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**The Neuroscientific Research of the
Emotional and Functional Performance
of TV Commercials**

Theses of PhD dissertation

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I. THE RELEVANCE AND BACKGROUND OF THE STUDY

The history of advertising and promotions dates back to ancient times. The first surviving advertisement was written on papyrus around 3200 BC in ancient Egypt, calling attention to a runaway slave (Sandage – Fryburger, 1963). Other ancient artifacts, such as wine labels or paintings advertising products for sale on the walls of houses, demonstrate that advertising and its purpose have been a part of our lives since the dawn of civilization (Starcevic, 2015). The general purpose of advertising is to convey information about a product or service and introduce its features to consumers, thereby influencing the decision-making process and, ultimately, consumer behavior.

In the context of advertising, a decision-making process and a deeper understanding of consumer behavior are inevitable. This is because they carry information that influences consumers' choice between products and services. It is not surprising, given its significance, that advertisers spent nearly 777 billion USD¹ on advertising worldwide in 2022. Television commercials played a prominent role in this, with the global television

¹ Forrás: <https://www.statista.com/statistics/237803/global-tv-advertising-revenue/>

advertising market reaching 171 billion USD^{2,3} in the same year, accounting for 22% of the total global advertising expenditure. However, despite the enormous volume of advertising, its market efficiency seems to be declining due to information saturation. Of the approximately 1,300 advertising messages that consumers encounter daily, 98% do not reach or engage with them (Esch, 2008).

In recent years, studies have shown that the introduction of new products has a success rate of only 10%, which challenges the reliability and validity of traditional marketing research (Cherubino et al., 2019; White, 2006). The current challenges in understanding consumer behavior and decision-making processes, as well as the effectiveness of advertising, can be addressed by incorporating neuroscience, as all consumer behavior is rooted in brain function. Our brain receives 11 million bits of information per second from our senses (taste, hearing, touch, sight, and smell), of which only 40-50 bits become conscious, or 0.0004% (Raab et al., 2009). This illustrates the futility of relying solely on traditional focus groups or questionnaire-based research to obtain reliable data on conscious decision making, as most factors influencing actual consumer behavior remain unconscious. Furthermore, even when conscious factors are identified, they can be difficult to articulate and measure accurately.

² Forrás: <https://www.zenithmedia.com/global-ad-market-on-track-for-8-growth-in-2022/>

³Forrás:<https://www.zenithmedia.com/zenith-forecasts-4-5-growth-for-2023-after-7-3-uplift-in-2022-marking-continued-healthy-growth/>

Neuromarketing is a rapidly growing field of neuroeconomics that combines the disciplines of neurology, economics, psychology, physics, and radiology. Neuromarketing research typically originates from the intersection of neuroscience, cognitive psychology, and marketing. Neuroscience is the scientific study of the nervous system, whereas cognitive psychology is the study of the relationship between human thought and behavior. Together, these fields provide a unique perspective on consumer behavior and decision-making. (Kenning – Plassmann, 2005). As a further development of this line of thinking, one of the leading researchers in the field, Ramsoy (2014), considers neuromarketing to be the latest combination of neuroscience, psychology, and economics. This is reinforced by another prominent researcher in the field, Hausel (2008), who describes neuromarketing as a mix of neuroscience and marketing research, in which brain waves and the effects of our brains on our bodies without conscious influence are measured and analyzed to better understand consumer habits and motivations.

Neuromarketing, as a subfield of neuroeconomics, aims to analyze and understand consumer behavior from an economic perspective, using scientific methods from the field of neuroscience. The term "consumer neuroscience" was first introduced by Hubert and Kenning in 2008 as a broader interpretation, and has since become a common term, particularly in university research. In Hungary, the commonly used translation of this term is "fogyasztói neurotudomány" (Varga, 2016). Cherubino et al. (2019, p. 2) later defined consumer neuroscience as " a new approach within consumer research that has rapidly

developed, which aims to enhance the understanding of consumer behaviour using insights and methods from neuroscience." The widespread adoption of consumer neuroscience research can be attributed to technological advancements, which have made purchasing preferences, motivations, and expectations more accessible, and the integration of neuroscience into the study of consumer decision-making, which has fundamentally broadened the scope of marketing research (Ariely - Berns, 2010).

Neuroscientific research can be of utmost significance in the analysis of advertisements, particularly for understanding the emotional and motivational processes that influence consumer decisions. Undoubtedly, this field represents one of the most popular areas of application for neuroscientific research (Lim, 2018). However, despite the popularity of this topic, the investigation of advertising effectiveness remains a relatively underexplored and poorly understood area. The complexity of the consumer decision-making process, the time lag between exposure to brand information and its impact on the decision-making process, and the uncharted mechanisms of this process are among the primary reasons for the lack of understanding. In addition, the role and operation of conscious attention, emotions, and arousal, which are key factors in successful advertising, require further examination.

In my doctoral study, I have chosen to focus on the neuroscientific research of television advertisements, which is one of the fundamental areas of neuromarketing that examines theoretical and practical issues related to advertising effectiveness. My goal is to go beyond the general presentation in the field of neuromarketing and

identify the main consumer neuroscience trends. This can help systematize and theoretically ground the application of neuromarketing in practice, as well as provide an important starting point for further domestic development of the field. Furthermore, my research aims to answer current questions such as the categorization of television advertisements based on their emotional impact and cognitive processes. I sought to understand the level of emotional impact and cognitive processes involved in the categorization of television advertisements. In this study, I examined the correlations and characteristics of emotional and attentional neuromarketing metrics. In addition, I introduce new contexts for the neuroscientific analysis of advertisements, such as product categories and various brand attributes and effects. These novel and unique approaches contribute significantly to the field of neuroscientific research in Hungary. I hope that my findings will provide opportunities for more effective television advertisements in the future. This will result in less advertising noise but more efficient and relevant content that meets the needs and desires of consumers.

II. PRESENTATION OF THE RESEARCH

Brain responses to advertisements and consumer decisions depend on a complex set of neurobiological processes that are still largely unknown, because there is no single brain region responsible for consumer decisions (Ariely - Berns, 2010). With this in mind, I have chosen to examine the emotional and functional performance of television advertising as my research topic. My aim is to use an advertising database that includes neurometrics to categorize and analyze television advertisements, with a particular focus on the emotional and functional impact of advertisements on different factors. The significance and novelty of this research lies in the fact that such a categorization of television advertisements using such a large amount of neuroimaging data has not yet been conducted in Hungary. In addition, expert evaluations will also be incorporated into the research, which will allow us to examine the relationships between expert evaluations and the metrics derived from neuroimaging data.

In summary, I would like to build on the literature of previous neuromarketing research to establish the foundations of an advertising evaluation framework in which neurodata can be used to consider and categorize the different contexts that affect advertisements along with their cognitive and emotional parameters, thus enabling the design of more successful and effective advertising strategies. Thus, I hope that the usefulness of my thesis will not only serve the theoretical development of the field by identifying possible new connections, but will also be judged in terms of its practical utility.

II.1 Structuring the research

There are many possible ways to increase the effectiveness of television advertising through neuroscientific research, so it is necessary to narrow down the topic, which I have done in the different contexts of TV advertising. In the case of advertising, several contexts can be identified, such as the price of the product, the life cycle of the product, the way it is sold (online or in person), brand loyalty, product consumption, and many other factors that influence the effectiveness of advertising. Based on the literature recommendations and previous research on the subject, I have included the following contexts in my analysis:

- Brand effects, including brand recall and attitudes towards the brand.
- The impact of the product category, focusing on the the two ends of the scale, the FMCG food and drink categories and the financial sector advertisements.
- The impact of the communication objectives, specifically examining image-based and commercial/promotional advertisements.

These contexts have been well studied by measuring the emotional and functional (cognitive) performance of advertising. The structure of the research is illustrated in Figure 1.

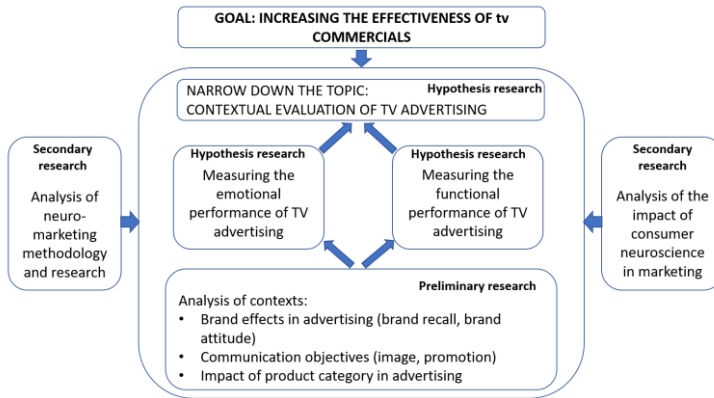


Figure 1: The structure of the study
 Source: Own work

In order to design the research and interpret the results, it is necessary to study and understand the national and international literature, and to use the results and methodologies already incorporated into marketing through consumer neuroscience, so I conducted the following secondary and preliminary research for the hypothesis research:

SR1: Overview of the methodology and research conducted in the field of neuromarketing, both domestically and internationally.

My aim was to provide a comprehensive analysis of the development of neuromarketing in the past two decades, both internationally and domestically, in order to identify potential future research directions, such as the possible utilization of neuromarketing research or the integration of consumer neuroscientific findings into traditional marketing theories. Through monitoring the scientific

progress of the field, I was able to gain insight into the current state of neuromarketing, its level of advancement, active domestic focal points, researchers and their work, as well as research centers. The analysis shows that domestic neuromarketing works, which have processed many resources, provide a thorough theoretical framework for those interested in the field. The number of consumer neuroscientific studies has increased globally and in Hungary in recent years. The main content focus of domestic works is similar to that found in international literature, although there is a slight lag in the areas of product and branding, and due to the small number of instrumental studies, the development of ethical standards and the presentation of ethical issues have not received the same level of research attention as in the international community.

SR2: A study of neuromarketing attitudes in Hungary

In order to further investigate the perception and presence of neuromarketing methodology in Hungary, I conducted a research with the help of my supervisor teacher, following the work of Eser et al. (2011), to find out what knowledge, opinions and attitudes the different actors working in the field of marketing have about neuromarketing research. As in the original study, the online questionnaire survey targeted three groups: marketing researchers, marketing practitioners and neuroscientists.

It was found that there is general interest and openness in neuromarketing research, even if the perception is mixed. The interest is stronger among marketing practitioners than among marketing researchers, who would like to get

direct, practical information from neuromarketing. At the same time, there is less interest from marketing researchers and academics, who, due to the lack of theoretical grounding, consider neuromarketing research as a tool that can't be used in itself and feel that it is only useful and necessary in certain specific field.

SR3: Identifying points of convergence in neuromarketing research

In the field of neuromarketing, one of the major questions for future development is how and at which points it can be implemented and integrated into the classic marketing theory. My research has shown that the literature emphasizes the elements of the marketing mix and brand research as potential points of connection. Accordingly, I conducted a thought experiment to examine a possible interpretive framework for a new type of neuroscientific (consumer decision-based) marketing mix, as well as Plassmann and Ramsoy's (2012) new type of brand effect model that can be used in neuroscientific research.

As a result of our study, I was able to not only consider the brand effect framework and consumer decision-based marketing mix interpretation as future neuromarketing research directions and possible points of connection for consumer neuroscience in marketing theory, but also to connect them (Figure 2) as both are centered on better understanding and comprehending the consumer decision-making process.

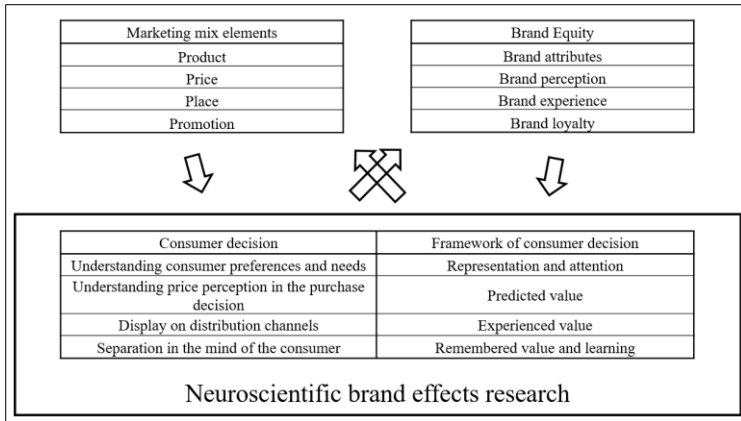


Figure 2.: Interconnections between neuromarketing research directions

Source: Own work

In general, my aim with the preliminary research was to investigate the contexts that influence the effectiveness of television advertising with the commercials in the provided research database.

PR1: Examining brand effects in advertising (brand recall, brand attitude)

I used a replicated study by Klucharev et al. (2008) to investigate how the presence of expert celebrities in advertising affects brand recall and consumer attitudes towards the brand in advertising. The research showed that the presence of credible expert celebrities in advertising positively influences these brand attributes and thus the consumer decision process.

PR2: Impact of communication objectives in advertising (image, promotion)

In this study, I investigated the relationship between neuroscientific metrics and expert evaluations in order to determine whether advertisements with higher emotional content truly contain image-based messages, assuming that advertisements with lower emotional performance are indeed functional, promotional messages as identified by expert classification.

The research confirmed that experiential, emotional advertisements have a greater emotional impact than functional advertisements, and conversely, a large proportion of emotionally impactful advertisements are experiential in nature. The results indicate that, in the sample examined, 70% of the top ten emotionally impactful advertisements, as classified by experts, were image-based advertisements. It is important to note that, in addition to the previously accepted bipolar categorization, I was able to identify a third group of hybrid advertisements that contain both types of impact to a similar degree. Three advertisements from this group were included in the ranking of the most emotionally impactful advertisements.

PR3: Impact of product category in advertising (FMCG food and drink, financial sector)

As a complement to the previous study (PR2), I analysed the impact of the different emotional or functional consideration process per product category identified by Binet and Field (2018) on the emotional and functional performance of advertisements and thus their classification by advertising type. The results showed that

the top eight out of the top ten emotionally performing ads were FMCG ads, supporting the authors' hypothesis that there is a correlation between product category and the emotional and functional performance of the ad.

II.2 Hypotheses of the research

The secondary and preliminary research presented here was all aimed at providing a scientifically sound basis for the neuroscientific investigation of the emotional and functional performance of television advertising, along with the formulation of appropriate hypotheses. Accordingly, the following hypotheses will be tested in the context of this dissertation.

H1: There is a strong positive correlation between the aggregated engagement EEG metric and the emotional index of the expert evaluation.

The strong positive relationship between the expert evaluation criteria of Couwenberg (2017) and the instrumentally measured neuroscientific emotional metrics would indicate that the instrumental measures of emotional performance of advertisements and consumer perception are nearly identical, which could be a good basis for future automated advertising testing procedures.

H2: There is no correlation between the aggregated engagement EEG metric and the functional index of the expert evaluation.

I investigate whether instrumentally measured emotional metrics can be used to describe a functional index of the expert evaluation. If not, it would prove that there is no correlation between the instrumentally measured emotional performance of commercials and the functional performance of the expert evaluation.

H3: I will find no detectable correlation between the emotional index and functional index of expert evaluation.

My aim is to investigate the potential relationship between the emotional and functional performance of advertisements, as evaluated by experts. Specifically, I seek to examine the H2 hypothesis in relation to the emotional index of expert evaluations. This is important because it can help to confirm the findings of Heath's (2007) study, which suggests that there is an orthogonal relationship between emotional involvement and conscious attention. In other words, there is no necessary correlation between the two. This means that a high level of emotional involvement in an commercial does not necessarily indicate a low level of conscious attention, nor does a low level of emotional involvement necessarily indicate a high level of conscious attention. By exploring this relationship further, we hope to gain a deeper understanding of the factors that contribute to the success of advertisements, and to provide valuable insights for advertisers and marketers.

H4: Among the indicators in the neuromarketing database provided, I will find a metric with a strong negative or positive correlation with the functional index of the expert evaluation.

In the field of neuroscientific attention, there has been a greater emphasis on the instrumental measurement of emotional metrics, assuming that cognitive processes such as attention are more easily articulable and measurable by traditional marketing research methods than emotions. However, I posit that there is no strong relationship between the functional index of expert evaluation, in other words, the complex cognitive performance of advertising, and either instrumental or questionnaire-based indices and metrics in the neuromarketing database. If this is indeed the case, it highlights the need for future studies on brain processes that are of particular importance in information processing, such as attention metrics.

H5: Product category as context strongly influences the emotional performance (EEG engagement) of advertisements.

At this point, I investigate how the instrumentally measured emotional performance of advertisements is affected by the product category due to the underlying consideration processes.

H6: The product category as a context strongly influences the emotional performance of advertising as determined by expert evaluation.

The reason why the H5 hypothesis should be tested in comparison with the emotional index of the expert evaluation is that emotions are more difficult to consciously identify and measure, and thus the impact of the product category may not be as evident in the perception of the emotional performance of the advertisement as in the case of the measurement by a neuroscientific tool. If both H5 and H6 are true, then the effect of product category on the emotional performance of advertising can be considered to be confirmed.

II.3 The research methodology

In the realm of research, two fundamental approaches can be distinguished: qualitative and quantitative research. When it comes to the qualitative approach, it is worth noting that neuromarketing studies take into account numerous indicators that are examined in this field (Bergkvist - Langner, 2017): attitude, attention, memory, beliefs, recall, and practically any psychological phenomenon that occurs in the consumer's mind. With their help, it becomes possible to examine these indicators more accurately and to quantify them, which leads to the quantitative approach. In the vast majority of neuromarketing studies, statistical analyses are applied, which are essential for interpreting the output data and drawing appropriate conclusions. Thus, it can be seen that neuromarketing cannot be fully attributed to either method, nor can it be completely separated from them.

My research aligns with the post-analysis approach commonly used in neuromarketing studies for analyzing advertisements. Specifically, the aim is to measure the effectiveness of advertising campaigns through the

examination of the brain reactions of testers to product advertisements. This approach is based on the work of Ariely and Berns (2010). Our theoretical framework cannot be strictly classified as either positivist or constructivist, but rather is a combination of the two. This duality is also reflected in our research methodology, as we investigate both structured and unstructured problems. For the former, we employ a cross-sectional research design to conduct causal research, while for the latter, we use exploratory research methods to interpret the measured correlation coefficients and relationships.

In this study, a combination of various research methods and a two-part research process was conducted. Firstly, I utilized a semi-structured questionnaire with open-ended questions to gain insight into consumer habits and behavior. Secondly, we employed a multivariate regression analysis of instrumentally measured brain reactions, neural activity, and emotional metrics using statistical software to explore the correlation between variables. This approach provides a comprehensive understanding of the complex interplay between consumer behavior and neural activity.

Taking into account the specificities discussed above, in order to have as much systematic data as possible, I used data from the neuromarketing advertising effectiveness database of Synetiq Ltd. The database provided by the company contains neuro metrics and questionnaire data for a total of 350 new TV ads appearing monthly between 1 January 2018 and 31 December 2018, in the financial and FMCG/Food & Drink product categories. The data were collected monthly with a minimum of 160 participants each month, all of whom were active TV and

internet users in the target group of 18-59 ABC Esomar status, distributed approximately equally in terms of their basic demographics by gender and age groups 18-29, 30-39, 40-49 and 50-59.

At the time of data recording, each monthly survey included 80 selected ads and each ad was tested with at least 75 people. The data were recorded using instrumental backgrounds that met the expected scientific standards, which also met the content expectations of Shiv's (2011) model. Accordingly, my hypotheses in the model are related to the transmission power - the ability of an ad to convey its key message and connect with a brand - and persuasion power - the ability of an ad to emotionally engage and persuade consumers. As a tool kit for this, Shiv (2011) recommended specific questionnaires, such as a test to measure cognition-related brain responses, and methodologies to measure emotional brain responses, such as EEG.

To the research neuromarketing tools were used to measure the internal and external neural activity of the brain, as proposed by Lim (2018). Specifically, EMOTIV EPOC 14-channel EEG headsets to record EEG signals during the study, along with other instruments that measured skin resistance (EDA) and heart rate (PPG), as well as continuous eye-tracking data. The participants were watching a specially designed program for approximately one hour, which included a 20-minute tool calibration. Emotional starting points were determined for each individual by assessing their emotional state during the calibration, which was necessary for later qualitative analysis and interpretation of the data.

Each participant viewed 2*20 advertisements randomly selected from various product categories and advertisers. Care was taken to ensure that different product categories or advertisers were properly rotated in the ad sets, without overemphasizing or omitting any product category, advertiser, or product. Emotional metrics, such as attractiveness (approach), emotional involvement (engagement), and excitement, were generated for each advertisement based on the data obtained in 1-second intervals. In addition to neuromarketing tools that primarily measure emotional metrics, we also placed special emphasis on a three-phase questionnaire survey of classic advertising effectiveness factors that indicate the success of information processing.

During participant screening, demographic and basic data were recorded, in addition to health compliance with the medical examination for the instrumented study. Prior to the study, each participant completed a questionnaire at home regarding their preferences and consumption of brands in the product categories studied (category usage, supported recall, brand consideration). After each advertisement, basic questions were asked to determine activation, relevance, brand fit, and perceived reach, and after viewing all advertisements, spontaneous and supported ad recall and changes in purchase consideration were examined.

During the data collection, special attention was paid to filtering out possible distortions and adhering to ethical norms according to current standards. Therefore, participants who wore glasses with high diopters or had any neurodegenerative diseases were excluded from the research process. All participants voluntarily participated

in the study and signed an EEG consent form after being properly informed.

It is important to note that the methodology and algorithms used to generate individual neuromarketing metrics and questionnaire data are the protected intellectual property of the Synetiq Ltd. company that provided the database. Therefore, it was not possible to examine and present the details of these methods and algorithms in this study.

III. THE RESULTS OF THE RESEARCH

For the hypothesis tests, the number of selected advertisements was set at 30. These were selected randomly within the database, in addition to the ten ads that performed the best emotionally and were selected earlier. As for the experts, I recruited a team for the evaluation with an average of nearly 15 years of experience in media or advertising agency or television advertising, an average age of 36.5 years and a mix of 6 women and 4 men.

In the expert questionnaire, functional and emotional evaluation elements were scored on a scale of 1-4, expressing the dominance of the given property. Prior to analyzing the results, the Cicchetti IRR (Inter-rater reliability) test was applied based on expert evaluations per advertisement. The interpersonal correlation between emotional evaluations was found to be 0.82 (range: r min. = 0.69 - r max. = 0.94), which, according to Cicchetti's (1994) classification, still indicates a good and strong relationship. Therefore, we deemed the obtained data suitable for further processing. When examining the interpersonal correlation between functional evaluations,

we first found that testers probably find it easier to consciously identify the characteristics of advertisements of this nature than emotions, as a narrower range was observed with a higher average positive correlation of 0.84 (range: $r_{\min.} = 0.72$ - $r_{\max.} = 0.94$).

After the evaluations were deemed satisfactory and suitable for the continuation of the research, the classification of advertisement types was conducted, which showed a 90.7% accuracy rate in relation to the expert classification and categorization based on their evaluations. It is worth noting that discrepancies only occurred in the case of hybrid advertisements, where both emotional and functional effects were present in nearly equal measure according to expert evaluations. These findings suggest that this classification method is highly reliable and effective in identifying advertisement types.

III.1 Presentation of hypothesis studies

H1: There is a strong positive correlation between the aggregated engagement EEG metric and the emotional index of the expert evaluation.

Investigated the relationship between emotional expertise evaluation and emotional engagement metrics. Our findings revealed a significantly decreased positive correlation ($r=0.51$) compared to previous research, where a strong positive correlation was observed ($r=0.86$). The Pearson significance test confirmed that H_0 was false and the p value ($p=0.004$) indicated a significant relationship between the two variables at the 0.01 significance level. The decrease in correlation strength is likely due to the

difficulty experts faced in identifying and evaluating emotional performance in advertisements that did not elicit the strongest emotional responses.

Based on these results, we can only partially confirm the first hypothesis (H1), as we found only a moderately strong positive correlation ($r=0.51$) between the EEG engagement metric and the emotional index of expert evaluation. However, it is encouraging that the significance test revealed a strong relationship between the two variables.

H2: There is no correlation between the aggregated engagement EEG metric and the functional index of the expert evaluation.

Hypotheses H2 and H3 use different types of data, but essentially address the same question of whether there is a correlation between the emotional and functional performance of an advertisement. In this thesis I examined the correlation between expert functional evaluations of advertisements and instrumentally measured engagement metrics. Specifically, I compared the functional evaluation scores of each advertisement with the corresponding engagement metrics, in order to investigate whether there is a relationship between emotional and functional performance. The analysis revealed that there is no significant correlation between engagement metrics and functional evaluation scores ($r=0.05$). This lack of correlation suggests that there is no clear explanation for the emotional performance of advertisements based on the logical and conscious evaluation of experts, and vice versa. This finding was further supported by the

significance testing, which showed that the variables are not significantly related ($\rho = 0.785$). Therefore, we can conclude that the second hypothesis (H2) is true, and that there is no detectable relationship between expert functional evaluations and neuroscientifically measured emotional engagement metrics.

H3: I will find no detectable correlation between the emotional index and functional index of expert evaluation.

In this thesis, I examined the potential relationship between the functional and experiential evaluation scores provided by experts. Supposing that the functional performance can be expressed in the functional attributes of the product, such as its utility, characteristics, promotion, and call-to-action messages, which were evaluated by experts as part of the functional elements of the advertisement. Our results showed a weak negative correlation ($r = -0.36$) between the emotional and functional evaluation average scores of the advertisements. This was further supported by the significance test, where the ρ value ($\rho = 0.048$) indicated a significant relationship between the two variables at the 0.05 significance level. These findings suggest that, based on expert evaluations, there is a weak negative correlation and significant explanatory relationship between the emotional and functional effects of an advertisement. Therefore, our H3 hypothesis cannot be supported.

However I think, it is worth considering two additional factors in interpreting the results. Firstly, it is possible that the experts have a vague correlation between the

emotional and functional factors of advertisements in their minds, and thus they feel or think of the ads in a certain way, resulting in their scoring. Secondly, the results of the H2 study showed that there was no relationship between the emotionally measured metric and the functional expert evaluation, what leads us to conclude that the experts have typically erred in their emotional evaluation of the advertisements, which is supported by the weaker correlation found between the emotional engagement metric of the database and the expert emotional evaluation, as found in the H1 study.

H4: Among the indicators in the neuromarketing database provided, I will find a metric with a strong negative or positive correlation with the functional index of the expert evaluation.

In the database provided by Synetiq Kft, there are three emotional metrics that are primarily used: engagement, excitement, and approach. However, these metrics are inherently unsuitable for measuring sustained cognitive processes such as attention, as confirmed by the correlation analysis. In addition to the engagement metric previously studied in H2, the excitement metric also showed no correlation with expert evaluations of functional value ($r=-0.06$), while the approach metric showed only weak correlation in the same direction ($r=0.21$), which is more indicative of feedback on individual advertising elements such as music, actors, or even execution quality due to the nature of the metric. In addition to the instrumentally measured metrics in the database expanded the field of research to investigate the

relationship between expert evaluations and various questionnaire indicators, such as the activation power of advertisements, changes in consumer consideration following advertisement viewing, and the recall of advertisements. Found that the correlation between the activation indicator and the functional expert evaluation was weak and negative ($r = -0.35$), while discovered a moderately strong positive correlation with the changes in purchase intent and consideration ($r = 0.46$), what index was later reinforced also by the significance test showing a relationship at the 0.05 significance level, with a p value of 0.019. In order to fully examine our hypothesis, we investigated the relationship between the two most significant factors, activation force and changes in purchasing intent, with the engagement metric indicating emotional involvement (Table 1).

Table 1: Engagement correlation with functional indexes

Corr. Activation vs Eng.	Corr. Consideration vs Eng.
0,36	0,22

Source: Own work

The metrics showed a weak positive correlation, leading us to conclude that we could not identify any metric or indicator in the neurodatabase that demonstrated a strong negative or positive correlation with the functional index of expert evaluation. Thus, we were unable to fulfill the H4 assumption, and we did not discover any metric or indicator that could be used in future research.

H5: Product category as context strongly influences the emotional performance (EEG engagement) of advertisements.

The intention was to investigate the relationship between advertisement classification and product categories. To achieve this, two rankings were created based on the expert classification and the measured engagement metrics, respectively. The advertisements were sorted in these lists in descending order based on their emotional impact and also included the product category for each advertisement. According to the rankings based on the emotional engagement neuro-metric data, eight out of the top ten performing advertisements were from the food and beverage product categories. On the other hand, when examining the least emotionally engaging advertisements, six out of the last ten were from the FMCG product category. However, it is worth mentioning that for these advertisements, regardless of the product category, the communication strategy was the determining factor in the advertisement's characteristics.

By examining the average engagement metrics for each product category, we can see the systematic effect of the product category as a context on the emotionally measured performance of advertisements (Table 2). These findings suggest that the product category can significantly influence the emotional impact of advertisements, and communication strategies should be tailored accordingly.

Table 2 : Average emotional impact of advertising by product category (EEG-engagement metric)

Product category	Avg. Engagement/ commercial
FMCG food & drink	0,018
Financial service	-0,026

Source: Own work

The results demonstrate the strong impact of product category on the emotional performance of advertisements and in most cases also determine the communication goal of the ad.

H6: The product category as a context strongly influences the emotional performance of advertising as determined by expert evaluation.

The expert analysis of the list based on the H5 results clearly shows that the most emotionally impactful ads (nine out of the top ten) were almost exclusively from the FMCG sector, and all of them were experiential in nature. On the other hand, the lowest emotional impact ads (seven out of the bottom ten) were predominantly from the financial sector and, except for the Szentkirályi ad, were all functional or promotional in nature, as shown in Table 3.

Table 3 : Average emotional impact of advertising by product category (EEG-engagement metric vs expert evaluation emotional score)

Product category	Avg. Engagement/commercial	Avg. Emotional expert score/commercial
FMCG food & drink	0,018	2,72
Financial service	-0,026	2,03

Source: Own work

In summary of this research, which has been expanded to include product categories, it can be concluded that advertisements for emotionally-driven products are capable of generating higher emotional attachment when compared to those for more rational products, when both are communicating the same purpose. Specifically, experiential advertisements for food and beverage categories have a greater emotional impact than, for example, image-based advertisements for the financial sector. This correlation is also observable in functional advertisements, where functional advertisements for FMCG categories have a higher emotional impact than those for financial services. Thus, we can confirm the H6 statement. Furthermore, it can be noted that product categories where emotional considerations are more prominent in the purchasing decision tend to advertise their brands and products to consumers through experiential ads (80% of ads in the category were experiential), which are capable of generating stronger emotional impact. Conversely, advertisements for rational product categories generally achieve lower emotional involvement and typically appear on television with

promotional, functional advertisements (80% of ads in the category were functional).

III.2 The practical interpretation of research results

In the beginning of this dissertation, my articulated aim was to validate or refute certain assumptions through the hypothesis research results, which would bring us closer to, or possibly enable us to establish, a framework that could make advertising more effective through the measurement of emotional and functional performance of ads in specific contexts. Based on the results unfortunately, this framework cannot be established within the scope of this paper due to the lack of a cognitive attention neuroscientific metric. However, it provides a good indication for the possibility of future research, and for illustrative purposes, the examined contexts can be evaluated along the coordinate systems shown in Figure 3, where ads can be evaluated based on their functional and experiential, emotional value on the X and Y axes, respectively.

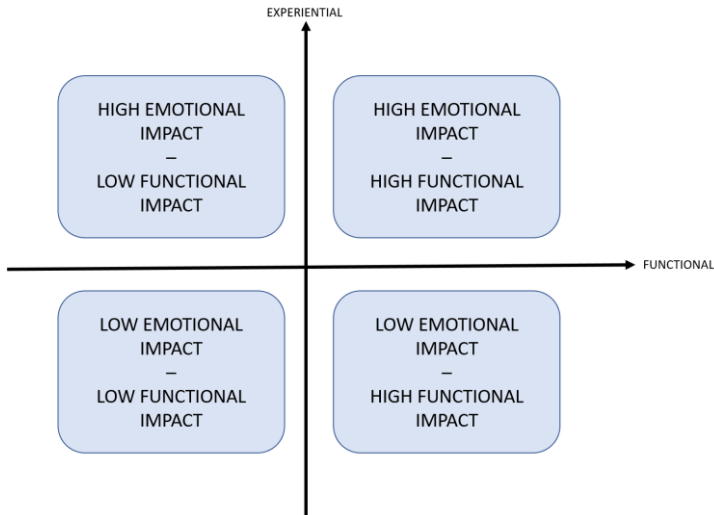


Figure 3: Presentation of the emotional and functional performance of advertising

Source: Own work

This is the foundation of categorizing and classifying advertisements based on the presence of emotional and functional components. This framework allows us to filter out poorly performing ads or those that receive a classification that deviates from their intended creative or marketing purpose (as shown in Figure 4). By analyzing the emotional and functional aspects of advertisements, we can better understand their impact on consumers and improve the effectiveness of advertising campaigns.



Figure 4: Categorisation of the ads according to their emotional and functional performance

Source: Own work

The purpose of this research was to demonstrate the extent to which the performance of an advertisement can be deciphered without access to internal information such as the advertising objective or the creative execution. The results are presented in a table, which illustrates the coordinates of each advertisement in a Cartesian plane, with the average functional and emotional expert evaluations as the origin. The distance of each point from the average performance represents the deviation of the advertisement's performance from the mean.

IV. SUMMARY

The evaluation of neuromarketing research has been highly mixed since its inception. Some researchers believe that studies conducted with neuroscientific tools can

provide advertisers with a manipulative ability that leaves consumers vulnerable and exposed to the communication campaigns of companies (Wilson et al., 2008). Other researchers argue that neuromarketing belongs more to the realm of science fiction than science, emphasizing that individuals' decisions and thoughts are so heavily influenced by their personal experiences and emotions that it is impossible to generalize, predict, or significantly influence them on an individual level (Hubert, 2010). Supporters of neuromarketing, such as Lindstrom (2009) and Dooley (2010), highlight the numerous advantages that neuroscientific research and tools can offer both companies and consumers in the form of more effective product development and successful advertisements.

Despite the progress made in neuromarketing and consumer neuroscience, the field is not where it could be. While the business applications have attracted the attention of advertisers and the market (with 80% expressing interest in neuromarketing or consumer neuroscience methods), the lack of proper scientific standards, unified methodologies, and theoretical grounding may hinder the future development of the field, leading to confusion and skepticism towards the results and findings of research.

Taking into account these indications, I conducted preliminary and exploratory research and drew conclusions based on the formulated hypotheses. The preliminary studies revealed a dynamic growth in research on neuromarketing and consumer neuroscience both internationally and in Hungary. It became clear that the early, predominantly theoretical approaches have been replaced by academic practical research, attempting to

keep pace with the rapid progress in business applications. As previously mentioned, challenges continue to arise in the field of neuromarketing that need to be addressed. These include the need for standardization of methods and protocols, the exploration of intersections between consumer neuroscience and marketing, and the establishment of standardized research methodologies and metrics. Therefore, in my dissertation, special attention was given to presenting the literature on these areas, examining the potential connections between brand effects and the marketing mix, and describing the proper utilization of neuroscientific tools.

In the context of television advertisements, particular emphasis was placed on reviewing the theoretical developments in the mechanism of emotional decision-making and categorizing advertisements based on their emotional and functional performance. Additionally, I investigated the impact of contextual factors such as brand attitude, brand recall, and the purpose of communication on advertisements. The results of preliminary studies demonstrated that these contexts significantly influence the emotional performance and evaluation of advertisements. Hypotheses formulated in relation to the main research aimed to examine factors contributing to a better understanding of emotional and functional attributes in the evaluation of advertisements and the potential development of a unified evaluation framework. Summarized the findings in Table 4.

Table 4: Summary of the hypothesis testing

HYPOTHESIS		METHODOLOGY		VERIFICATION
		quantitative	qualitative	
H1	There is a strong positive correlation between the aggregated engagement EEG metric and the emotional index of the expert evaluation.	questionnaire, statistical analysis	neuromarketing dataset	partially verified
H2	There is no correlation between the aggregated engagement EEG metric and the functional index of the expert evaluation.	questionnaire, statistical analysis	neuromarketing dataset	verified
H3	I will find no detectable correlation between the emotional index and functional index of expert evaluation.	questionnaire, statistical analysis		not verified
H4	Among the indicators in the neuromarketing database provided, I will find a metric with a strong negative or positive correlation with the functional index of the expert evaluation.	questionnaire, statistical analysis	neuromarketing dataset	not verified
H5	Product category as context strongly influences the emotional performance (EEG engagement) of advertisements.	statistical analysis	neuromarketing dataset	verified
H6	The product category as a context strongly influences the emotional performance of advertising as determined by expert evaluation.	questionnaire, statistical analysis		verified

Source: Own work

In the examination of the first hypothesis, I found that there is not a strong positive correlation, but only a moderately positive and statistically significant relationship between the metric of measured (EEG) engagement and the emotional index of expert evaluations. This result is consistent with previous research on the topic, as the two methodologies address emotions at different levels (Kolar, 2021; Venkatraman et al., 2015). The questionnaire data represents consciously articulated responses to consciously perceived marketing stimuli, whereas EEG captures non-conscious brain processes, including emotional reactions, providing complementary information in many cases (Shen and Morris, 2016; Deitz et al., 2016; Ohme et al., 2010; Haley and Baldinger, 2000). Nevertheless, the result only partially confirms H1. In H2, it was hypothesized, in line with the literature, that there would be no detectable correlation between instrumentally measured emotional metrics and the functional outcomes of expert

questionnaire evaluations, which was confirmed by the results.

In H3, I examined the emotional and functional outcomes of expert evaluations in relation to each other. Similar to the hypothesis in H2, no significant correlation was expected between the factors. The results did not support the hypothesis, as a weak negative and statistically significant relationship was found between the indexes. I believe this result reflects the difficulty in expressing, perceiving, and evaluating emotions, highlighting the challenges of non-instrumentally measured advertisement categorization. In the investigation of H4, based on the results of previous hypotheses, I examined whether there is any metric or indicator in the available neuromarketing database that demonstrates a strong correlation in any direction with the functional evaluations of experts. According to the study, this claim could not be supported, as no indicator showed a connection stronger than a weak correlation with expert functional indexes. These investigations clearly confirmed that there is an orthogonal relationship between emotional and attention metrics and functional information processing, indicating a lack of connection.

The research on H5 and H6 has demonstrated that the effect of product category on the emotional performance of advertisements is present in both the results of instrumental (EEG) examinations and the emotional indexes of expert evaluations. The advertisements of product categories with predominantly stronger emotional considerations are capable of generating greater emotional impact on consumers than those of product categories that generate more rational consumer deliberation.

At the outset of this research, it was set out to develop a framework for evaluating advertisements based on their functional and emotional performance. However, due to the lack of an attention metric that reflects the functional cognitive processes of the brain, as measured and validated by neuroscientific methods, it was unable to create such a framework. Nonetheless, a version of the framework based on expert evaluations was developed. While its interpretation is limited by the potential inaccuracies of the data and other limitations, this version provides a solid theoretical foundation for future research in this area.

V. OWN PUBLICATIONS

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