


APPLICATION OF THE EMOTIONAL INDEX IN THE STUDY OF THE IMPACT OF TELEVISION ADVERTISING ON THE RECIPIENT

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Abstract: This paper explores the possibility of using an emotional index to study the impact of television advertising on the viewer. The empirical data have been collected in a neuroscience study using GSR (galvanic skin response) and HR (heart rate) techniques. They enable us to read and analyse the skin surface and myocardium while watching advertisements. Emotion monitoring makes it possible to verify which parts of an advertisement have evoked positive and negative emotions. The analysis uses the AIDA model of advertising influence as a blueprint for audience behaviour in the marketplace.

Keywords: advertising, cognitive neuroscience, emotional index

JEL classification: M37, C91

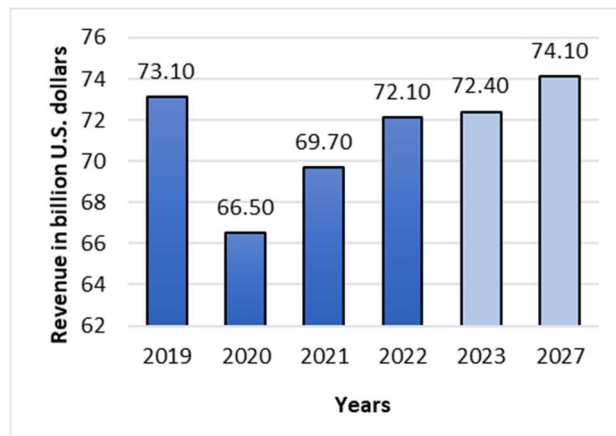
INTRODUCTION

Advertising plays a significant role in the life of societies as a means of promoting and facilitating the sale of products and services. The origins of advertising can be traced back to the early days of commerce. The first traces of outdoor advertising, as described in a brief history of advertising by C. McDonald and J. Scott, were found in the monuments of the ancient civilizations of Babylonia, Egypt, Pompeii, Athens and Rome. Even then, advertising performed the same functions as it does today: it informed, assisted sales, and reminded customers of vendors. It was, of course, much less widespread than today due to the limited number of products in the trade and the small number of media available [McDonald, Scott 2007, 18]. For almost a century [Harvey 2016], television has been a very

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popular and successful medium for advertising. Worldwide consumers still have a lot of faith in it. It was expected that TV advertising revenue in the United States would grow from 72.4 billion U.S. dollars in 2023 to 74.1 billion in 2027 [Statista 2023a]. Global TV advertising spending stands at \$132 billion [Statista 2023b]. After the market collapsed in 2020 due to the COVID-19 pandemic, the projected growth in advertising expenditures is shown in Figure 1.

Figure 1. TV advertising revenue in the United States from 2019 to 2027



Source: own research based on [Statista 2023a]

The abundance of information, resulting in the existence of competition among advertisers [Nan, Faber 2004, 7-30], means that with increasing expenditures, advertisers need reliable assessments of the effectiveness of the impact of advertising on the viewer. On the one hand, numerous indicators and tools are known to measure the effectiveness of advertising, but on the other hand, it is difficult to tailor them to the specific needs of a given advertiser [Kingsnorth 2016, 260]. Technological developments are taking place not only on the side of the media but also on the side of research tools, which can include cognitive neuroscience techniques that enrich existing methods, such as surveys, with the ability to measure evoked emotions. Measuring physiological reactions that cannot be controlled avoids casting doubt on the results obtained. The use of non-invasive methods, such as pulse or skin resistance measurements, does not raise ethical objections, although the very use of neuromarketing to influence buyers already raises such objections [Flores et al. 2014, 77-91; Morin 2011, 131-135]. Neoclassical economics propagated the idea that human behaviour is predictable and logical for a long time. But because human behaviour, particularly in the context of advertising, is difficult to describe, currents emerged that gave rise to the idea of behavioural economics. This discipline focused on understanding real human behaviour while accounting for human limitations, allowing for the use of psychology, sociology, and cognitive neuroscience to partially explain observed behavioural anomalies. For many years there have also

been attempts to describe the impact of advertising, which have led to the development of models of the impact of advertising on audiences. Models are some kind of formulas or schemes that identify ways in which audiences behave in the market. They differ in their assumptions, the number of stages that audiences go through or sequentiality. They have been created and developed since the mid-19th century. The oldest, fully functional model AIDA was created by Elias St. Elmo Lewis [Lewis 1899, 65-66]. Other well-known models of advertising influence are e.g. AIDCAS, AIDMA, DIPADA, DAGMAR, Lavidge-Steiner, EKB or Ray [Wijaya 2012, 73-85]. All advertising is directed at people, and the models are meant to describe their reactions to these ads. The disadvantage of many models is that they do not indicate depending on which factors to build a communication strategy. Therefore, it is important to describe human behaviour in the context of these interactions.

LITERATURE REVIEW

Representatives of behavioural economics will prove that in decision-making people are less rational than they think and that the sources of human behaviour should be sought in the functioning of the brain. Kahneman and Tversky began to compare their cognitive models of decision-making under risk and uncertainty to economic models of rational behaviour. They have demonstrated that for people the negative value of the loss is greater than the positive value of profit [Kahneman, Tversky 1979, 263-292]. Economists were prompted by these developments to reevaluate the potential use of psychology in economic theories and models [Camerer et al. 2004, 4-6]. An emotion (latin *e movere*, in motion) is a state of significant agitation of the mind. Precisely defining the concept of emotion, however, is not straightforward. As early as the early 1980s, researchers counted about a hundred definitions of the concept [Solomon 2008, 3]. A characteristic feature of emotion is its sudden appearance associated with somatic arousal. Emotions can reach considerable intensity, but are transient [Monge et al. 2012, 43]. The study of emotions is hampered by the possibility of hiding them in interpersonal interactions. In order to fully understand them, it is necessary to be able to separate the emotions felt from those shown. Perceived emotions are a person's actual emotions, whereas displayed emotions are those required by the organisation and considered appropriate in a given setting [Robbins 2004, 81]. Therefore, the question can be asked to what extent the theoretical models of advertising impact are effective, and how to measure them. The most popular models of advertising impact are linear. Models of advertising impact on the recipient present also a hierarchy of advertising effects in various combinations of such elements as comprehension, emotions, and behaviour. Each of them assumes, that advertising audiences go through different phases (cognitive-thinking, affective-feeling and behavioural) [Barry, Howard 1990, 121-135]:

- Cognitive – related to the level of knowledge of the customer which is the result of information carried by an advert message.
- Affective (emotional) – related to shaping a customer’s attitude toward a product being influenced by an advert.
- Behavioral (actions) – associated by inducing the customer to act [Fennis, Stroebe 2020].

The power of advertising to influence the viewer is not only due to its nature and the way it works but also equally due to how we choose and buy brands. It is a consequence of innate, natural mental processes, and therefore we are not influenced by it [Heath 2003]. AIDA example model consists of four stages, Attention, Interest, Desire, Action and three phases, Cognitive, Affective and Behavioral, as shown in Table 1.

Table 1. AIDA model

Stage	Description	Phase
Attention	To attract the viewer’s attention, make a positive presence in the viewer’s mind, and offer the benefits of watching the rest of the ad. The consumer becomes aware of a category, product or brand	Cognitive
Interest	To arouse the viewer’s interest through the developed content of the message. The audience must be interested in the advertisement or part of it. The consumer becomes interested in learning about brand benefits & how the brand fits with the lifestyle	Affective
Desire	Desire involves emotions that need to be stimulated. The consumer develops a favorable disposition towards the brand	Affective
Action	Make the audience aware of their emotions or desires to elicit an immediate response. The consumer forms a purchase intention, shops around, engages in a trial or makes a purchase	Behavioral

Source: own research based on [Rawal 2013]

MATERIALS AND METHODS

Galvanic skin response and heart rate were measured using the Neurobit Optima 4, a device for physiological measurements. The galvanometer’s functions allow measurements of changes in skin conductivity based on generic modelling of the sympathetic nervous system. GSR measurement was performed using reusable electrodes worn on the fingers. Because physiological stimulation and autonomic nervous system activation are linked, variations in skin electrical resistance may indicate the occurrence of emotions or an involuntary response to the stimuli [Boucein et al. 2012, 1017-1034; Dawson et al. 2007]. The heart rate (HR) measurements were taken with disposable ECG electrode taped to the left wrist and

registered to establish the frequency of heartbeats per minute [Dulleck et al. 2014]. The Neurobit Optima device has 4 channels for voltage, resistance, conductance and temperature measurements. Data transmission was carried out using Bluetooth digital communication, and the recording of GSR and HR signals was done in CyberEvolution's BioExplorer application, recommended by the equipment manufacturer, Neurobit Systems. The measurement data was recorded with a resolution of 0.5 s, then after transferring to a spreadsheet and calculating the emotional index, a graph of the flow of changes in the emotional index was made [Piwowski 2018]. Emotional indices were calculated based on test results (GSR and HR) to assess the effect of advertising on receivers. Results of emotion tests show the level of emotions excited by analysed advertising in their subsequent scenes, presented in Figure 2.

The emotional index (EI) was determined according to the formula:

$$EI = 1 - \frac{\beta}{\pi}, \quad (1)$$

where

$$\beta = \begin{cases} \frac{3}{2}\pi + \pi - \vartheta & \text{if } GSR_Z \geq 0, HR_Z \leq 0 \\ \frac{\pi}{2} - \vartheta & \text{otherwise} \end{cases}. \quad (2)$$

GSR_Z , HR_Z represent the Z-score variables of GSR and HR respectively;

$$\vartheta = \arctg(GSR_Z, HR_Z).$$

The β angle is defined in order to obtain the EI varying between [-1, 1].

According to (1) and (2), negative $HR_Z < 0$ and positive $HR_Z > 0$ values of EI are related to negative and positive emotions [Mauss, Robinson 2009, 209-237; Vecchiato et al. 2014].

EMPIRICAL DATA

The data were collected in the cognitive neuroscience laboratory of the University of Szczecin. All participants gave written informed consent to participate in the study prepared under the 2013 Declaration of Helsinki, approved by the Bioethics Committee at the Regional Medical Chamber in Szczecin (code 02/KB/VII/2020). The experiment was conducted for a group of 32 persons (19 women and 13 men) of different ages, from 22 to 68 years old. The mean values and the standard deviations are listed in Table 2.

Table 2. The mean values and the standard deviations for participant's age

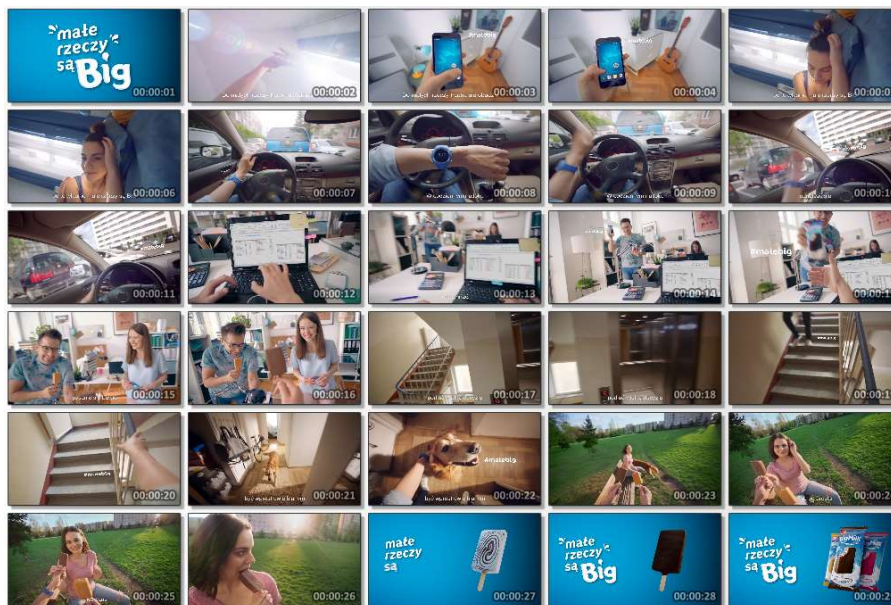
	N	M	SD
Whole sample	32	41.75	12.68
Women	19	39.95	11.35
Men	13	44.38	14.94

Source: own calculations

The statistical data analyzed for the population under study should be based on random samples large enough to provide a basis for quantitative inference so that the results can be generalized to the entire population [Borkowski et al. 2004, 12]. In the field of behavioural neuroscience, as in all fields of science, determining the sample size is an important factor in ensuring the reliability and accuracy of the results obtained in a study, as well as the reproducibility of the study itself. In studies using advertisements as stimuli, the average number of recruited participants is 33 [Bazzani et al. 2020]. A study conducted to determine how reducing the sample size would affect the results identified thresholds above which the results still showed significance. Assuming a reference population of 36 samples, it was acceptable to reduce the sample size to 24 for a 30-second commercial [Vozzi et al. 2021].

Participants in the study watched a commercial television advertisement for ice cream - a spot with a typical length of 30 seconds. The film frames (seconds) are shown in Figure 2.

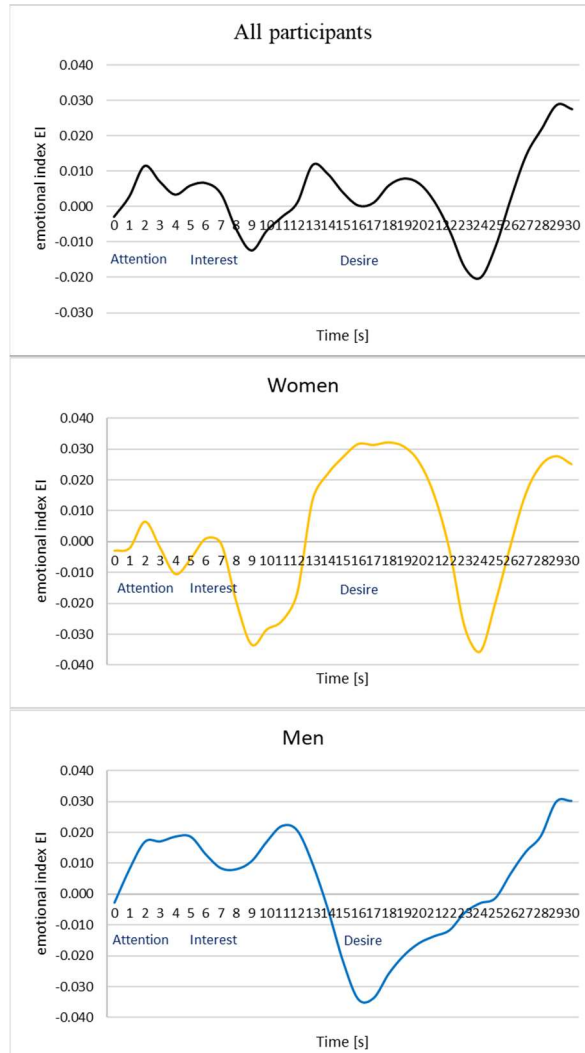
Figure 2. Film frames of the analyzed advertisement



Source: <https://vimeo.com/269621878>

RESULTS

After calculating the emotional index for the entire study cohort and for women and men separately, the corresponding charts were made. The results are shown in Figure 3.

Figure 3. *EI* emotional index charts

Source: own calculations

The unified index for all participants remains low (most of the time in the $[-0.02$ to $0.02]$ range). The index for men and women takes on values with a much higher amplitude than the average. The charts show that women and men may feel different emotions when watching the same scenes. Until the 13th second, the *EI* for men is higher than average, while for women it is lower. After that, the situation is reversed: the *EI* for women increases, reaching a value of 0.032, and for men, it decreases to -0.034. The final drop in the emotional index to a minimum at the 24th second is -0.036 for women and 0.003 for men. Referring to the AIDA model, the

Attention stage elicited almost no emotions in women, while men experienced moderately positive emotions. In the Interest stage, women initially experienced negative emotions and then strongly positive emotions, while men experienced the opposite. Only the last seconds of the commercial (the Desire stage) were received equally positively by both men and women. It can also be noted that according to Solomon's theory of opposing emotions, after the onset of negative emotions, the nervous system compensates with positive emotions, increasing, however, more slowly [Solomon 1980, 691-712].

SUMMARY

The purpose of the article was to present cognitive neuroscience techniques (GSR and HR) for the study of emotions and to verify whether there is a correlation with the corresponding stages of models of advertising influence on the viewer. The study was based on the AIDA model. The results of the analysed advertisement showed that it is possible to assess with a high degree of accuracy whether the advertisement was properly designed (for the adopted model). By analysing the *EI* determined from the GSR and HR studies, it is possible to make appropriate adjustments at the stage of advertising implementation. Referring directly to the analysed advertisement, it should be noted that positive and negative emotions can appear in different situations, depending on gender. The same scenes can be perceived positively by women and negatively by men, and vice versa. Such insights should be taken into account during design and preliminary testing even before broadcasting.

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