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Research Paper: The Role of Event Related Potentials in Pre-Comprehension Processing of Consumers to Marketing Logos

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ABSTRACT

Background: In human behavior study, by peering directly into the brain and assessing distinct patterns, evoked neurons and neuron spike can be more understandable by taking advantages of accurate brain analysis.

Objectives: We investigated the role of Event Related Potentials (ERPs) in pre-comprehension processing of consumers to marketing logos..

Materials & Methods: In the framework of an experimental design, twenty-six right-handed volunteers (13 men, 13 women) participated in 2013 in the University of Tabriz. An individual task with a presentation of familiar vs. unfamiliar logos was designed. Stimuli were displayed on a monitor controlled by a PC using the Mitsar® stimulus presentation system PsyTask. Statistical analyses of ERPs data were analyzed by repeated measures ANOVA.

Results: Our results showed, when subjects were dealing with familiar logos, higher peak amplitude for the N1 component in right hemisphere of the brain can be observed. These variations on averages of early components of ERPs in occipital lobe can be referred to the pre-perceptual brain activities.

Conclusion: Investigating early components of ERP can be utilized further as an effective factor in prediction of the consumers 'preference particularly in neuromarketing field.

Keywords: Evoked potentials, Comprehension, Neuro-marketing

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Highlights

- ERP components can be utilized as an effective factor in prediction of the consumers' preference.
- The N1 component of ERP reflects pre-perception the familiar and unfamiliar logos

Introduction

Recently, researchers in marketing and advertising have appealed to neuroscience to better comprehend the bases of marketing behavior. Marketing behaviors comprise motivational aspects, social attributes, and decision-making [1-4]. Similarly, a lot of attention has been paid to psychophysical scaling methods for the quantitative understanding of behaviors related to choices [5]. Experts in psychology and physiology have already started to implement such techniques and made huge advances in our understanding of the cognitive and emotional factors involved in decision-making processes. Many social scientists use neuroimaging as a standard tool or procedure for research [6]. Although traditional marketing has focused on the value and competitive advantages of a product or service, recent marketing takes a more comprehensive approach by considering the purchasing process and the retail store atmosphere to stimulate a positive shopping experience [7].

Interdisciplinary studies in cognitive science have led to the creation of neuromarketing. Neuromarketing refers to a novel application in the neuroscientific approach to human behavior in the marketing context. Instead of simply trying to use science to better explore the decision-making processes of individuals, neuromarketing studies delve into subjects' reactions to certain stimuli to reveal consumers' preferences. The findings of these studies can potentially predict differences in the thinking process of consumers that might not necessarily be seen on their behavior [8]. Evaluation of conscious and unconscious processes in the brain is an important factor in understanding the human mind and its operation [9-11].

While conversational language can vary from culture to culture, the brain language is the same across the cultures. Neuromarketing aims to study the physiological responses of the brain to advertising and marketing strategies. To assess the effectiveness of these strategies, neuroimaging techniques monitor and assess brain activities. Now neuroscientists can directly study frequency, location, and timing of neuronal activities in a totally innovative way. However, marketing researchers might overlook these developments and their potential benefits [1].

Neuromarketing uses different techniques such as Positron Emission Tomography (PET), functional Magnetic Resonance Imaging (fMRI), Electroencephalography (EEG), and Magnetoencephalography (MEG). Although most of these techniques are expensive and or unavailable, EEG and the Event-Related Potentials (ERPs) are relatively inexpensive and available in most research centers [12]. 'Branding' has a critical role in the mechanism of preference. This issue directly affects customers' purchasing behavior and loyalty [13]. Brand familiarity is one of the methods which is typically employed to evaluate individuals' preferences among products. In this regard, Ambler et al. (2002) found out that familiar brands engage different brain regions and are processed faster [14].

In neuromarketing studies, brand familiarity and product preference are associated with neural activities [9, 15, 16]. Evidence has shown the links between medial prefrontal cortex with both brand familiarity and product preference [17]. Although the processes of post-perceptual involvement of brain regions like the P3 component of ERPs have been researched considerably in several recent studies on neuromarketing and decision-making purchase [18], early components which happen before perceptual processes have not been assessed substantially so far. In addition, many previous studies have reported that the visual N1 component is larger for attended-location stimuli compared to unattended-location stimuli.

This difference is seen merely in tasks involving differentiation of the attended-location stimuli, suggesting that the N1 wave reflects a discrimination process applied to the attended location [19, 20]. Using early components of ERPs and pre-perceptual brain activities enables us to understand better consumers' preferences towards marketing stimuli. In this research, we have assessed the role of ERPs in consumers' precomprehension processing of marketing logos.

Materials and Methods

Study design

In an experimental design, one group of participants were exposed to two types of stimuli (e.g. familiar and unfamiliar logos) and then their evoked-brain potential in response to each stimulus was studied and compared.

Study participants

By using convenience sampling method, 26 right-handed volunteers (13 men, 13 women) with the Mean±SD age of 23.50±2.37 years, (age range: 18 and 26 y) participated in the current research which was conducted from 2013 to 2014. They were in a good health condition, had normal or corrected vision, and reported no history of neurological impairment. All testing procedures were performed at Hamrah Child and Adolescent Multidisciplinary Neuropsychiatric Center in Tabriz City, Iran in 2013. All participants were asked to give their informed consent before the study.

Stimuli and task

The study stimuli contained 8 logos of the familiar brands (Zam Zam, Bavaria, Istak, and Coca-Cola) and unfamiliar brands (Sunkist, Star, Holsten and Ayda cola) in two familiar and unfamiliar conditions. Familiar logos were selected based on cultural preferences. Moreover, unfamiliar logos were artificial. The images belonged to either well-known or familiar brands (e.g. Coca Cola) or unknown or unfamiliar brand (e.g. Ayda cola) in two different categories: four beverages' brand and four beer's brand. Another additional logo, including the picture of a water bottle, was considered as a neutral condition. Each familiar/unfamiliar logo was presented 14 times while the water logo was presented 28 times. All stimuli were presented 140 times in total, of these 40% (56 trials) were familiar, 40% (56 trials) were unfamiliar and the remaining 20% (28 trials) were water logo (neutral). These stimuli were presented according to the oddball paradigm, i.e. logos of familiar and unfamiliar brands were presented as frequent stimulus and logo of water was presented as a rare stimulus.

Each stimulus was presented for 200 ms. The duration of each stimulus was 200 ms, and the interval between the stimuli was randomly varied between 1400 and 1600 ms. The participants were asked to watch pictures while keeping their attention on stimuli. They were required to hit the response key as soon as they see the water logo. To reduce the hemispheric lateralization effect on hand response command, half of the participants were asked to press the right mouse key, while the other half were asked to press the left one. In other words, the subjects used different hands for pressing the mouse keys.

Study procedure

In a sound-attenuated room, the subjects were asked to sit on a comfortable chair facing a computer monitor after placement of the electrodes. They were asked to look steadily at the center of the monitor 70 cm away, where the stimuli were presented in a white background. The stimuli were displayed on the monitor controlled by a PC using the Mitsar® stimulus presentation system (PsyTask). In addition, for homogenizing the subjects' context and increasing their attention, a short story was told to choose a drink before electrophysiological recording:

Imagine you have finished a tough exam and you have become exhausted and thirsty. You decided to take a taxi to get out of this situation. Unfortunately, you got stuck in heavy traffic but you could get off and go to the nearest supermarket to get cold water. Inside the supermarket, cold water was not available and you had to choose another drink. You saw many different drinks with different brands and flavors. You had to pick one.

Electrophysiological recording

The subject's EEG was recorded from 19 tin electrodes, mounted in an electrode cap (Electro cap®). Electrode positions were the standard locations in the 10-20 system. The EEG recording was amplified (Mitsar® Instruments, Model 24 channels, EEG-202) with a bandpass of 0.35-30 Hz. The reference was the left earlobe and electrode impedances were kept below 10 kΩ. The EEG analog signal was digitized at a 250-Hz sampling rate. The subjects were instructed not to blink during stimulus presentation. We used off-line ICA computerized artifact correction to delete trials in which detectable eye movements or blinks occurred. Then, the obtained single-subject ERPs were used to derive the group mean waveforms for display and analyses .

EEG data were averaged according to the task conditions (familiar and unfamiliar logos), separately. ERPs were averaged over a window of 500 ms with 100 ms pre-stimulus. Then, the maximum peak amplitudes of N1 component was calculated on pre-attended time window in 100-200 ms after stimuli presentation in the occipital lobe (O1 and O2) towards familiar versus unfamiliar stimuli.

Statistical analyses

The peak amplitudes of N1 component were analyzed by Repeated measures ANOVA (RANOVA) based on two factors: "familiarity/unfamiliarity" (familiar logos versus unfamiliar logos) and "electrodes" (left occipital versus right occipital) as within-subject factors.

Results

ERPs

Figure 1 displays grand average ERP waveforms for familiar logos, unfamiliar logos, and all logos. RANOVA results revealed significant effects of electrode position (F=11.45, P=0.01) where the amplitude of the right occipital is higher than the left side one with regard to the N1 component. The main effect of familiarity/unfamiliarity (F=3.51, P=0.01) and the interaction effect of electrode position with familiarity/unfamiliarity were significant (F=4.66, P=0.04), too. Behavioral results showed that about 68% of the verbal preference of the participants is dedicated to choose a familiar brand.

Discussion

Following the onset of the stimulus, the component N1 was observed in the occipital lobes in a 50-200 ms time window for both conditions (familiar and unfamiliar brands) which indicates that visual processing before 250 ms is common for both stimuli. In addition, the right occipital cortex was more active compared to its corresponding area in the left hemisphere. Also, the observed component amplitude was larger for familiar brands. On the other hand, comparing to evoked activity for unfamiliar brands, evoked activity for familiar brands was faster, which means the latency for the familiar logos in the right occipital cortex was shorter than unfamiliar ones. According to this study, N1 reacts differently to the familiar and unfamiliar logos and therefore these activities are suggested as the potentials of "familiar brand" or "brand-familiarity".

It can be assumed that the timing of neuronal population activity in the occipital lobes in the N1 component may be produced by recognition and perception of a familiar brand. It also seems that the familiar brands facilitate the activation of more cells in order to manipulate and modify the accessible data for a familiar brand.

It is still a matter of debate whether or not the P300 component, which has been widely considered in the studies on neuromarketing and the consumers' preferences, can be influenced by an early component such as N1, which is suggested in this study. The existing data to evoke both components could possibly be in the occipital regions, which are involved in data processing for decision-making. Engaging the occipital lobes, these components can suggest the "branding-related processing" and the process of their related preferences. In fact, whether each of these components (N1, P3) is early or latent involves their respective proceedings of data processing aimed at decision-making and choosing [18].

In order to support these suggestions, we point to the larger amplitude of the N1 component in the occipital and inferior temporal regions, which is typically observed in the stimulus discrimination tasks, and the electrophysiological differences between the familiar and unfamiliar brands.

The higher activity in the right hemisphere in response to the familiar brands in this study is in line with the study by Ambler et al. [14]. They asked the subjects undergoing MEG scan to mention three brands they choose when they were shopping. The results showed that familiar brands activate the right hemisphere. In fact, the N1 component in the occipital lobe is evoked by the presentation of a familiar brand. The higher involvement of the brain with the familiar brands is in line with the behavioral responses in the present study because the subjects mostly preferred the familiar brands (68%).

In sum, these observations suggest that the processing of the accessible data for the familiar brands, which are included in the early ERP components such as N1, possibly influence our preference and behavioral choice. For the famous brands, the brain processes the data faster. In fact, the accessibility of data for a popular brand facilitates the processing of it in the early stages of perceptual processing in the sensory cortex. In addition, data accessibility causes lower activity in the regions involved in working memory, and facilitated activity in the regions involved in the excitement. Perhaps the unfamiliar brands delay brand recognition, or in other words, "brand-specific" activity.

Actually, the processing of an unfamiliar brand data takes more time, and during this time, the brain leans towards the familiar brands that has already been exposed to and chooses that [21]. This delay in data processing for an unfamiliar brand can be in agreement with the studies on the effect of the social environment and attributes as well as the reward system in choosing the familiar brands [4, 21].

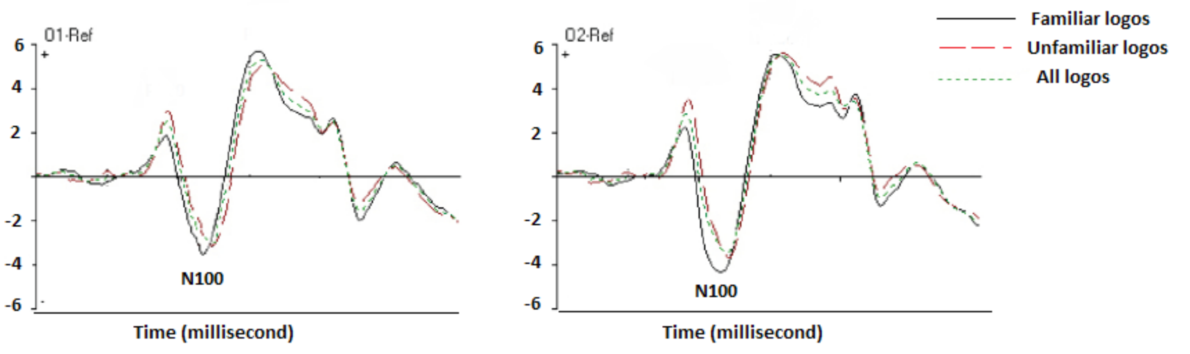

Figure 1. Ground average waveforms

Familiar, unfamiliar, and all logos occipital lobe (green line). The black line represents the ERP waveform (N1 component) of familiar logos while the red line represents the unfamiliar logo.

On the other hand, some studies have shown that popular brands evoke more pleasure, joy, and positive emotions compared to the unpopular ones [22]. In choosing and preferring a familiar brand (even when one does not know which brand is presented to him/her), the past pleasant experiences can affect the first quick and emotional process involved in brand preference [15].

These electrophysiological findings along with the behavioral observations indicate that choice and preference occurs more quickly and more easily for a familiar brand. Since brand recognition has become a specific phenomenon of "social cognition" in a modern commercial society, accessible data are important for quick and early processing of a brand [23]. Actually, it can be said that preference of a familiar brand occurs through social reward [21], as the advertisements for these brands use the people' feelings and lifestyles. This is while an early preference (observed in the N1 component) might be caused by positive and pleasant emotions, and in fact, followed by quick activation of the individual's reward system for repeated and faster choice of the brand [4, 21, 23].

Moreover, it seems that emotions and feelings influence our decision-making mechanisms [24]. Thus, the findings of this study suggest that the early N1 component in the occipital cortical area, under the influence of emotions, can quickly choose and prefer based on previous rewards. In fact, the early N1 component in the occipital area only responds to the familiarity or unfamiliarity of the logo according to the designed and permanent low-level visual features of a brand (e.g. logo, shape, color, words), while the other later components such as P300 respond to a set of numerous and more complicated features.

The previous studies, focusing on the P300 component as reflecting the neural activity of the cellular populations of the Dorsolateral Prefrontal Cortex (DLPFC) and Ventromedial Prefrontal Cortex (VMPFC) in the frontal cortex, have explained the decision-making process, reward system, and generally the conscious processes of decision-making [15]. However, this study by focusing on an early components such as N1, and the unconscious processing which occurs quickly and easily on the basis of the accessible data, past experiences, and the degree of pleasantness, explores a new dimension of research about the fast and unconscious data processing involved in deciding on and preferring a brand.

Perhaps, the timing of neuronal population activity in the occipital regions in N1 component is resulted by recognition and perception of a familiar brand, because the familiar brands may facilitate the activation of more cells in order to manipulate and modify the accessible data for a familiar brand.

In this regard, our study task, in which the subject was supposed to press the key on seeing the neutral brand of drink "Water", let the researchers examine the unconscious responses of the individuals to the familiar brands and their processing. In brief, the findings of this study suggest that the right occipital cortex hemisphere dominance in the early ERP components for processing and preferring a familiar brand can be the subject of further research. Accordingly, it seems that the early ERP components are evoked in the presence of a familiar brand. Because the application of the accessible data for the fast, facilitated, and unconscious processing of a familiar brand is the result of an early processing and an initial process of decision-making based on emotions, it is possible that the same process takes place for other brand categories besides drinks as well. Therefore, our study suggestions can pave the way for further research about the early and initial ERP components and their roles in the consumers' preferences and behavior.

Conclusion

We presented ERP evidence-based reports that the N1 component of the occipital lobes is significant enough to be considered in neuromarketing research fields and branding approaches. Additionally, it is a valid factor for preference prediction. As a result, the role of early components of ERP and precomprehension brain activities in revealing attention to a particular brand should be considered more. In other words, it can be utilized in the prediction of consumers' preferences.

Ethical Considerations

Compliance with ethical guidelines

The ethics of this paper was reviewed and approved by the Department of Psychology, Ferdowsi University of Mashhad (registration no.: 546). All participants were required to give their informed consent prior to their participation in the study.

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The present paper was extracted from the MSc. thesis of the third author, in Department of Psychology, Faculty of Education Sciences and Psychology, Ferdowsi University of Mashhad.

Authors contributions

Collecting and analyzing the data: Zohreh Gholami Doborjeh, Taktom Amanzadeh Oghaz; Supervising the project, designing the computerized tasks: Javad Salehi Fadardi, Mohammad Ali Nazari, Sayyed Amir Amin Yazdi; and Manuscript preparation, submission, and replying the comments: All authors.

Conflict of interest

The authors declared no conflict of interest.

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