing approach to advertising has a potential to increase its effectiveness and appeal, more so „*advertising is not only an economic activity, but also a socio-cultural phenomenon, associated with society´s cultural, value-based and ideological codes*" [9]. In literature, various authors have pointed to the importance of neuroscientific approach in marketing and consumer research and multitude of advertising research by the means of EEG or combination with other methods (usually GSR or eye-tracking) have been conducted. For example, Astolfi et al. [10] examined recall of television advertising (n = 10). They found different patterns of cortical activity (in anterior cingulate cortex and cingulate motoric region) in subjects who remembered the ad compared to subjects who did not recall the ad after ten days. Ohme and Reykowska [11] pointed to other useful application of EEG – pre-tests of different audio-visual advertising versions (n = 45) and confirmed a hypothesis that the brain can notice slight changes we may not consciously be aware of. Also, brain produces different reactions to marketing stimuli even if consumers have not noticed any difference.

1.2. MAC Model

MAC model is a model of advertising effects. As a short from Memory – Affect – Cognition it was introduced by Tim Ambler and Tom Burne in 1999 [12]. Basically, it says about the transition from cognition to consumer behaviour. The basic assumption is that effective advertising must cause a change in long-term memory because of the time difference between ad exposure and its impact on behaviour with memory being a driver of decision making. According to Ambler „*Behavior is a reflection of memory, affect and cognition which then loops back as feedback to change/maintain awareness, associations, attitudes and conditioning*" [T. Ambler, *Intermediate Advertising Effects: the Mac Model*, http://facultyresearch.london.edu/docs/96-906.pdf]. Aforementioned three MAC components are understood as simultaneous and not successive [12]. Before, traditional models put more emphasis on cognition; however, there exist theories focused solely on affective responses built on a premise that consumers are creating their preferences based on their feelings (as in the case of ad likeability theories).

In order to test proposed MAC model, Ambler and Burne later conducted an experiment testing four commercials (two with high/low affect and two so called placebo commercials with participants influenced by β-blockers, n = 18). Participants who got β-blocker Propranolol (interacting with brain regions mediating affect) showed reduced perception of ad's affective component, but not the cognitive one. Affective commercials were better recalled by placebo group [12]. These results supported the main premise of the MAC model that ads with higher affective content have higher recognition and recall. Even though Ambler and Burne put more emphasis on affect, they did not claim that cognitive appeals are inferior, they just point to key role of affect in memory processes.

2. Research

2.1. Research characteristic

We are focusing on a research problem of measuring participants' emotional responses while watching ten selected audio-visual advertising. As an emotional response we understand a reaction to certain feelings accompanied with physiological changes that create certain action or behavioural response [13]. Emotional responses are assessed by the means of electroencephalography. At the same time we are determining ad recall based on assumptions of MAC model saying that emotions are crucial for remembering. Our research is based on existing and verified knowledge and practices regarding application of EEG within the field of neuromarketing.

The objective of our research is to identify elements or parts causing elevated emotional response in selected advertisements and verify and validate EEG results by the means of a questionnaire. Practical applications of our

research include identification of key elements in particular set of ads with the possibility to provide useful insights for marketing experts responsible for advertising design and execution.

We focused on following main research hypothesis based on previously described MAC theory:

H1: We suppose that the higher the emotional response of an individual during the advertising screening, the higher the probability of that particular advertisement to be remembered/recalled.

We also examined additional research questions:

Q1: Which parts of examined advertising content invoke in participants elevated emotional responses?

Q2: What are the differences in recall based on the character of advertisements (positive/negative/neutral)?

Q3: What are the differences in EEG results based on the character of advertisements (positive/negative/neutral)?

Q4: To what extent do results from EEG agree with results from questionnaire?

In order to provide a suitable research sample for EEG measurements we recruited a homogenous group of five male participants aged 23 to 55. Due to the differences in brain lateralization we selected only right-handed individuals.

2.2. Research material

For the purposes of a better comparison we chose only one product category – cars. This category is commonly known and used, highly competitive, international and with a wide variety of brands and advertisements to choose from. Stimulus material for our EEG research consisted of a video (length 00:11:17) with ten audio-visual commercials:

A) Honda Ridgeline - A new track to love [https://www.youtube.com/watch?v=Op4qhwKP6Wg],
B) New Toyota Auris Hybrid - Say Hello [https://www.youtube.com/watch?v=851mjjIzrYs],
C) Audi RS3 – Birth [https://www.youtube.com/watch?v=QnMxcM7Gbjo],
D) Fiat 500 Abarath [https://www.youtube.com/watch?v=9dvqOJUf-DY],
E) Volkswagen Passat – Force [https://www.youtube.com/watch?v=Ndj5sy8ytmY],
F) Peugeot 308, CZ - Výkupní bonus [https://www.youtube.com/watch?v=5J7oYMDOG60],
G) Audi RS4 – Spider [https://www.youtube.com/watch?v=02eJUk7Mbsg],
H) Kia Optima - Dream Car [https://www.youtube.com/watch?v=DNYPYL9SHGA],
I) Volvo XC90 - Made by Sweden [https://www.youtube.com/watch?v=OHZ9fS6JDIs],
J) Citroen DS3 Cabrio – Baby [https://www.youtube.com/watch?v=qk19qM3ttGI].

Commercials were selected in order to cover various kinds of stimuli. Three (B, F, I) of them were labelled as neutral (we could say fairly common with car passing through certain terrain or road with no or only a vague storyline). These neutral commercials are spread among other chosen stimulus material. Then a commercial with fear as a main element was selected (G). Audi RS4 commercial contains horror motives such as darkness, spider webs, scary sounds (creaking, squeaking, playing an old radio, braking glass), tension, fast changes of scene. In the end, spider jumps at the viewer and changes into Audi car. We also used commercial that could be described as unattractive, unpleasant, shocking or disgusting (C). Commercial C presents Audi RS3 in an original way as being born from another car. Even though two last described commercials represent the same brand they contain interesting elements that allow comparison as well as answering research questions no. 3 and no. 4. We also selected a commercial with humorous character and erotic elements (D). Commercial D presents Fiat 500. The main character is an average shy man who sees a beautiful temperament woman on the street representing a promoted car. Commercial includes sensuality, a shot of woman's legs or cleavage and a scene of a coffee foam dropping between actresses' breasts. We also included commercials (A, E, H, J) with humour as a dominant attribute. Commercial A for Honda presents 'unusual' sheep that sing *Somebody* to love from Queen. Commercial E promotes Volkswagen Passat with the story of a little boy dressed as Darth Vader from Star Wars movie trying to control things accompanied by the sound of The Imperial March. Commercial H presents Kia – Optima. It applies story-telling with a version of a male 'dream fairy' sparkling sleeping couple with magical powder and showing their secret dreams. Commercial J for Citroen DS3 Cabrio presents a main idea of a feeling a driver is having while driving a cabrio car with 'wind in your hair' by showing a child with extremely long hair riding a horse.

2.3. Methods

In order to get primary data we used a combination of an EEG and a questionnaire. When trying to grasp the unconscious processes in human brain we have to take into consideration the availability and financial costs of elaborate brain scanning techniques. EEG suits our needs also because of its non-invasive character. Compared to other brain scanning techniques it is not only cheaper, but also it does not generate radiation or magnetic field and it is more comfortable for participants. Scanning techniques such as MRI, fMRI and MEG can cause discomfort because patients have to lie inside without movement and they can be quite noisy. Some people may experience claustrophobic feelings during scanning process. For the purposes of our research we used EEG model Winnereuro 1.2. with 16 electrodes and computer software Winneuro 1.8. EEG results were interpreted by two medical practitioners – neurologists. They focused on theta activity that is in literature linked to limbic system and elevated emotional response and beta activity

representing a marker for alertness, focus and attention that play a significant role in remembering [4, p. 44]. Changes in frontal and temporal lobe linked to emotions and memory were also observed.

Since EEG has its limits both in terms of technological and practical aspects and interpretation, we decided to apply an easy to use, verified and classic marketing method – an individual personal one-time electronic questionnaire with mostly open – end questions regarding previous knowledge of research material, ad recall, commercials and their scenes participants consider to be the most interesting, description of feelings evoked by presented commercials, what an effective advertising should look like and further comments. Moreover, combination of methods ensures higher reliability of research.

2.4. Research procedure

EEG research was carried out during one afternoon with each participant individually following the same procedure. Participant was greeted and seated into the armchair. EEG cap was placed on his head and conductive paste was put into electrodes. During this necessary preparation participant was informed about research purpose and the whole process. All participants agreed with the research by signing an informed consent. After setting the electrodes he was asked to sit comfortably and try to eliminate all movements that could cause disrupting artefacts in EEG output. Also, we tried to eliminate all disruptive elements in the room itself (cell phones turned off, windows closed, total silence). Afterwards, recording of EEG started first within a 30 second calm phase with eyes closed and then while watching stimulus material where the beginning and end of each commercial was recorded as well as any occurring behaviour of particular participant (e.g. laughter, movement, sneezing). Ten days after EEG research, each participant completed an electronic questionnaire.

3. Analysis and results

An analysis of EEG output is very difficult therefore we left it to medical professionals and in this part we would like to present just condensed results suited more for marketing experts. It is partly caused by the limits of EEG device we used. For the purposes of future research we find it beneficial to try to arrange a device with more electrodes (hence enabling more precise analysis). In the context of EEG output analysis we are focusing our attention on the character of waves - beta activity is important because it is linked to attention and concentration. Nevertheless, when subject is awake with opened eyes, this activity is normal and natural and that is why we will focus on less frequent and more extraordinary theta activity that is in literature related to increased emotional response, learning and memory. Except from the type of waves, the location of brain activity is important. For the purposes of our research we focused on theta activity in frontal and temporal lobes linked to emotions and

memory. Because of the large amount of data (10 commercials), we do not present location for each important point in EEG analysis, we just present a summary of advertising motives and moments that triggered theta activity and attention of research participants. When interpreting these crucial parts of commercials we will consider a margin of several (max 3) seconds before and after measured moment because we did not have a software synchronizing EEG with presented video material.

First research question regarded the identification of elevated emotional response in particular advertisements. Except for commercial (G) (Audi RS4 Spider) each commercial invoked higher EEG activity at least once (Table 1).

Table 1. Condensed results.

Name of the campaign	Character of commercial	Elevated theta activity	Recall
A) Honda Ridgeline – A new track to love	humorous	2	1
B) Toyota Auris Hybrid – Say hello	neutral	1	1
C) Audi RS3 – Birth	disgusting	2	4
D) Fiat 500 Abarath	erotic	2	0
E) Volkswagen Passat-Force	humorous	2	1
F) Peugeot 308 – Výkupní bonus	neutral	3	0
G) Audi RS4- Spider	scary	0	3
H) Kia optima – Dream car	humorous	2	1
I) Volvo XC90 – Made by Sweden	neutral	1	1
Citroen DS3 Cabrio – Baby	humorous	2	1

Note: numbers represent number of participants, previously seen/known commercials were excluded from recall.

Commercial (A) (Honda Ridgeline – A new track to love) triggered theta activity in the minds of two participants. In first case it was when owner is leaving (singing) sheep alone and they start to sing again, in second case attention is triggered by a detail to sheep's head when it starts to sing. In case of (B) (Toyota Auris Hybrid – Say hello) ad theta activity occurred in case of Participant 2 during two scenes: car lights with brand and back of the car with logo. While watching commercial (C) (Audi RS3 - Birth) theta brainwaves were observed in case of two participants: one time while watching a scene with a detail of promoted car and in other case when the main point of the whole advertising was revealed – the older model of Audi 'gave birth' to younger one. During commercial (D) (Fiat 500 - Abarath) theta activity was detected in case of two participants during the very same scene when a woman (representing promoted car) gives man a slap in the face. One of these participants also showed theta activity during a shot where woman is grasping man by his tie and gets very close to him (attention could be triggered also by woman's cleavage). During video (E) (Volkswagen Passat – Force) theta activity occurred in two participants when little boy was trying to 'move' the dog with the 'force'. Spot

(F) (Peugeot 308 – Výkupní bonus [Sale bonus]) generated the most response in terms of observed theta brain activity. Theta waves were observed around 00:04 when man was cutting off clay from the side of supposed car, 00:11 during a scene showing a car and steering wheel with Peugeot sign and 00:16 during displays of the whole car, its interior and steering wheel with Peugeot sign. Even though this advertising was labelled as neutral, interest could be triggered by fast pace of the whole ad, music, original idea of erasing unnecessary features of promoted model, voiceover or other aspects that are certainly worth further examination. Commercial (G) (Audi RS4 - Spider) did not generate in our research any theta activity. Such result is quite unforeseen, because of the dramatic, thrilling, scary character. This lack of observed theta activity may be caused by low sensitivity of EEG we used; we have also to keep in mind that our research sample is small. Or maybe this advertising was not scary enough for adult male participants so it did not cause changes in brain waves.

Humorous and story-based commercial (H) (Kia optima – Dream car) generated theta activity during a scene where male 'dream fairy' stumbles and scatters too much magical dream powder on a sleeping man, as well as when he sprinkles magic powder on a sleeping woman. Ad (I) (Volvo XC90 – Made by Sweden) triggered theta response just once during a shot showing a back of promoted car with logo and model name. Unusual commercial (J) for Citroen DS3 Cabrio showing a long haired baby riding a white horse on a beach triggered a theta activity during a detail shot on baby's floating hair, its face and eyes and in other case later on when it was showing back of the car with logo followed by the scene of the whole car.

We noticed that theta activity was often triggered by certain turnover, a moment of surprise or breaking point in advertising and also when logo was displayed (here we can discuss the role of preferences in attention, elevated activity could by caused by mental processes of interpretation).

In relation to the hypothesis stemming from MAC theory saying that the higher the emotional response of an individual during the advertising screening, the higher the probability of that particular advertisement to be remembered (H1) in terms of our research we have to reject it. From the purely descriptive point, in 28 out of 50 cases (56%) there was an accordance (ad generated theta activity at least once and was recalled or ad did not generate theta activity and was not recalled). Yet, when we were looking for a relationship between recall and occurrence of theta activity there was no correlation ($r = 0.04$, $p = 0.775$).

All commercials were recalled at least by one participant except from (D) (Fiat 500 - Abarath) and (F) (Peugeot 308 – Výkupní bonus [Sale bonus]). Important implication is that participants were able to recall a brand, but never an exact promoted model of a vehicle. Results for commercial (D) were surprising because it of its erotic content, humour and story. The most recalled (by 4 out of 5 participants) advertising was (C) (Audi RS3 Birth). Participants lately described it as evoking negative, unpleasant feelings, disgust and aversion. One participant considered it to be original, interesting and surprising. There is an on-going discussion in the field of advertising whether a negative advertising

is still a good or effective advertising. We do not dare to solve this long-debated issue. On the one side, this advertisement met its purpose and was remembered (all four participant also correctly assigned a brand to it), but on the other side we cannot say what effect on overall brand evaluation and image will transfer of (this negative) affect have. A similar case was commercial (G) Audi RS4 - Spider recalled by three participants also evoking negative feelings. In general, advertisements with unattractive content were remembered the most while those labelled as attractive and neutral were recalled approximately to the same extent (an answer to research question Q2).

Regarding EEG results elevated emotional response (an answer to Q3) occurred most often in case of positive content, followed by content with neutral character and negative character, but the differences are very small.

Results from questionnaire and EEG recording were compatible (Q4) to a very small extent (6 times). EEG results (in terms of measured theta activity) and questionnaire (in terms of recalled ads) were congruent in cases of adverts C, E and I. The most interesting was a case of Participant 5 and advertising (C) (Audi RS3 – Birth) with a total agreement between a scene described in questionnaire as the most essential and most interesting (00:01:09) and measured theta activity. At this point, commercial is climaxing. Another interesting aspect was the presence of the same EEG activity of two participants in case of commercial (D) (when attractive woman gave man a slap).

Furthermore, we posed participants a complementary question about a kind of advertising they consider to be effective. Older participants put emphasis on informative and descriptive aspects, younger participants named mainly the presence of humour. Hereby we have to point out that only a few current car ads offer detailed information about particular model. The trend is primarily to build brand awareness and image with informative part being very weak.

4. Discussion and conclusions

From the very beginning of its existence, neuromarketing addressed many enthusiasts all over the world who have considered it to be the field of the future bringing possibilities beyond classic marketing methods. Idealistic ideas and concerns about marketing experts getting into heads of consumers had vanished away quite quickly as a result of demandingness (in terms of time, money and expertise) of neuromarketing approaches. Still, a combination of classic and neuroscientific tools, knowledge and methods has a potential to enrich the field of consumer behaviour and advertising research. In this paper we presented a combination of an EEG research with questionnaire that was supposed to bring more precise results. As one could see, our EEG and questionnaire results were more likely to contradict each other. We have to acknowledge that some of the differences may be caused by the delay between an EEG measurement and a questionnaire. This ten day delay was set on purpose since the basic assumption of the MAC theory we were focusing on has been that advertising should cause a change in long-term memory with a ten day delay being quite common in

research regarding advertising recall. Despite this fact, we believe that presented research brought some interesting results worth further elaboration and it enabled a comparison of a large amount of material in a highly competitive and heavily financed marketing field (car advertising) where each insight may be the key one. We found out that a video of Peugeot 308 with a neutral common character generated the most theta activity during EEG measures with no recall later in questionnaire. We listed scenes that triggered theta activity and may indicate an increased interest or elaboration. Most often increased brain activity occurred in case of commercial (F) (Peugeot 308); no special brain activity was detected for Audi RS Spider advertisement. Theta activity was often triggered by a turnover, moment of surprise or when logo was displayed. EEG waves varied just slightly based on the type of advertising content. Elevated emotional response occurred the most often in case of positive content, followed by content with neutral character and negative character.

The interpretation of EEG results was limited by the fact that we could not determine the source of the excitation (whether it was interest in particular protagonist or attraction to him/her, fear, likeability, elaboration of presented information etc.). Sometimes, a comparison with a questionnaire helped, but since we are looking into deeper unconscious mental processes, it was not always enough. We think that a more advanced EEG device would help, but still, looking inside one's brain brings a more fuzzy image general public would expect.

Most recalled was an advertisement for Audi RS called Birth. Interestingly, in all cases, participants were able to recall a brand, but not an exact model of a car. Advertisements with unattractive content were remembered the most. Our results did not support the research hypothesis stemming from MAC theory saying that the higher the emotional response to advertising, the better it will be remembered.

Our future research intentions include a further insight into emotional reactions based on the character of advertising (with humour, scary content, sexual information and compared to more neutral advertising) as well as reviewing MAC theory with a more precise EEG device (Lau and Gwin [14] discussed how many electrodes in EEG research is enough and agreed on number 35) and eliminating at least some of the limits of conducted research we are very well aware of: MAC model not counting for so called vampire effect (viewer remembers the story in the ad but is not able to correctly assign brand name to it) or a small research sample (due to the difficulties of neuroscientific research itself, research samples are in general smaller).

Preparation of this research was very insightful. We believe that new knowledge from the field of neuroscience can bring interesting results that will contribute to better understanding of advertising perception and will help marketers create more interesting and functional messages.

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