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Investigation of Images on Social Media with EEG during the Covid-19 Pandemic*

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Keywords
Social media images, covid-19 pandemic, mask use, EEG.

Abstract
An experimental design was created to measure the reactions in the brain of the individuals with the images shown to the individuals within the scope of social neuroscience with this research. Social neuroscience has its origins in going deeper into understanding the cognitive processes and underlying mechanisms helping explain consumer behavior. This Research is meant to examine the images on social media with EEG during the covid-19 pandemic. In the research, 50 images circulating on social media were selected primarily. A group of 40 people was asked to rate 50 images, and the 10 images that got the highest point according to the scoring formed the image set of the research, consisting of 77 seconds. EEG shots were made in the experimental atmosphere created with 16 volunteer participants to analyze the image set with EEG. EEG shots were made with the Mitsar EEG device and the data obtained from the shots were transferred to the WinEEG package program. In the analysis, the highest activations of Alpha waves at Fp1, F3, and F7 points were examined. As a result of the research, it was seen that the image, which is in the 4th place in the image set, created the highest activation at the Fp1, F3, and F7 points of many volunteer participants. This image draws attention as an image that points to respiratory distress, shows bed dependency, and covers the intensive care process.

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1. Introduction

Consumer neuroscience is considered a growing approach that directs researchers to the field with the increasing interest among researchers in the fields of consumer neuroscience, marketing, and consumer research alike. Marketing researchers began to accept the shortcomings of the outputs obtained through the quantitative and qualitative methods of the data obtained through questionnaires and interviews. Consumer researchers started to look for alternative/complementary methods to overcome the biases inherent in the reports, therefore. Neuroscience methods provide an alternative model to quantitative and qualitative methods as well as going deeper to figure out the cognitive processes and underlying mechanisms that help explain consumer behavior. Kenning and Plassmann (2008, p. 532) state that the purpose of consumer neuroscience is to "use insights and methods from neuroscience to improve the understanding of consumer behavior". While gaining visibility in the last decade, this approach to consumer research has slowly begun to gain widespread use among marketing scholars as an effective and applicable methodological approach, it has not received enough attention, however.

A neuroscientific approach to comprehending consumer behavior is increasingly used by business practitioners, particularly consumer brand managers. Major consumer product brands and companies like Coca-Cola and Campbell's are using functional magnetic resonance imaging (fMRI), eye tracking, electroencephalogram (EEG), magnetoencephalography (MEG), and other biometric measurements (eg, physiological measures used to characterize human behavior) (Looney, 2016). Other companies, such as General Electric (GE), established a research center called the GE Barbecue research center, where researchers use EEG methods to research consumers' responses to food and flavors to consummate barbecue recipes (Garun, 2015). Corporations like The Neuromarketing Science & Business Association provide a list of neuromarketing companies around the world, including major US-based consulting firms serving as A.C. Nielsen and Forbes Consulting Group.

There is a growing tendency in consumer neuroscience within academia and has footprints in many related fields. The major solution for consumer neuroscience is still neuroscience journals (for a review of consumer neuroscience studies in specific areas, see Solnais et al., 2013). Other journal publications appear in journals in the fields of psychology, marketing, and bioengineering. In marketing magazines, EEG-based studies have so far been often utilized in conjunction with brands and advertising incentives.

Studies in the literature for marketing or consumer-related EEG studies provide an overview. Several studies also used MEG, a related methodology that is similar to EEG in terms of its neurophysiological processes (Ambler et al., 2004; Braeutigam et al., 2001, 2004). However, there seems to be a bias toward fMRI use when marketing researchers apply a neuroscientific approach to finding out consumers' behavior (Reimann et al., 2011; Plassmann et al., 2015).

Regardless of the specific neuroscience approach, Plassmann et al. (2015) proposed five ways through which neuroscience can be applied to improve

academic and practitioner understanding of marketing theories and consumer behavior. These are:

- identifying mechanisms,
- measuring implicit processes,
- differentiating between psychological processes,
- understanding individual differences,
- improving behavior predictions.

Unconscious mental processes are important influences in people's negotiations. Among the newest techniques for measuring marketing stimuli, there are neuroimaging techniques that create an image of the human brain using non-invasive tools. These methods used in marketing to understand consumer behavior related to markets and trade are called neuromarketing techniques (Lee et al., 2007).

The use of neuromarketing activities has led to some controversy. On the one hand, some critics believe that the use of such techniques would affect consumers' ability to choose not to consume marketed products, rendering individuals unable to resist such efforts, and making them easy targets for company campaigns (Wilson et al., 2008). On the other hand, advocates of neuromarketing activities like Lindstrom (2009a, 2009b) and Dooley (2010) discuss the benefits of the technique to both consumers and organizations. According to the researchers, consumers would benefit from the creation of products and campaigns geared towards them and facilitate their decisions rather than manipulate them, while organizations would maintain greater competitiveness and deliver improvements for customers by keeping the bulk of their budgets currently used in inefficient and ineffective campaigns. There exists another group of researchers believing that neuromarketing would be much more science fiction than reality. When assessed in general, evaluations may change and may vary according to personal experiences, values, and character (Hubert, 2010).

Although studies on this topic were first conducted in the early 1990s, studies in this area are still considered a limited research area due to high costs and the need for special equipment. However, neuromarketing offers new approaches that, if incorporated into other methodologies, may have authentic and impressive effects and expand the results of marketing strategies in different segments. Organizations can be encouraged to develop market research using neuroimaging techniques for product development, channel selection, pricing, and communication decisions. Similarly, there seem similar situations in multiple images used concerning covid.

2. Neuromarketing Approach in Images

The first reports on the use of neuromarketing techniques were published in June 2002. In particular, Brighthouse, an advertising company from Atlanta (USA), announced the establishment of a department for the use of functional magnetic resonance images (fMRI) for marketing research (Fisher et al., 2010). It is a well-known fact that even before the technical prefix "Neuro" was adopted, some

companies were already using such neurophysiological techniques as electroencephalography (EEG) to solve their marketing problems (Fisher et al., 2010).

However, with the advances in technology, neuromarketing techniques were used to explore consumers' preferences (Murphy et al., 2008). The potential to analyze consumer preferences received a lot of attention among marketing research companies. In addition to companies' interest in using this market niche, the theme aroused curiosity among academic researchers and disturbed some individuals in the community (Murphy et al., 2008; Fisher et al., 2010; Lee et al., 2007).

Many neuromarketing concepts were found among the examined texts. Neuromarketing is a field of research (Murphy et al., 2008), a field of neuroscience (Perrachione & Perrachione, 2008), a field of study (Lee et al., 2007; Eser et al., 2011), a part of marketing (Fisher et al., 2010), the interconnection of perception systems (Butler, 2008), a scientific approach (Senior & Lee, 2008), a subfield of neuroeconomics (Hubert & Kenning, 2008), and a different discipline (Garcia & Saad, 2008). Regarding its purpose, while some authors discuss neuromarketing as a way to acquire scientific knowledge (Lee et al., 2007; Murphy et al., 2008; Fisher et al., 2010; Butler, 2008; Senior & Lee, 2008; Eser et al., 2011), others consider neuromarketing as a potential tool for commercial marketing (Perrachione & Perrachione, 2008; Hubert & Kenning, 2008; Fugate; 2007; Orzán et al., 2012; Green & Holbert, 2012; Vecchiato et al., 2012).

Despite the differences in the views of researchers, it is possible to observe that some concepts related to neuromarketing converge. The most recurring themes in the category of "definition of neuromarketing" include understanding neuromarketing as a measurement of brain activity, a research tool, research on consumer behavior, a field of neuroscience, a marketing tool, a measurement of emotions and psychological processes, a commercial technique, analysis of physiological and cognitive processes related to the nervous system and the way of representing behaviors in images and colors.

The relationship between the field of study of neuromarketing and cerebral activity is evident in its etymology, literally. Even so, many researchers reconfirm this relationship. Murphy et al. (2008), for example, state that companies are emerging that provide information about brain-based consumer preferences. Butler (2008), Senior and Lee (2008), Hubert and Kenning (2008), and Morin (2011) associate neuromarketing with a neuroscience technique that identifies cortical regions responsible for consumer behavior.

Neuromarketing is also defined as a research tool that enables direct observation of brain reactions during marketing stimuli (Hubert & Kenning, 2008). According to some researchers, the brain is a black box that hides the emotions and preferences of consumers (Marci, 2008; Javor et al., 2013; Fugate, 2007; Green & Holbert, 2012), pointing out that neuromarketing works as a window that reveals and provides access to emotions (Green and Holbert, 2012; Ohme and Matukin, 2012; Fisher et al., 2010). Researchers would be able to understand, evaluate and predict consumers' behavior while gaining insights from individuals' brain

processes (Fisher et al., 2010, Hubert & Kenning, 2008; Perrachione & Perrachione, 2008).

Besides defining neuromarketing as the neuroscience of consumers (Babiloni, 2012; Ohme & Matukin, 2012), some researchers emphasize the difference between the two fields. Fisher et al. (2010) classify neuroscience more broadly as a neuroscientific field that studies consumers, while neuromarketing is defined as the simple application of these results to administrative practices. Lee et al. (2007) made the following definition to clarify the issue; neuromarketing can be defined as the application of neuroscientific methods to analyze and understand human behavior in markets and marketing.

Several researchers consider neuromarketing as a field arising from the relationship between two or more disciplines. According to Senior and Lee (2008), neuromarketing consists of social psychology, econometrics, and marketing research based on social sciences. While Page (2012) defines neuromarketing as the convergence between neuroscience, experimental psychology, and experimental economics, Garcia and Saad (2008) and Hubert and Kenning (2008) associate neuromarketing with consumer behavior and cognitive neuroscience, that is consumer behavioral sciences and neurobiology, respectively. However, the vast majority of articles approach neuromarketing as the link between neuroscience and marketing (Hubbert & Keening, 2008; Garcia & Saad, 2008; Lee et al., 2007; Fisher et al., 2010; Ohme & Matukin, 2012; Senior & Lee, 2008; Fugate, 2007; Butler, 2008; Morin, 2011; Page, 2012; Perrachione and Perrachione 2008; Vecchiato et al., 2012).

Many researchers still refer to neuromarketing as a "brain imaging study" (Hubert & Kenning, 2008; Perrachione & Perrachione, 2008; Babiloni, 2012; Reynolds, 2006; Garcia & Saad, 2008; Green & Holbert, 2012), "brain monitoring study" (Eser et al., 2011; Vecchiato et al., 2012) and "neuro-technology" (Murphy et al., 2008; Fisher et al., 2010; Perrachione & Perrachione, 2008; Green & Holbert, 2012; Javor et al. ., 2013; Orzán et al., 2012; Fugate, 2007; Morin, 2011).

In this broad definition approach, several researchers offer more detailed explanations of neuromarketing. For example, some researchers report neuromarketing as a way to reveal the cognitive emotional processes (fear, motivation, recognition, well-being, and reward) underlying human conscience (Lee et al., 2007; Murphy et al., 2008; Butler, 2008). Fugate (2007) approaches the subject in two ways (simple and detailed) about the concept of neuromarketing. It is claimed that neuromarketing is a technique that makes it possible to show that the physical and psychological are interdependent, with images that record the rational and emotional responses to marketing stimuli, circulating between the emotional and rational parts of the person, as a result.

Although the field of neuromarketing makes room for different understandings and observations, it is clear that the definitions are interrelated. Therefore, a comprehensive definition can be drawn, listing the main points of repetitive neuromarketing in the studies. Neuromarketing can be defined as a research area that bridges the fields of neuroscience and marketing, as a consequence (Butler, 2008; Senior & Lee, 2008; Hubert & Kenning, 2008). Marketing stimuli have the

purpose of establishing a relationship between the brain areas in which these stimuli are processed and physiological outcomes related to the nervous system, so that these areas may be associated with cognitive, psychological, and emotional processes and create an understanding of the consumer (Lee et al., 2007, Murphy et al., 2008; Senior and Lee, 2008).

3. Research Method

16 volunteers with different demographic characteristics, and having normal hearing and normal vision participated in the experiment, which was designed according to the purpose of the research. Volunteer participants were briefly informed before the experiment, and it was stated that the experimental design would not have any negative effects on the volunteer participants, and their consent was obtained, accordingly. Since the findings of the participants gave meaningful results, the measurements of all participants could be evaluated. In this experimental study, ethics committee approval was obtained by the Isparta University of Applied Sciences Ethics Committee Commission following the research.

In the research, a design was made for the evaluation of quantitative data through the experimental design. In this context, the materials and methods of the research were carried out in a certain order. In the research, firstly, the research problem is explained. The problem posed a research question to explain the method. In this respect, the purpose of the research was determined and the importance of the research was mentioned to explain why the evaluation was made within the framework of this purpose. Since the scope of the research questions reveals the direction of the research, how the research questions are formed is explained. Finally, the assumptions and limitations of the research are discussed.

3.1. Purpose and Importance

The use of masks emerged as an indispensable necessity of human life, especially with the emergence of the pandemic. The use of masks is constantly emphasized by all experts, as well as many academic studies on how important it is to protect health, especially during the pandemic. The number of people affected by the pandemic due to not using masks around the world is increasing day by day. If current behavior patterns continue, it seems likely that many losses will be incurred in the future, both in the covid-19 epidemic and other pandemics that may arise due to not using a mask (WHO, 2017). The literature shows that in cases where masks are not used during pandemic periods, it is associated with an increased likelihood of consequences such as illness, death, and permanent ailments (Jagadesan et al., 2010; Sahoo et al., 2015). In addition to these risks, there are likely to be many different negative consequences for the psychological effects of using and/or not using a mask (Mohammed et al., 2018).

It is stated that the uncontrollable spread of the pandemic is associated with many human-based factors (Kuzbicka and Rachon, 2013; Raj and Kumar, 2010). Protecting human health and raising awareness about the pandemic is possible with a multidimensional approach to the issue, therefore (Kodama, 2008). This makes it one of the substantial risk factors for several chronic and infectious diseases, including other related conditions, as well as causing deterioration of

human health (Musaiger and Al-Hazzaa, 2012; Tokunaga et al., 2012). Pandemic-related diseases are recognized as a considerable burden for individuals and society worldwide (Seidell and Halberstadt, 2015; Tremmel et al., 2017). In addition to leading to enormous medical care and treatment costs, the pandemic is causing a lower quality of life and posing an increased mental risk like depression. This reveals a circular causality of negative consequences for the social, mental, and physical well-being and health of individuals, accordingly.

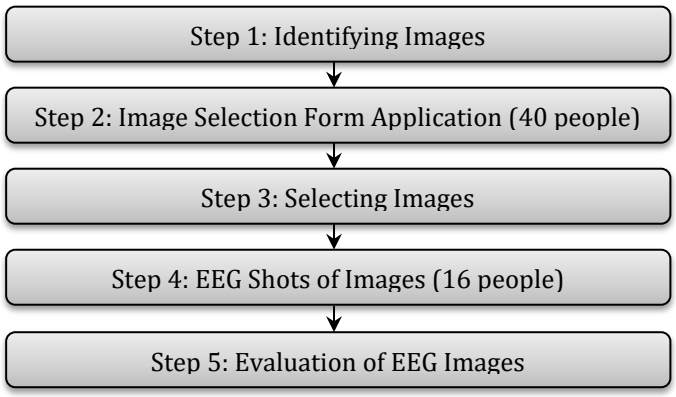
Considering that social media images, which are considered image elements, form habits by directing the behaviors of individuals, and giving direction to people, an important problem arises. From this point of view, the problem situation of this research was evaluated as to whether image elements affect mask usage behaviors.

Based on these explanations, the study aims to examine the social marketing images related to covid-19 in social media. It is intended to determine the reaction to the image elements for the use of masks, to be protected from the covid-19 pandemic, to raise awareness, and to create a strategy through EEG, as a result.

3.2. Research Model

The research process was modeled in five steps. According to the research model, in the first step, images that are frequently used in social media were determined. In the second step, an image evaluation was made to specify which image motivated to use of a mask. In the third step, the images were scored and twenty images to be used in EEG shots were resolved. In the fourth step, EEG shots of twenty regulated images were performed. In the fifth step, twenty images of which EEG shots were taken were evaluated by the people who participated in the EEG shots. Figure 1 shows the model showing the research process.

Figure 1. The Research Model Process



3.3. Collection Tool and Process

Since data collection would be conducted employing EEG, different tools were used. For data collection, first of all, social media images were addressed. In the selection of images, only images in photographic format were compiled. In the first step, within the framework of the purpose and subject of the research, it was tried to determine what the images that were consciously or unconsciously broadcast on social media could be for individuals in the society to use masks. Accordingly, a

total of 50 images in different photo formats on social media in the period of June 2020 were collected.

In the second step of the research process, 50 images were simultaneously shown to a group of 40 people to determine whether the images affected people's use of masks. Each image was given a number, and for each question image, the group of 40 people was asked, “Does this image motivate you to use a mask?”. Then, the participants were required to rate the answer sheets in the range of 1 = not motivating at all, 5 = motivates.

In the third step of the research, the scores given for all images were evaluated. The scores given to the images by the 40 participants, included in the second part of the study, were accumulated. The total score of each image was formed according to the answers given by the participants so that the first 10 images with the highest score were selected to be used in EEG shots.

In the fourth step of the research process, an image set to be used in EEG shots was created with 10 determined images. In the creation of the image set, 10 images were arranged one after the other so that each image was displayed for 5 seconds. Between each image, the + sign was shown on the 3-second blank screen to enable the brain to switch between images and neutralize perception. Thus, a 77-second image set emerged. EEG shots were carried out in the laboratories of the Isparta Neuro Science Application and Research Center, which is within the Isparta University of Applied Sciences. All shots were made with the Mitsar EEG device in the inventory of the Center and analyzed with the WinEEG package program. In addition, the numerical values given by WinEEG were evaluated with the SPSS package program.

3.4. Data Collection and Analysis

The research was conducted in Isparta in June 2020. The research was carried out with 16 voluntary participants, 8 men, and 8 women, from different groups in terms of demographic characteristics such as age, gender, occupation, and income level. Although studies are expressing that the sample size should be considered quantitatively in experimental studies, it is mentioned that quantitative sample size is left to the researcher in human-oriented electrophysiology (including EEG and ERPs) studies (Larson and Carbine, 2017: 34).

Participants were given information about the research process through the "Voluntary Participation Form" and "Research Information Form" and their voluntary participation was ensured before EEG shots. Volunteer participants were made to watch a total of 77 seconds of images related to the negative effects of covid-19, and electroencephalography (EEG) outputs were analyzed. In the research, a 19-channel EEG device whose image set was designed according to the international 10-20 system was used. This high-resolution device, called Mitsar EEG, collects data at a frequency of 2048 Hz per second. The EEG device sends the collected data to the computer via a wireless network within a 128 Hz frequency sample. The data measured by the Mitsar EEG device analyzes the emotional reactions of the volunteer participants participating in the research according to certain algorithms. EEG waves obtained with the help of electrodes placed on the skull skin with the help of a cap are non-periodic rhythmic waves. They vary

according to the activity state of the brain. The frequencies of these fluctuations vary between 0.5-70 Hz and their widths are in the range of 5-400 μV. As activities in the brain increase, EEG wave frequencies increase or decrease in width according to these increases. The electrodes measure the voltage differences in brain activities in the microvolt (μV) range, and the activities of multiple neurons are measured by EEG. EEGs are tools with 8 or 16-channel electrode heads shooting the activities of different parts of the brain regularly. EEG is a method used to resolve the responses of any subject in the field of neuromarketing to stimuli by measuring the electrical activity in the brain. Electrodes placed in contact with the scalp are serviced to designate the instantaneous responses of the brain to stimuli (Yücel and Çubuk, 2014: 134).

In the research, a data set including 19 different parameters was created with the data obtained from 19 channels with the EEG device. The created data set was analyzed by WinEEG. During the interpretation and reporting of the analyzed data, certain codings were used both in terms of academic ethics and confidentiality of personal data in the research. In addition, the results of each voluntary participant in the study were evaluated separately. Participants are numbered as Volunteers 1, 2, and 3... according to the order of participation in the research.

3.5. Findings

The findings obtained in the research are discussed under two headings: the selection of the images and the evaluation of the selected images. These findings were discussed in turn.

3.5.1. Findings on the selection of images

In the research, an image selection form was created with the perception of the consumer to measure which images on social media related to Covid-19 are more effective in using masks. For each of the 50 images determined in the image selection form, there is a scale in the range of 1-5 that the participants can evaluate. In this scale, the value of 1 is used to mean that it does not motivate to use masks at all, while the value of 5 is used to infer that it motivates to use masks. The participants were asked to evaluate each image and give a score between 1 and 5 for the images. In the image selection form, questions on the age, gender, and educational status of the participants were also asked. The findings regarding the image selection form obtained with the scheme filled by the participants for each image after watching related images are shown in the table below.

Table 1. Demographic Findings Regarding the Image Selection Form (n=40)

Variable		f	%
Age	under 30 years old	8	20,00%
	31-40 years old	10	25,00%
	41-50 years old	13	32,50%
	51 years and older	9	22,50%
Gender	Man	17	42,50%
	Woman	23	57,50%
Education	Associate degree	9	22,50%
	Bachelor's degree	22	55,00%
	Master's degree	7	17,50%
	Doctorate	2	5,00%

When the questions asked to figure out the characteristics of the participants in the first part of the image selection form are evaluated, it is obvious that 20.00% of the participants are under the age of 30, 25.00% are in the 31-40 age range, 32.50% are in the 41-50 age range, 22.50% are 51 years old and over. It is understood from the table that 42.50% of the participants are men and 57.50% are women. Considering the education variable, it is clear that 22.50% of the participants are associate degree graduates, 55.00% bachelor's degree graduates, 17.50% master's degree graduates, and 5.00% doctorate graduates.

To determine the images to be used in the research, the score and average of each of the 50 images shown to 40 participants were calculated according to the answers given by the participants. The first 10 images determined according to the averages are shown in Table 2.

Table 2. Top 10 Images Determined Regarding the Image Selection Form (n=40)

Image Ranking	Image Code	Image	Total Points	Average	Standard Deviation
1	Image 41		189	4,725	,70122
2	Image 27		185	4,625	1,02380
3	Image 5		183	4,575	1,24237
4	Image 12		176	4,400	1,03200

5	Image 15		175	4,375	1,16623
6	Image 19		171	4,275	,61520
7	Image 6		164	4,100	,91529
8	Image 32		158	3,950	,10671
9	Image 21		155	3,875	,62360
10	Image 7		151	3,775	1,10127

Note: Among the 50 images, only the images with the highest score to be used within the scope of the research are included in this table.

When Table 2 is examined, the images are listed as follows: Image 41 (∑=189, $\bar{x}$=4,725, S=,70122), Image 27 (∑=185, $\bar{x}$=4,625, S=1,02380), Image 5 (∑=183, $\bar{x}$=4,575, S=1,24237), Image 12 (∑=176, $\bar{x}$=4,400, S=1,03200), Image 15 (∑=175, $\bar{x}$=4,375, S=1,16623), Image 19 (∑=171, $\bar{x}$=4,275, S=,61520), Image 6 (∑=164, $\bar{x}$=4,100, S=,91529), Image 32 (∑=158, $\bar{x}$=3,950, S=,10671), Image 21 (∑=155, $\bar{x}$=3,875, S=,62360), Image 7 (∑=151, $\bar{x}$=3,775, S=1,10127). Only the 10 images in the top ten are included in the table. These images formed the image set to be used in the research.

3.5.2. Findings on the evaluation of images

In the study, a 77-second image set was shown to 18 participants to evaluate the images via EEG. Since it took some time to prepare for full signal acquisition from the electrodes in the EEG cap, the average time spent in the laboratory for each volunteer participant was 30 minutes. As people who had not seen the image set before were included in the study as voluntary participants, EEG shots were made with 16 people with different demographic characteristics. The demographic characteristics of the volunteer participants who participated in the EEG shots are shown in Table 3.

Table 3. Demographic Characteristics of Volunteer Participants in EEG Shoots (n=16)

Variable		f	%
Age	under 30 years old	3	18,75%
	31-40 years old	5	31,25%
	41-50 years old	7	43,75%
	51 years and older	1	6,25%
Gender	Man	8	50,00%
	Woman	8	50,00%
Education	Associate degree	3	18,75%
	Bachelor's degree	11	68,75%
	Master's degree	2	12,50%

When the demographic characteristics of the volunteer participants participating in the EEG shots in Table 3 are examined, it is seen that 18.75% of the participants are under the age of 30, 31.25% are between the ages of 31-40, 43.75% are between the ages of 41-50, and 6.25% of them are 51 years old and over. Regarding gender, it is understood that the male-female distribution of the volunteer participants is equal (50.00%). When the educational background of the participants is considered, it is clear that 18.75% of them are associate degree graduates, 68.75% are bachelor's degree graduates, and 12.50% are master's degree graduates.

The results of the findings obtained from the EEG shots were evaluated separately for each volunteer participant and the findings were examined in this context. The localization of the source and the composed parameter maps were used in EEG shots, accordingly. The maps show the brain lobe activation revealed by marking the beginning and end of the 5-second image at the localization of the source. In addition, the brain maps formed by the participant's delta, theta, alpha, beta, and gamma frequencies were examined with parameter maps. Here, since the measurement of alpha waves (8-13 Hz) in the left frontal lobe (Fp1, F3, F7) shows the intensity of the response to the image, evaluations were made over alpha values. The summary findings created according to the shootings are shown in Table 4.

Table 4. Reactions to Images in EEG Shots (n=16)

Participant Code	Intensely Responded Image	Electrode Code
Volunteer Participant 1 (VP1)	4th image	F3, F7
Volunteer Participant 2 (VP2)	4th image 6th image	Fp1, F3, F7
Volunteer Participant 3 (VP3)	1st image 4th image	F3, F7
Volunteer Participant 4 (VP4)	4th image 7th image	F3, F7
Volunteer Participant 5 (VP5)	4th image 6th image 9th image	Fp1, F3, F7
Volunteer Participant 6 (VP6)	3rd image 4th image	Fp1, F7
Volunteer Participant 7 (VP7)	1st image 4th image	F3, F7

Volunteer Participant 8 (VP8)	4th image	Fp1, F3, F7
Volunteer Participant 9 (VP9)	2nd image 4th image	Fp1, F3, F7
Volunteer Participant 10 (VP10)	4th image 10th image	Fp1, F7
Volunteer Participant 11 (VP11)	4th image 5th image	Fp1, F3, F7
Volunteer Participant 12 (VP12)	4th image 8th image	Fp1, F3, F7
Volunteer Participant 13 (VP13)	5th image	F3, F7
Volunteer Participant 14 (VP14)	4th image	Fp1, F3, F7
Volunteer Participant 15 (VP15)	1st image 7th image	F3, F7
Volunteer Participant 16 (VP16)	4th image	Fp1, F3, F7

According to Table 4, it is seen that Volunteer Participant 1 (VP1), who participated in the research, reacted to the 4th image. VP1 has the highest activation at F3 and F7 points. For Volunteer Participant 2 (VP2), it is obvious that the response to the 4th and 6th images has the highest activation at the Fp1, F3, and F7 points. For Volunteer Participant 3 (VP3), it is seen that the response to the 1st and 4th images has the highest activation at F3 and F7 points. For Volunteer Participant 4 (VP4), it is inferred that the response to the 4th and 7th images has the highest activation at the F3 and F7 points. For Volunteer Participant 5 (VP5), it is evident that the response to the 4th, 6th and 9th images have the highest activation at the Fp1, F,3, and F7 points. For Volunteer Participant 6 (VP6), it appears that the reaction to the 3rd and 4th images has the highest activation at Fp1 and F7 points. For Volunteer Participant 7 (VP7), it is seen that the reaction to the 1st and 4th images has the highest activation at F3 and F7 points. For Volunteer Participant 8 (VP8), it seems that the response to the 4th image has the highest activation at Fp1, F3, and F7 points. For Volunteer Participant 9 (VP9), it is clear that the response to the 2nd and 4th images has the highest activation at the Fp1, F3, and F7 points. For Volunteer Participant 10 (VP10), it is obvious that the response to the 4th and 10th images has the highest activation at the Fp1 and F7 points. For Volunteer Participant 11 (VP11), it appears that the response to the 4th and 5th images has the highest activation at the Fp1, F3, and F7 points. For Volunteer Participant 12 (VP12), it is evident that the response to the 4th and 8th images has the highest activation at the Fp1, F3, and F7 points. For Volunteer Participant 13 (VP13), it is apparent that the reaction to the 5th image has the highest activation at F3 and F7 points. For Volunteer Participant 14 (VP14), the response to the 4th image appears to have the highest activation at Fp1, F3, and F7 points. For Volunteer Participant 15 (VP15), it is comprehensible that the reaction to the 1st and 7th images has the highest activation at F3 and F7 points. For Volunteer Participant 16 (VP16), it is understood that the response to the 4th image has the highest activation at Fp1, F3, and F7 points. When the images are evaluated in general, it can be deduced that the participants in the research mostly

reacted to the 4th image, and there appears an activation related to the 4th image. The 4th image in the image set draws attention as an image that displays respiratory distress, points to dependence on the bed, and covers the intensive care process.

4. Discussion and Conclusion

There exist many studies in the literature associated with neuroscience based on social science. Here, an evaluation related to these studies was made. Yadava et al. (2017) evaluated the predictive modeling framework by examining EEG signals to reveal consumer preferences for e-commerce. Independent testing was used to record both consumer attitudes and the accuracy of consumer choices with the hidden Markov model.

Wannyn (2017) explored the need for neuromarketing experts to develop academic challenges and discursive strategies on the image of neuromarketing. Walter et al. (2005) provided an overview of social interaction for neuroeconomics and economic behavior. In addition, general conclusions about neuromarketing were made with the research, and they explored the results obtained concerning the effects of insights about the motives of human behavior for a profound inference.

Grimes (2006) examined the hemispheric lateralization of brain function. The study provided a scientific review to research and critically evaluate marketing practices in the region. In the study, a brief overview of individual methods such as conceptualized organizational cognitive neuroscience for human decisions, behaviors, and interactions is provided (Lee Vechamberlain, 2007). Researchers argued that neuroimaging measurement methods converge as they differ. Lee et al. (2007) attempted to examine consumer behavior related to neuromarketing and trademarks. Ma et al. (2007) investigated the neural mechanism for a particular product category with other product brand categories.

Astolfi et al. (2008) explored brain activities for television commercials using EEG shots. They examined behavior during the memorization of television commercials and its effectiveness for cortical networks. Ma et al. (2008) questioned brand extension and the decision to qualify for brand extension. Wilson et al. (2008) reviewed the effect of neuroscience methods on marketing practices. Morris et al. (2009) interrogated emotion, communication, pleasure, stimulation, and dominance in brain regions triggered by brain activation patterns and marketing. Guevara (2009) searched neuromarketing and its applications with neuroimaging techniques. Rapp et al. (2009) studied the tensions between advertiser interests and consumer needs and issues of customer privacy. Jain (2010) focused on the emotional effects of food and beverage products on advertising and food marketing.

Ma et al. (2010) conducted a study on the effect of negative affect on brand extension and concluded that negative emotion hurts brand extension. Ohme et al. (2010) analyzed frontal cortex activation for television commercials. Reimann et al. (2010) performed four experiments on the psychological characteristics of packaging design and aesthetic experiences. Stallen et al. (2010) used the fMRI technique to explore the effect of reputation on product memory and purchase

intention. Treleaven-Hassard et al. (2010) researched the relationships between brands and interactive advertisements. Vecchiato et al. (2010) checked into thoroughly the use of adequate statistical techniques in neuro electromagnetics with brain mapping. They evaluated the study using test data in a neuromarketing experiment.

Kenning and Linzmajer (2011) discussed consumer policies, neuroethics, and consumer protection. Morin (2011) focused on the effectiveness of neuromarketing in commercial and purposeful advertising messages. Santos et al. (2011) designed an fMRI study for the decision process and brand preference. Vecchiato et al. (2011) researched how to work for commercial video clips by analyzing changes in EEG. Berns and Moore (2012) carried out a study to estimate cultural popularity using fMRI and neuroimaging. Berthoud (2012) focused on neuromarketing for hedonic, motivational, and cognitive processing in the modern food environment. Falk et al. (2012) centered on large-scale population behavior on change and brain activations by shooting the views of smokers while watching television campaigns. Jones et al. (2012) investigated consumer preferences through conceptual processes related to anxiety and gender by perceptually thinking in making a thoughtful purchase decision. Lucchiari and Pravettoni (2012) used EEG to examine brand attachment on brain modulation. Plassmann et al. (2012) focused on the consumer psychology of brands for the application of neuroscience to marketing.

Reimann et al. (2012) conducted a study on the real brand selection using fMRI. Schneider and Woolgar (2012) researched neuromarketing to determine why certain products are preferred more than other products in consumer accounts. Spranger (2011) performed research to view outcome procedures in neuromarketing. Wang et al. (2012) studied neuromarketing for brand extension with an unrelated task. Khushaba et al. (2013) realized customer-oriented research with the physiological decision process in product preference using EEG signals. Kong et al. (2013) examined the effect of video ads on consumers by using EEG. Lindell and Kidd (2013) concentrated on the neuromarketing of education by employing fMRI brain imaging.

Pykett (2013) provided a comprehensive review of developments in economics in behavioral economics and neuroeconomics. Sánchez-Porras (2014) attented to marketing in audiovisual mass media. Thomas et al. (2013) worked through a study to test the relationship between brand and social psychology in anonymous products and implicit positive attitudes. Wood and Ball (2013) searched for the emergence of the 'brand landscape', which combines the “brand” concept with the “landscape”. Bruce et al. (2014) studied how food logos activate certain parts of the brain in children in advertising and branding using the fMRI technique. Koç and Boz (2014) proposed a new approach to consumer behavior with psychoneurobiochemistry. Lee et al. (2014) performed a study focusing on green consumers with the use of frontal theta brain waves of 19 right-handed people. Mesly (2014) looked for the brain of the financial predator and prey to figure out the predatory core in human behavior.

Pop et al. (2014) focused on the neuromarketing technique for marketing research and ethical principles. Vecchiato et al. (2014) centered on measuring emotions

through the estimation of cerebral variables. In the study, some experiments were conducted by using EEG, and galvanic skin response in a group of healthy participants. The main purpose of their studies is to reveal the disadvantages of previous standard marketing tools. Vecchiato et al. (2014) focused on cognitive and emotional changes. Yilmaz et al. (2014) used EEG to determine consumers' like and dislike decisions and preference indicators.

This study is meant to examine the images on social media with EEG during the covid-19 pandemic. In this framework, an experimental design was created to see which images the human brain responds to more. Within the scope of the experimental design, the activations at Fp1, F3, and F7 levels were examined with EEG. The 4th image shown to the volunteer participants was evaluated as the image with the most brain activation. When the characteristics of this image are examined, it can be mentioned that it is an image that demonstrates respiratory distress, presents bed dependence, and covers the intensive care process. It was observed that there exist people who do not use masks during the Covid-19 period; however, regular social marketing campaigns are organized for these people and significant expenditures are made for these campaigns alike. The use of similar images in the results of this study can be considered a crucial strategy to boost the effectiveness of all campaigns. In cases where similar pandemics appear in the future, using similar images in campaigns and/or emphasizing this direction may produce more compelling results, therefore.

This research has certain constraints. The limitations of the research also include suggestions for possible future studies in this area. The high research costs (experimental design and process) can be expressed as a considerable constraint., The research can be renewed with a much wider audience across different cultures with additional funding sources. In this case, it would be possible to come up with different results and to make comprehensive evaluations with generalizable and comparable results. Within the scope of the research subject, different experimental designs can be created with different images for consumption habits, creating a healthy lifestyle, and adapting to changing conditions.

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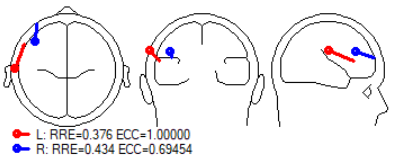
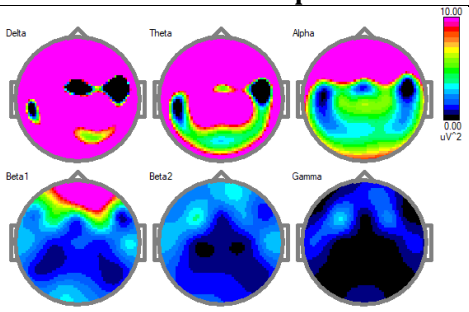
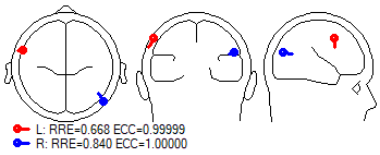
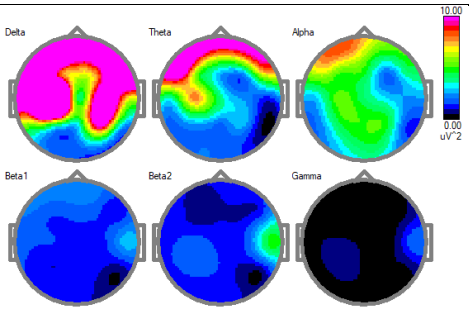
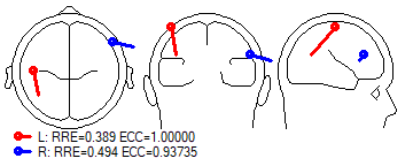
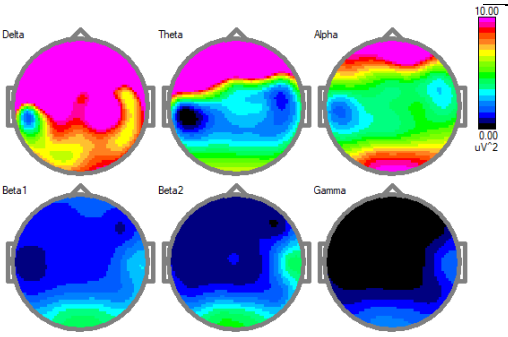
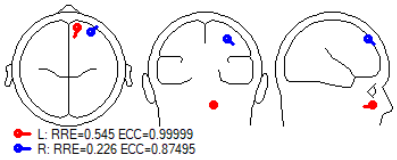
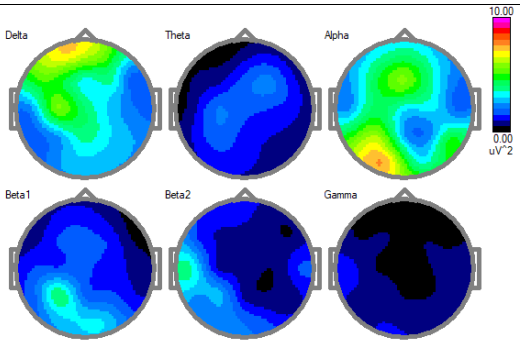
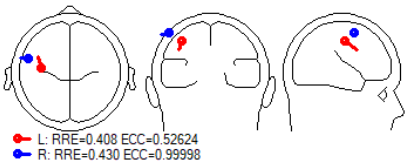
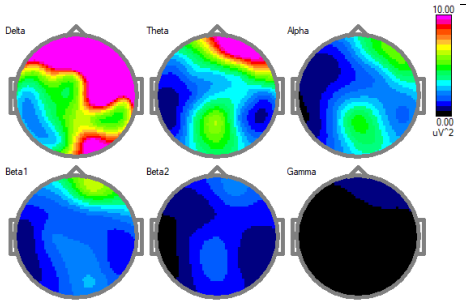
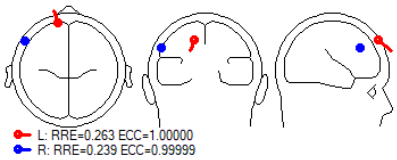
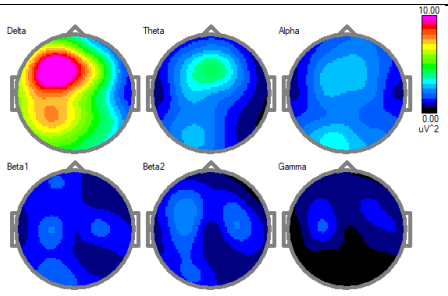
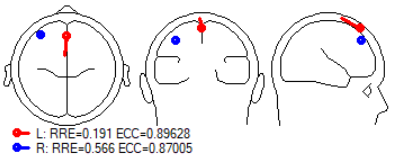
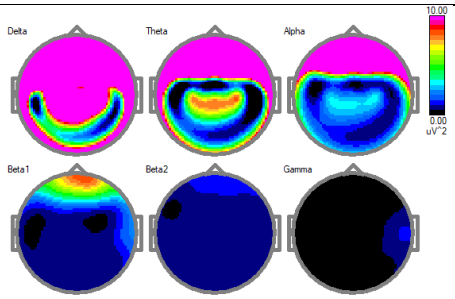
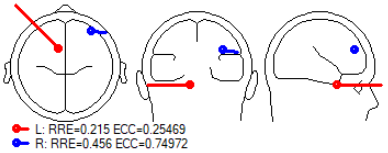
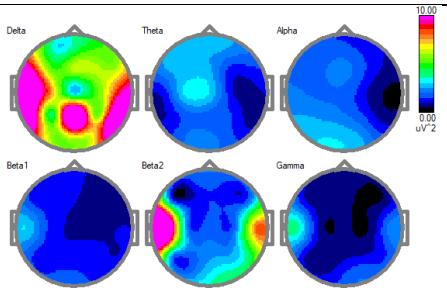
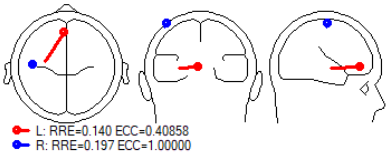
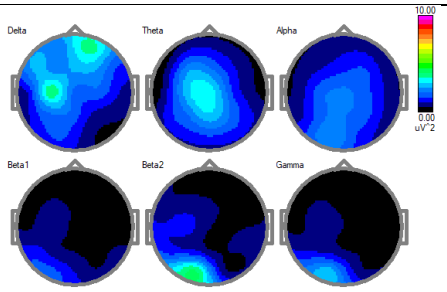
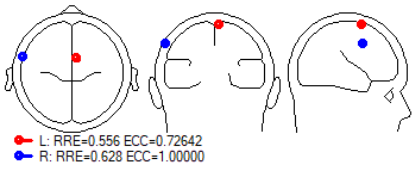
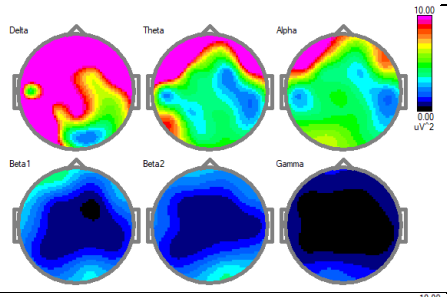
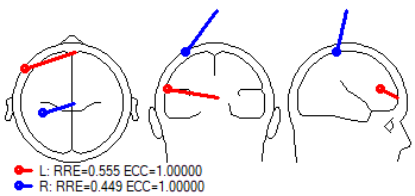
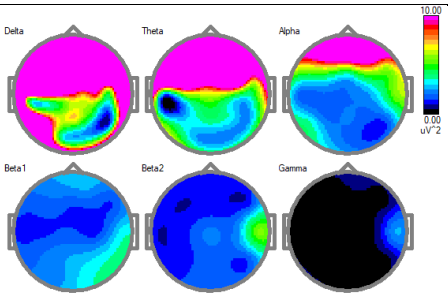
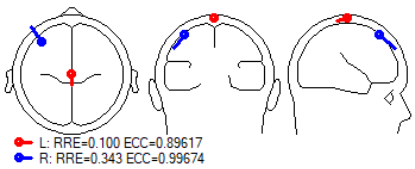
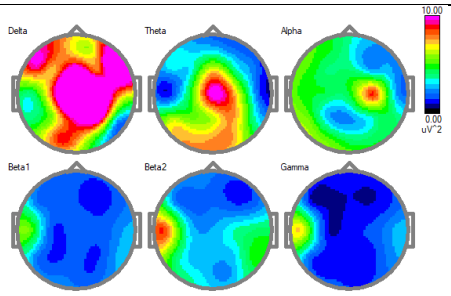
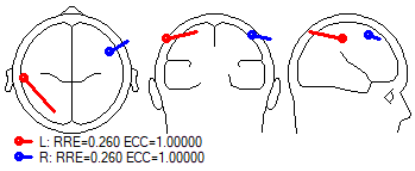
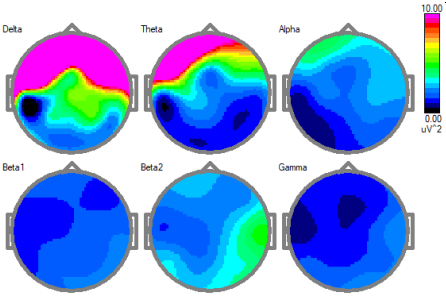
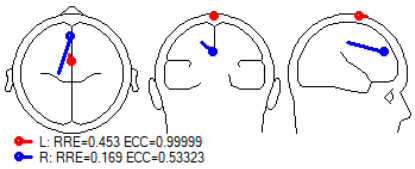
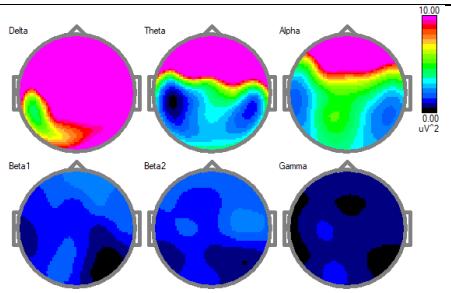
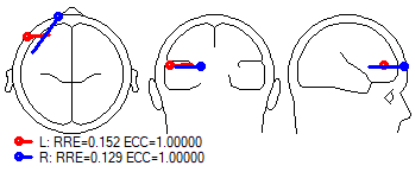
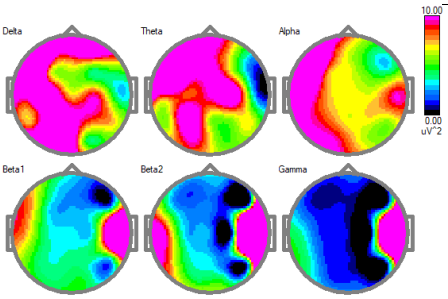
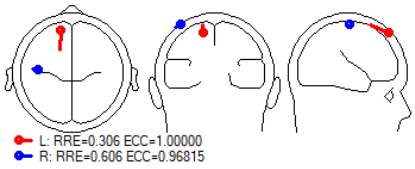
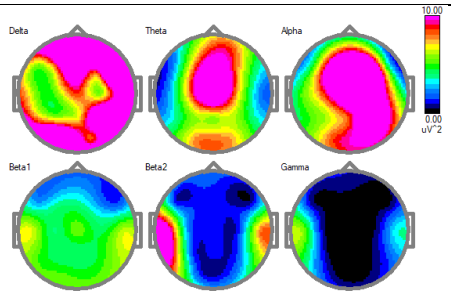
Appendix: Parameter Maps of Volunteer Participants

Paricipant	Localization of the Source	Parameter Maps
VP1		
VP2		
VP3		
VP4		
VP5		

VP6		
VP7		
VP8		
VP9		
VP10		
VP11		

VP12		
VP13		
VP14		
VP15		
VP16		

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