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# The use of event related potentials brain methods in the study of Conscious and unconscious consumer decision making processes

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ABSTRACT

The question of whether consumer purchasing decisions are conscious choices or unconscious has long been studied in marketing. The ability to measure mental changes with high temporal resolution makes the EEG-based event-related potentials (ERP) method very useful in studying the distinction between consciousness and unconsciousness. Although experiences with brands significantly affect the awareness or unconsciousness of decisions to purchase, ERP studies have ignored experiences of consumers in relation to brand purchases. For this purpose, EEG recordings of participants were taken in the order they saw brand names: experienced brands, review-based brands, and unknown brands. Participants chose one of the three options for the brands they saw on the screen: buying, not buying, and no idea. 35 people participated in the study. The results indicate that early ERPs, which are unconscious mental reactions, related to purchase decisions for previously unknown brands. Late ERPs associated with conscious mental reactions are related to purchasing review-based brands or experienced brands. We conclude that purchasing decisions about unknown brands occur as a result of automatic, unconscious mental processes, whereas purchasing decisions about previously experienced brands and based on consumer reviews result from conscious mental processes. Our study is the first that demonstrates the relationship between ERP's and purchasing decisions, with an experimental design focused on consumer experience and consciousness.

## 1. Introduction

A typical consumer who enters the supermarket to make daily shopping choices does so among 45 thousand different products (see Marketswatch, 2017). But how does the consumer make a conscious choice in purchase decisions while facing all these alternatives? When or to what extent is consumer choice a result of fully automated mental processes?

The majority of studies and theoretical models in the marketing literature are based on the assumption that customers are conscious of their choices (Williams and Poehlman, 2016). However, working memory, which is the conscious processing mechanism of the human mind, is far from capable of coping with the incredible load of information that consumers encounter daily due to its limited capacity (Baars et al., 2003; Cowan, 2000; Schacter, 2001). As a result, many of their decisions are actually the result of the harmony of conscious and unconscious processes (Fitzsimons et al., 2002), with the latter making the greater contribution. According to Zaltman (2000), 95% of all decision-making processes are unconscious and automatic. In fact, there are studies indicating that, in certain cases, unconscious decisions lead to more satisfying results than conscious decisions (Dijksterhuis and Van Olden, 2006; Gao et al., 2010; Messner and Wänke, 2011).

As a result of these developments, the study of conscious and unconscious decision-making processes has increased rapidly in recent years. Similarly, efforts to create a theoretical framework that considers consumer decisions as a mix of conscious and unconscious processes have increased as well (Martin and Morich, 2011). According to some researchers, the question is no longer if unconscious processes exist, but when and how they work (Bargh, 2002; Zaltman, 2000). However, we still lack definitive models dealing with both unconscious and conscious processes.

The high temporal resolution of the ERP (event-related potential) technique brings along a significant advantage in studying the distinction between consciousness/unconsciousness and answering the questions of when and how such processes function (Luck, 2014). Studies indicate that reactions that occur within the first 300 ms of

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decision-making are automatic and unconscious (Libet, 2004). On the other hand, reactions occurring after 300 ms begin to become more related to conscious inclinations (Li and Han, 2010; Moran et al., 2013). Hence, for the ERP technique with an ± 5 ms margin of error, it is possible to reveal the mental reactions of consumers while making purchasing decisions (Luck, 2014) and to study the conscious/unconscious processes of purchasing decisions in the context of ERP components.

## 2. Conceptual framework

Steen (2007) defined consciousness as a combination of attention, perception, memory and, most importantly, awareness. Bargh (1994) identified four components of unconscious behavior: lack of awareness, unintentionally initiated, efficient and effortless, and out of one's control. He also defined lack of awareness as being unaware of the factors affecting one's judgments and feelings, and mistakenly attributing them to some other salient factor of which one *is* aware. In order for a behavior to be unconscious and automatic, all of these elements do not need to co-occur. The existence of only one of these conditions is thought to be sufficient for the behavior to be accepted as unconscious and automatic (Chartrand and Fitzsimons, 2011). When evaluated in this context, consumers' unconscious decisions are generally included in descriptions of lack of awareness (Martin and Morich, 2011).

In other words, consumers are not fully aware of the factors that affect many of their decisions. This lack of awareness is particularly evident with regard to brands/products with which they have no previous knowledge/experience. In this case, consumer decisions are the result of unconscious mental reactions (Chartrand et al., 2008). On the other hand, experiences with brands consumers have used play an important role in future purchases (Jimenez and Mendoza, 2013; Ling et al., 2010). Neuroscience studies indicate that the mind consciously accesses past information arising from previous purchasing experiences, and consumers make conscious decisions based on this information (Esch et al., 2012; Van der Pligt et al., 2000). Therefore, we can assume that consumers make conscious decisions based on experience and unconscious decisions when purchasing new brands or products with which they have no experience. In our study, we consider experience as being comprised of the composite of cues resulting from the consumption of the product/service (Berry et al., 2002).

Given the advances in technology and increased access to information, individuals can find information and consumer reviews about unknown products/brands before deciding to buy them. We can regard the search for such information as an effort to make purchases as a result of a conscious decision. However, previous studies have shown that, despite the circumstances that advanced technology and easy access to product-related information are provided, unplanned and impulsive buying of unfamiliar brands is commonly observed in some decision making such as in stores, especially when engaged in non-goal-directed shopping (Kacen et al., 2012). Furthermore, some studies have suggested that online stores tend to promote more unconscious purchases than traditional stores (Eroglu et al., 2001), documenting that impulse purchases are on average about 40% higher in online stores (Liu et al., 2013). Quite different factors ranging from the position of the logo (Dong and Gleim, 2018) to the font of the brand name (Doyle and Bottomley, 2004), the salesperson's physical attractiveness (DeShields et al., 1996) and the store's scent (Morrin and Ratneshwar, 2000) can directly or indirectly affect purchasing decisions. The reason these purchases are considered "unconscious" is that consumers are unaware of the factors that might affect their purchases. For example, Dong and Gleim (2018) reported that the higher positioning of the product's logo positively affected consumers' perceptions about its quality, which influenced their intentions to buy. However, consumers were generally unaware of the effect of the logo's position on their purchasing decisions.

Consumers' unconscious purchase behaviors, which are carried out without awareness about the various factors affecting their purchase decisions, account for most of their daily purchasing behavior (Zaltman, 2003). On the other hand, consumers who have positive experiences with a brand (Nasermoadeli et al., 2013) and are satisfied with it (Park et al., 2010) will continue to buy it. If the positive experiences and satisfaction persist, consumers will buy the brand routinely and automatically over time (Chandon et al., 2004).

Neuroscience studies show that the mind automates routine behavior to expend less energy (Yin and Knowlton, 2006). However, these semi-automated behaviors do not mean that the behavior is unconscious (Aarts and Dijksterhuis, 2000). Individuals can become aware of the reasons for purchasing the product and continuing to do so even after the purchasing behavior becomes a daily routine. On the other hand, when individuals make an impulsive or unplanned purchase of an unfamiliar brand, they are largely unaware of the factors that affect the purchase.

Accordingly, we divided the brands we considered into three categories to reflect consumers' actual behavior in real situations: 1) brands with which consumers have had positive and negative experiences, 2) brands that they know about from reading consumer reviews, and 3) brands with which they are unfamiliar. When asked to make a choice concerning an unfamiliar brand, consumers frequently act automatically without further consideration or make an impulsive choice based on an unconscious hunch.

### 2.1. Event-related potentials

The ERP technique offers unique opportunities for the study of unconscious purchase decisions. Although EEG measurements have a much lower spatial resolution compared to other brain imaging devices such as fMRI, their temporal resolution is the best among all current brain imaging techniques. In other words, EEG measurements are not as good as fMRI in mapping operational regions of the brain, and cannot record activation deeper in the brain as fMRI can. However, they are better at indicating the response time of the brain to stimuli in milliseconds An fMRI device can reflect a variation in the brain only with a 1.5–2 ms delay (Brühl, 2015). Thus, ERPs are based on the assessment of related measurements for potentials that emerge within milliseconds by capitalizing on the temporal resolution of EEGs.

Neurological studies can also classify the ERPs of brain responses to certain stimuli (Fisch and Spehlmann, 1999). Using an EEG-based approach, ERPs can potentially reflect variations during the processing of information about sensory and cognitive processes or motor activity for perceptions of stimuli registering in the central nervous system. Early ERP components (mental reactions occurring before 300 ms) emerge in conjunction with unconscious and automatic mental processes (Greenwald et al., 1996; Ibanez et al., 2012). By contrast, late ERP components such as LPP (Late Positive Potential) and LPN (Late Posterior Negativity) are connected with conscious reactions that generally occur later than 300 ms (Herron, 2017; Li and Han, 2010; Moran et al., 2013). Studies have shown that early components are linked to automatic, unconscious mental reactions, whereas late ERP components are linked to conscious orientations in many different decision contexts, ranging from the formation of consumer preferences to reactions to pain and empathy with financial gains and losses (Fan and Han, 2008; Han et al., 2008; Li and Han, 2010). Although there is a general tendency for the N100, P100, N200, and N170 early components to be linked to unconscious mental reactions and for the LPP and LPN components to be linked to conscious mental processes, the consensus of whether the P300 component, which emerges around 300 ms, is a conscious orientation or an automatic reaction remains an unresolved issue (Lamy et al., 2009; Silverstein et al., 2015). A similar debate occurs with regard to the N400 potential evoked within the range of 300–400 ms (Kutas and Federmeier, 2011). Studies show that N400 reflects both controlled and automatic processes (Coronel and Federmeier, 2016; Coulson and Brang, 2010). Research regarding both the P300 and N400 potentials reveals that the 300–400 ms time interval is a critical phase in the transition from

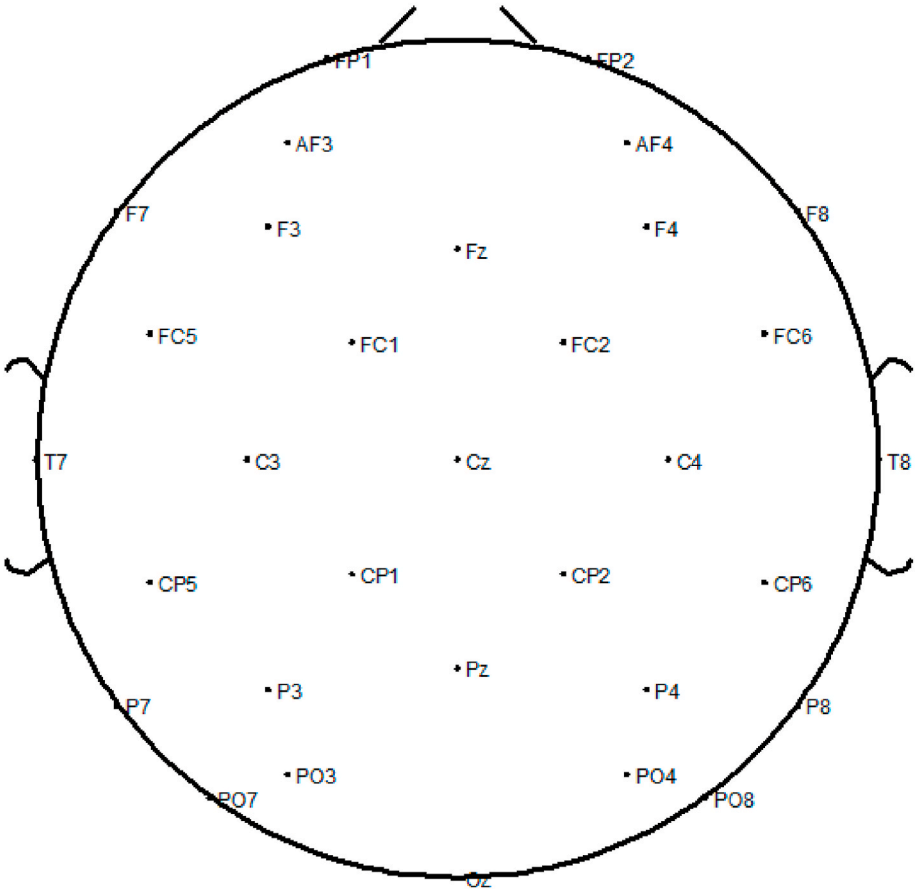


**Fig. 1.** EEG recording electrodes.

unconscious to conscious mental processes.

Relevant studies indicate that the P100, N200, P300, N400, and LPP components are related to consumer decision-making processes (Bosshard et al., 2016; Ding et al., 2016; Khushaba et al., 2015; Handy et al., 2010; Telpaz et al., 2015; Wang and Han, 2014). However, consistent conclusions cannot be drawn when subject-related studies are taken into account. Some studies claim that the P100 and N200 components, which are the result of unconscious interactions that occur around 200 ms, are the main components of consumer choice (Handy et al., 2010). Other studies suggest that the LPP component, which occurs after 300 ms and is related to conscious processes, is the main component of consumer choice (Bosshard et al., 2016). Yet other studies maintain that the P300 (Wang and Han, 2014) and N400 components are related to consumers' preferences (Khushaba et al., 2015). As a result, there is some ambiguity with respect to consumers' decision-making processes and when conscious and unconscious activities transpire. Our aim is to provide some evidence and insight to resolve this ambiguity.

### 2.2. ERP studies on consumers' decisions about purchases

Studies on consumers' purchasing decisions have not taken into consideration well the distinction between conscious and unconscious processes. However, when we classify the relevant studies on this basis, the results tend to confirm that purchases involving products that consumers have experienced are conscious decisions, whereas those involving previously unknown brands are unconscious. Studies conducted involving products that consumers have experienced indicate that only the late ERP components are related to their decisions (Bosshards et al., 2016; Wang and Han, 2014). On the other hand, in a study using unknown brand logos Handy et al. (2010) reported that early ERP components (P100, N200) are related to consumers' decisions. Nevertheless, the published research (Ding et al., 2016; Telpaz et al., 2015) has generally not indicated whether the consumers had used the product or brand in the past.

When we consider the results of the relevant studies using our three categories, we can see that the selection of a familiar product or brand is related to late ERP components, which are consciousness-related. On the other hand, choices involving unknown brands or products or those with which consumers have no personal experience are linked to early ERP components, which are related to unconscious automatic reactions. In this context, it can be said that the dual distinction in purchasing behavior of previously experienced and inexperienced brands offers an important opportunity to study conscious/unconscious decision making processes. However, it can be observed that relevant studies to date have ignored largely the distinction between experience and inexperience. In order to fill this gap, the aim of this study is to reveal ERPs that are related to consumer's decision making processes by employing an experiment explicitly addressing consumer experience for brands.

In the light of these justifications, customer purchasing decisions of previously experienced brands is expected to be associated with late ERP components, which are linked strongly to conscious mental processes. Similarly, it is expected that consumer purchasing decisions made on the basis of consumer reviews and considered a type of partial experience, will be the result of the changes due to late ERP components which are also linked to consciousness. On the other hand, it is expected that purchasing decisions for brands/products which have never been experienced before or are known by the consumers will be related to early ERP components that are linked to unconscious and automatic

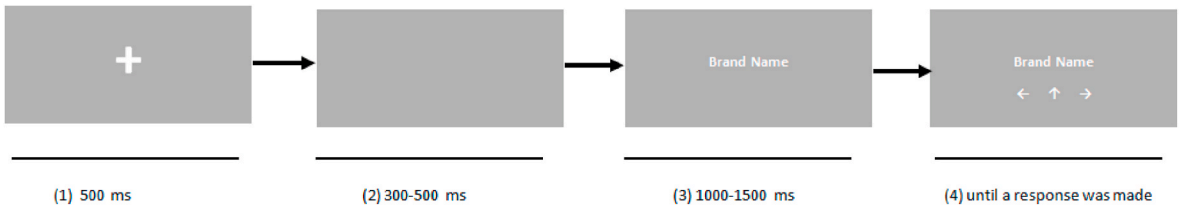


**Fig. 2.** Flow of the experiment.

reactions. Based on these observations and arguments, we make three hypotheses:

**H1**. Only early ERP components (before 300 ms) will significantly differentiate between purchased and not purchased brands in the unknown brand condition.

**H2**. Only the late ERP components (after 300 ms) will significantly differentiate between purchased and not purchased brands in the experienced brand condition.

**H3**. Only the late ERP components (after 300 ms) will significantly differentiate between purchased and not purchased brands in the review-based brand condition.

## 3. Methodology

### 3.1. Selection of the sample

To test our hypotheses, we sent an email invitation to over 2800 students in a Turkish university. Interested participants could click on the link in the email to be directed to the survey's website. At the beginning of the survey, we used open-ended questions to ask participants about brands with which they had good or bad experiences or about which they had positive or negative attitudes. We adapted items from Schlosser et al. (2006) to measure purchase intentions for the brands. The statements in the scale were translated into Turkish following a double back-translation method, which is the most commonly used translation technique because of its consistency and accuracy (Bracken and Barona, 1991). Participants were asked to indicate their handedness (right or left) and any psychological conditions they had that might affect their participation. In total, 760 students accepted the invitation and completed the survey.

For the EEG recording stage, participants were asked to indicate at least two clothing brands with which they had good or bad experiences or about which they had positive or negative attitudes. Indicated brand names were required to be 5–8 letters in length. All participants selected were right-handed and with no record of reported psychological illnesses. Based on these pre-requirements, 67 participants out of 760 were eligible for the EEG recordings, 38 of who were randomly chosen in return for course credit. All testing procedures were approved by the University of Eskisehir Osmangazi University Clinical Review Ethics Board, and written consent was obtained in accordance with the Declaration of Helsinki.

### 3.2. Design of the study

Stimuli consisted of brand names related to three different conditions: experienced, review-based, and unknown brands. In the first category, we included the names the participants provided on the questionnaire. We made up the brand names used in the other two categories. Before taking the EGG recordings, we gave the participants reviews about the brands and overall information for the review-based brand condition. We randomly changed the reviews from positive to negative for each brand name. All reviews were taken from an online e-commerce Turkish website (Please see Appendix B for some examples). After the participants read the reviews, they were taken to another room for the EEG recordings.

### 3.3. Execution of the experiment

We recorded the EEGs with G.Tec, a headset with 32 active dry electrodes (FP1, FP2, AF3, AF4, F3, F4, F7, F8, FZ, FC1, FC2, FC5, FC6, T7, C3, CZ, C4, T8, CP1, CP2, CP5, CP6, P3, P4, PZ, P7, P8, PO3, PO4, PO7, PO8, OZ). The positions of the recording electrodes are depicted in Fig. 1.

We recorded the EEGs with the G.Tec software at a sampling rate of 256 Hz and bandpass-filtered between 0.1 and 100 Hz. The ground electrode was mounted over the left mastoid, and the reference was mounted over the right mastoid; for both positions disposable pre-gelled electrode pads were used. All EEG electrode impedances were maintained below 5 kΩ. EEG electrodes were fixed to an EEG electrode cap (g. GAMMAcap) according to the extended international 10/20 electrode system.

Participants were comfortably seated at a distance of 100 cm from the LCD monitor and made their choices using the keypad we provided. Before the experiment, we told the participants that all of the brand names were related to the clothing sector and real brands, even though they might not know about some of them. Prior to the start of the formal experiment, the participants engaged in a 5-min practice session to become familiar with the procedures. They were asked to indicate whether they wanted to purchase the brands or not; they could also say they were uncertain. In addition, we told them that quick decisions were not necessary and they would have a chance to change their minds about their purchase decisions.

Participants saw the stimuli in the form of form blocks, where each block included four steps. The steps were the presentation of (1) a fixed white cross for 500 ms at the center of the display, (2) interstimuli intervals of 400, 500, or 600 ms, (3) brand names for 1000–1500 ms intervals, and (4) responses of purchasing, not purchasing, or no idea as choices. Participants could indicate their responses with the arrow keys, and the mapping of arrow keys varied for each block. For instance, in one block, the left arrow key might indicate a purchase, the right arrow key might indicate no purchase, and the upper arrow key might mean no idea. In the next block, this mapping changed randomly.

Fig. 2 illustrates the flow of the test. The display sequence of each brand name was also ordered randomly using Paradigm Experiment software. In each block, the stimuli were displayed 51 times, with a pause after each block for the participants to rest. After the presentation of the stimuli, the participants were asked whether they had known the brands in the review-based condition and unknown conditions beforehand. At this stage, none of the participants declared they already knew the brands that we made up for the study. They also filled out another questionnaire containing items about purchase intentions (Schlosser et al., 2006) for each brand included in the experiment. The items were measured with a 7-point Likert scale anchored with strongly disagree to strongly agree.

### 3.4. Data analysis

Preliminary analyses of the EEG signals were conducted with

**Table 1**
Means and standard deviations of trials by the three conditions.

| Conditions | Purchased | | Not Purchased | | Uncertain | |
|---|---|---|---|---|---|---|
| | M | SD | M | SD | M | SD |
| Unknown | 47.600 | 22.126 | 54.400 | 23.613 | 34.000 | 39.547 |
| Review Based | 67.028 | 17.465 | 63.142 | 16.784 | 5.828 | 15.395 |
| Experienced | 68.971 | 10.051 | 67.028 | 10.051 | – | – |

EEGLAB (Delorme and Makeig, 2004) under MATLAB. Before the time-locked separation of the obtained EEG records, 0.1 Hz high-pass and 30 Hz low-pass filters were applied (Luck, 2014). EEG data were segmented to epochs of 1000 ms after stimulus onset with a 200 ms pre-stimulus baseline, and the data were baseline-corrected using the mean of the pre-stimulus interval (−200 ms). We used the independent component analysis algorithm to remove known artifacts (e.g., eye movements, blinks, heart beats) (Jung et al., 2001). The software automatically eliminated periods with voltage deviations that exceed ±100 μV in the 100 ms time windows in the EEG signals. At this stage, the data of three participants with artifact rates of more than 25% were excluded from the analysis (Luck, 2014). Thus, we conducted analyses with the data obtained from 35 participants for the experienced and review-based brand conditions. For the unknown brands, we eliminated three participants who chose “no idea” for all brands. The final analysis was conducted with 32 participants for the unknown brand condition.

## 4. Results

Thirty-five participants (20 female, 15 male) aged 20 to 27 (mean 22.5 years, SD ± 2.3 years) were included in the study. To simplify the data analysis and increase the number of trials per condition for the ERP analysis, for each condition the brands that were marked as purchased were pooled and formed the purchased brands category. Similarly, for each condition we placed the brands that were not chosen in the not purchased category. The number of trials is unequal because the participants determined the categories purchased or not purchased. Table 1 lists the mean number of trials for each condition. As the table indicates, while the trials for the purchased and not purchased brands were distributed equally in the experienced brand condition, there was a slight difference in favor of purchased brands in the review-based brand condition. For unknown brands, the participants generally seemed to choose "no idea" more than they did with the review-based and experienced brand conditions. Within-subject, repeated measure ANOVAs with a Greenhouse-Geisser correction determined that the mean trial numbers differed significantly between conditions ($F(1, 34) = 12.54$, $p = .000$). Post hoc tests using the Bonferroni correction revealed that purchased and not purchased trial numbers were not significantly different within the unknown (47.60 ± 22.12 vs. 54.40 ± 23.61, respectively $p = .999$), review-based (67.02 ± 17.46 vs. 63.14 ± 16.78, respectively $p = .999$), and experienced brand conditions (68.97 ± 10.05 vs. 67.02 ± 10.05, respectively $p = .999$). In addition, there was no significant difference between the conditions in the trial number of the not purchased brands. However, purchased brand trials were significantly lower in the unknown brand condition compared to the review-based ($p = .001$) and experienced brand conditions ($p = .000$).

Therefore, we conducted paired sample t-tests for post hoc analyses that were not biased due to the number of trials. However, significant differences in the trial numbers indicate that including the conditions in the within-subjects repeated measure ANOVA might lead to bias. Another reason why we did not include the conditions in the ANOVA is that three participants in the unknown brand condition chose “no idea” for all options in their purchasing preferences. For this reason, we conducted separate paired *t*-test analyses for the unknown brand condition with 32 people in total without including the data of the three people involved. Therefore, adding the conditions to ANOVA as a factor under these conditions would lead to all of the analyses containing 32 participants instead of 35. Such a situation would have a negative effect on the power of the test. In the light of these two basic justifications, we preferred not to include the conditions as a factor in the within-subjects repeated measure ANOVA analysis.

To ensure that the data were normally distributed, we computed the Shapiro Wilk for all variables. The p-values varied between $p = .275$ and $p = .897$, indicating that the assumption of the normality of the data can be accepted.

Statistical analyses were conducted using SPSS (Version 20.0). First, 2 (purchased/not purchased) × 3 (frontal region/central region/parietal region) within-subjects repeated measure ANOVAs were conducted. Then, separate paired t-tests were performed for each condition for the follow-up, post-hoc tests. The Greenhouse–Geisser correction

**Table 2**
Results of the paired samples t-tests.

| Condition | ERP | Region | Purchased | | Not Purchased | | df | t |
|---|---|---|---|---|---|---|---|---|
| | | | M | SD | M | SD | | |
| Unknown | N100 | Frontal | −1.161 | 1.153 | −1.667 | 1.161 | 31 | 3.353** |
| | | Central | −1.022 | 0.904 | −1.695 | 1.019 | 31 | 5.326** |
| | | Parietal | −0.385 | 1.321 | −0.683 | 1.245 | 31 | 1.697 |
| | N400 | Frontal | 0.031 | 1.467 | −0.601 | 1.260 | 31 | 2.816** |
| | | Central | −0.377 | 1.248 | −0.899 | 1.381 | 31 | 3.106** |
| | | Parietal | −0.597 | 1.558 | −0.903 | 1.805 | 31 | 1.597 |
| Review Based | N400 | Frontal | −0.681 | 1.618 | −0.322 | 1.433 | 34 | −1.665 |
| | | Central | −1.044 | 1.830 | −0.455 | 1.474 | 34 | −2.406* |
| | | Parietal | −0.796 | 1.655 | −0.285 | 1.471 | 34 | −2.826** |
| | LPN | Frontal | −0.169 | 1.683 | 0.353 | 1.397 | 34 | −2.005 |
| | | Central | −0.841 | 1.555 | −0.014 | 1.261 | 34 | −3.761** |
| | | Parietal | −1.312 | 1.457 | −0.438 | 1.297 | 34 | −4.715** |
| Experienced | LPN | Frontal | −0.463 | 1.251 | −0.110 | 1.255 | 34 | −1.522 |
| | | Central | −1.337 | 1.263 | −0.470 | 1.355 | 34 | −3.689** |
| | | Parietal | −1.891 | 1.374 | −0.839 | 1.479 | 34 | −4.738** |

*$p < .05$ **$p < .01$.

(Greenhouse and Geisser, 1959) was applied to all statistical analyses when necessary. Three anatomical subgroupings were formed comprised of a frontal group (FP1, FP2, AF3, AF4, F3, F4, F7, F8, FZ), a central group (FC1, FC2, FC5, FC6, C3, CZ, C4, CP1, CP2, CP5, CP6), and a parietal group (P3, P4, PZ, P7, P8, PO3, PO4, PO7, PO8). We averaged the EEG channels for each anatomical subgroup (frontal region/central region/parietal region) before conducting the ANOVAs. Based on visual observation, ANOVAs were run on each of three post-stimulus time windows (1) 130–160 ms, (2) 350–450 ms, and (3) 610–810 ms for each condition. The ERPs analyses were conducted on the mean amplitude values for the frontal, central, and parietal anatomical subgroups within the predefined time windows.

Results indicate a significant main effect of purchased/not purchased for unknown brands ($F(1, 31) = 16.59$, $p = .000$) for the 130–160 ms time window. However, no significant main effects occurred for either experienced brands ($F(1, 34) = 0.01$, $p = .978$) or review-based brands ($F(1, 34) = 0.07$, $p = .788$) during this time window. On the other hand, a significant main effect of purchased/not purchased was evident for both experienced ($F(1, 34) = 13{,}744$, $p = .001$) and review-based ($F(1, 34) = 13{,}095$, $p = .001$) brands for the 610–810 ms time window, but there was no significant main effect for unknown brands ($F(1, 31) = 0.19$, $p = .665$) during this time window. Lastly, a significant main effect occurred for purchased/not purchased for both unknown ($F(1, 31 = 10{,}465$, $p = .003$) and review-based ($F(1, 34) = 5{,}919$, $p = .020$) brands within the 350–450 ms time window, but there was no significant main effect for experienced brands ($F(1, 34) = 1.22$, $p = .276$) during this time window. We conducted paired t-tests for follow-up, and used the Bonferroni adjustment to control for family-wise Type I errors in these analyses. Post-hoc results of the t-tests are reported in Table 2 and 3 for all conditions.

The related grand average ERP waveforms are shown in Figs. 3, 6, and 9. The time windows that have a significant differentiation in the ERP waveforms are marked with dashed boxes. In addition, scalp topographies for related time windows appear in Figs. 4, 5, 7, 8, 9, and 10.

N100 in Fig. 3 is a negative peak with the frontal and central maximums at about 150 ms for all conditions. The topographic map indicates a clear N100 component scalp distribution (Fig. 4). Pairwise comparisons show that the mean difference in amplitude in N100 (130–160 ms time window) between the purchased and unpurchased brands is significant for the unknown brand condition in the frontal and central regions (Fig. 3 and Table 2). More specifically, the amplitudes of the ERPs for the purchased brands are generally more negative for the 130–160 ms time window. This tendency is also evident in the 350–450 ms time window. On the other hand, in the review-based brand condition, this significant difference was evoked at around 300 ms on the central and parietal sites (Fig. 6 and Table 2). However, unlike in the unknown brand condition, in the review-based condition, the ERPs for brands that were not purchased are generally more negative. In Fig. 7, the negative distribution concentrated around the central and parietal sites appears at the 350–450 ms time window, which arguably can be considered an N400.

Comparisons show that the difference in the mean amplitude of the LPN (610–650 ms time window) between the purchased and unpurchased brands is significant for the review-based and experienced brand conditions in the central and parietal regions (Figs. 6 and 8, and Table 2). Purchased brands elicited a negative-going effect in the 610–650 ms time window (LPN) in both the review-based and experienced brand conditions (Figs. 6 and 8). In Figs. 8 and 10, the tomographic map at the 610–650 ms time window indicates that the LPN component showed a positive distribution concentrated in the frontal site and a negative distribution concentrated in the parietal site.

Results demonstrate that early ERP components are involved in consumers' decisions about unknown brands, whereas late ERP components are involved in their decisions about review-based and experienced brands. Early ERP components indicate automatic, unconscious responses, and late ERP components indicate conscious responses (Hajcak et al., 2009; Liddell et al., 2004; Schupp et al., 2000, 2004). Thus, the results suggest that consumers' decisions about buying unknown brands occur as a result of automatic processes, whereas, their decisions about review-based and experienced brands involve deliberative processes. This suggests that a consumer makes her decision unconscious and automatic when the product is unknown, and she makes her decision consciously when she is involved with the product, either with the reviews made by other people or based on her own experience. However, the results also indicate that the N400 component has a significant effect on purchase decisions involving unknown brands. Thus, we conclude that there is complete support for H2 and H3, but only partial support for H1. Overall, the findings provide general support for the hypotheses.

## 5. Discussion

The aim of our study was to reveal the effects of conscious and unconscious mental processes on consumer purchasing decisions through ERP analyses. For this purpose, purchasing preferences were examined in three different situations: brands with which consumer had no knowledge/experience, brands that were used and experienced in the past, and brands that were partially or vicariously experienced through reading the reviews done by other people. The findings support the existing research suggesting that consumers make decisions about whether to buy products using conscious and unconscious processes depending on their degree of knowledge about and experience with the brands they are choosing.

The literature focuses on cases where consumers have mental access to past information when making purchase decisions based on prior experience, and can therefore make conscious choices (Baars et al., 2003; Zaltman, 2003). A similar process also occurs when consumers read reviews of brands and make decisions with the help of this information (Chen et al., 2010). We might call this situation partial experience. In this case, consumers make decisions vicariously through the experiences of other users.

Our study contributes to this research by providing empirical evidence about changes in the brain involved in these decisions. We demonstrate that both personal and vicarious experiences affect conscious choices, evident in the activation of late ERP components. Our results accord with the work of Bosshard et al. (2016), Khushaba et al. (2015), and Wang and Han (2014), and indicate that purchasing takes place through conscious processes in these cases.

The results also indicate that early ERP components are related to purchasing decisions for brands that consumers do not know, an outcome that is in line with the work of Handy et al. (2010). This result supports the conclusion that people make decisions within a short period of time, as short as 250 ms (Harris et al., 2011; Milosavljevic et al., 2011), especially when considering purchasing new or unknown brands. Our findings suggest that such decisions are made automatically and unconsciously. A number of studies note that such processes are relevant and ubiquitous in consumer purchase decisions, but have been understudied (Dijksterhuis et al., 2005; Singer, 1993; Zaltman, 2000). Our results suggest that these processes are important for situations where consumers have little or no prior information about the products or brands they are considering buying. At this point, after making an initial decision about whether or not to purchase the brand, consumers are biased in favor of following through with that decision (Carlson and Russo, 2001; Russo et al., 1998, 2000).

The results of our study indicate that N100 and N400 potentials in unknown brand conditions, N400 and LPN potentials in review-based brand conditions, and LPN potential in experienced brand conditions are related to purchasing decisions.

We evaluated whether the potential appearing in the 130–160 ms time window was N100. Studies indicate that word-based stimuli evoke the N170 potential, which appears in the same time window as N100. Although the N170 potential appears frequently in word-based stimuli

(Maurer et al., 2008), as our experimental design focused on the purchases of the participants, the potential evoked here can be interpreted as an N100 potential, which represents the discrimination process and selective attention. Some studies have also reported that the N100 potential appears in word-based stimuli as well (Hinojosa et al., 2012; Sanders and Neville, 2003). In addition, the topographic maps showing the fronto-central negativity obtained within the 130–160 ms interval in our study (see Fig. 4) do not match the topographic map of the N170 potential showing parietal negativity. The overlapping of the N100 topographies, especially with studies focusing on selection-related variables (Lithari et al., 2010; Righi et al., 2014), overlap with the topographic maps obtained in our study, strengthening the belief that the potential is N100.

The results of our study indicate that the potential of N100 is smaller (more positive) for purchased brands in unknown brand conditions. No study has been conducted where the N100 potential directly contrasts with results obtained in relation to the selections of consumers. However, there are studies linking the N100 potential and selection related variables such as emotional arousal (Jessen and Kotz, 2011; Keil et al., 2001), and feelings such as attractive/unattractive (Righi et al., 2014), pleasant/unpleasant (Lithari et al., 2010), and like/dislike (Guo et al., 2018; Pizzagalli et al., 1999). Nevertheless, it is impossible to conclude that the results related to subjects show a specific pattern. Some studies that had more positive emotions elicited a larger N100 (Pizzagalli et al., 1999; Righi et al., 2014), whereas in other studies, negative emotions evoked a larger N100 (Jessen and Kotz, 2011; Lithari et al., 2010). When the results in the literature are evaluated in terms of positive/negative emotions, the larger N100 evoked for unpurchased brands accords with the results in Lithari et al. (2010) and Jessen and Kotz (2011).

In summary, the results of our study indicate that the potential of N100, which relates to automated, mental processes (Singhal et al., 2002), is related to consumers' decisions about buying brands with which they are unfamiliar. Furthermore, they make such decisions as a result of unconscious mental processes.

The results obtained show that the N400 potential elicited in the 350–450 ms time window is related to purchase decisions for both review-based and unknown brands. In the context of consumer preferences, Khushaba et al. (2015) indicated that the N400 waves for their preferred options were more negative than the N400 waves for their non-preferred options. In a similar vein, Coronel and Federmeier (2016) found that the N400 potential associated with statements indicating personal preferences such as, "For dessert, you like to eat cheesecake/-popsicles," was more negative. Our results show that the purchased brand in the review-based condition has a more negative N400 wave than the non-purchased brand. These results accord with those in the literature. Apart from the consumer context, the literature indicates that the N400 is related to selection (Tu et al., 2009; Wang et al., 2009). Furthermore, similar to findings reported in the literature, the scalp distribution of the current N400 hints at neural generators in the central parietal cortex (Kutas and Federmeier, 2011).

However, purchased brands in the unknown brand condition appear to have a more negative N400 wave. One explanation for this difference might be that the N400 potential contains controlled and automatic processes together. N400 reflects the organization of semantic memory (Federmeier and Kutas, 1999) as well as word knowledge gained through experience (Hagoort et al., 2004). In this context, N400 includes both controlled mental processes (word knowledge gained through experience) and automatic mental processes (organization of sematic memory) (Coronel and Federmeier, 2016). Therefore, in review-based processes, individuals can access information about the brand names with the help of other consumer comments.

However, the cognitive operation of the process of the unknown brand condition takes place through the organization of semantic memory processes, unlike the word knowledge gained through experience in the review-based condition. Therefore, for the review-based and unknown brand conditions, we maintain that the processes reflected in the N400 differ as controlled vs. automatic. As a result, the N400 wave may appear more negative for purchased brands in the unknown brand condition. Of course, more studies should be conducted focusing directly on the subject in order to obtain accurate information in this regard. Nevertheless, our results seem to support the studies suggesting that N400 is a result of both controlled and automatic processes (Coronel and Federmeier, 2016; Coulson and Brang, 2010).

The results show that the LPN potential (in the 610–810 ms time window) is related to purchase decisions for experienced brands and review-based brands. Parietally pronounced negativity and negative-going slow waves indicate that the potential within the 610–810 ms time window is LPN (Mecklinger et al., 2007). LPN is modulated by the amount of information actually used to reconstruct prior episodes (Mecklinger et al., 2016).

Therefore, in our study, LPN emerged as a result of the participants reconstructing their experience with the relevant brand. In a similar vein, when the participants saw the name of a brand related to the experience of other participants they saw before the experiment, the act of bringing it back to their memory caused LPN potential to appear for the review-based brands.

Our study is the first to demonstrate that LPN has an effect on consumer purchasing decisions. The failure to find such a result previously may be due to the fact that there has been no research focusing directly on consumers' past experience with products or brands. In their review of the LPN literature, Mecklinger et al. (2016) asserted that LPN might be related to the evaluation processes associated with reconstruction. In Brattico et al. (2010), LPN emerged in connection with the musical chords that individuals liked or disliked, with a more negative LPN evident in the chords that individuals liked. Our results accord with Brattico et al. (2010). They also support the argument that LPN is related not only to the construction of past episodes, but also to evaluations, as Mecklinger et al. (2016) suggested.

In summary, our results indicate that LPN, one of the late ERPs that indicate a conscious orientation (Herron, 2017), is significant in consumers' purchasing decisions based on their past experiences and other consumers' comments.

A limitation of our study is the use of only clothing brands as stimuli. In addition, we used only brand names, not product attributes or other information. Therefore, conducting studies involving the use of brands from different sectors and utilizing other stimuli such as logos and arguments for purchasing might confirm our findings and, at the same time, open up new avenues for study. Consistent with many EEG studies, our sample size was small. Furthermore, the participants were university students, although the stimuli were chosen to be relevant to students. Lastly, given that the trial numbers for the various conditions were unequal, we could not use them as a factor in the within-subjects ANOVAs. This situation increased the likelihood of Type 1 errors in the results. Despite these limitations, our study is the first to explore consumers' purchasing decisions through ERP while taking their experience with the brand into consideration.

## 6. Conclusion

Results indicate that LPN, which is associated with conscious mental processes, is related to consumers' purchase decisions about brands they have used and those they evaluate through the reviews of other consumers. On the other hand, the effect of the N100 potential, which is associated with unconscious mental processes, is evident in the purchasing decisions about brands with which consumers were unfamiliar. Our results also indicate that the potential of the N400 has an impact on decisions about buying both unknown and review-based brands. However the significant effects in the N400 amplitude move in opposite directions for unknown and review-based brands regarding those that are purchased and those that are not. One explanation for this outcome is that N400 is a reflection of both controlled and automatic mental processes.

While the changes in amplitude of the N400 in connection with the organization of semantic memory are related to automatic processes in the unknown brands condition, the review-based condition seems to have changed in connection with the word knowledge gained through experience related to controlled processes. As a result, different mental processes seem to be involved in the move of the N400 amplitudes in opposite directions for the brands bought/not bought in the review-based and unknown brand conditions.

In general, our results indicate that the role of consciousness on consumer purchasing decisions differs in conjunction with the experience of the purchased product. This shows that instead of a harmony of consciousness/unconsciousness in consumer decisions, relevant processes come into play in different ways, depending on the nature of the situation that the consumer faces. Therefore, future studies should consider how the engagement of conscious and/or unconscious mental processes and customers' level of experience with the products they buy occur. The results have the potential to explain the incomplete and contradictory results in the literature on ERP. Our study reveals that taking consumers' experience with the brand into account yields systematic, consistent results.Compliance with Ethical Standards.

## Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

## Funding statement

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## Declaration of competing interest

On behalf of all authors, the corresponding author states that there is no conflict of interest.

## Appendix D. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jretconser.2020.102202.

## APPENDIX A. Grand ERP Waveforms and Topographic Maps

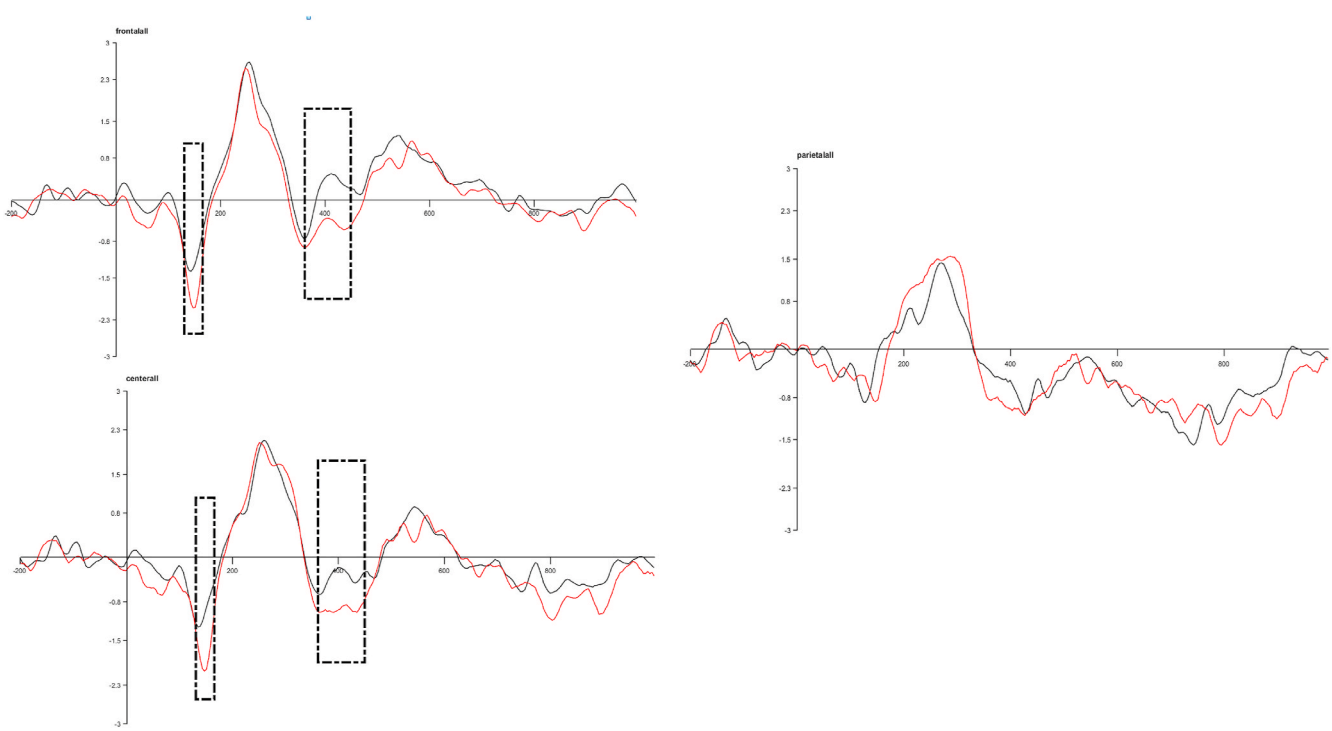


**Fig. 3.** Grand average event-related potential waveforms for unknown brands at frontal, central and parietal sites – Black lines: Purchased brands – Red lines: Unpurchased brands – Dashed box areas indicate the significantly differentiated time windows.

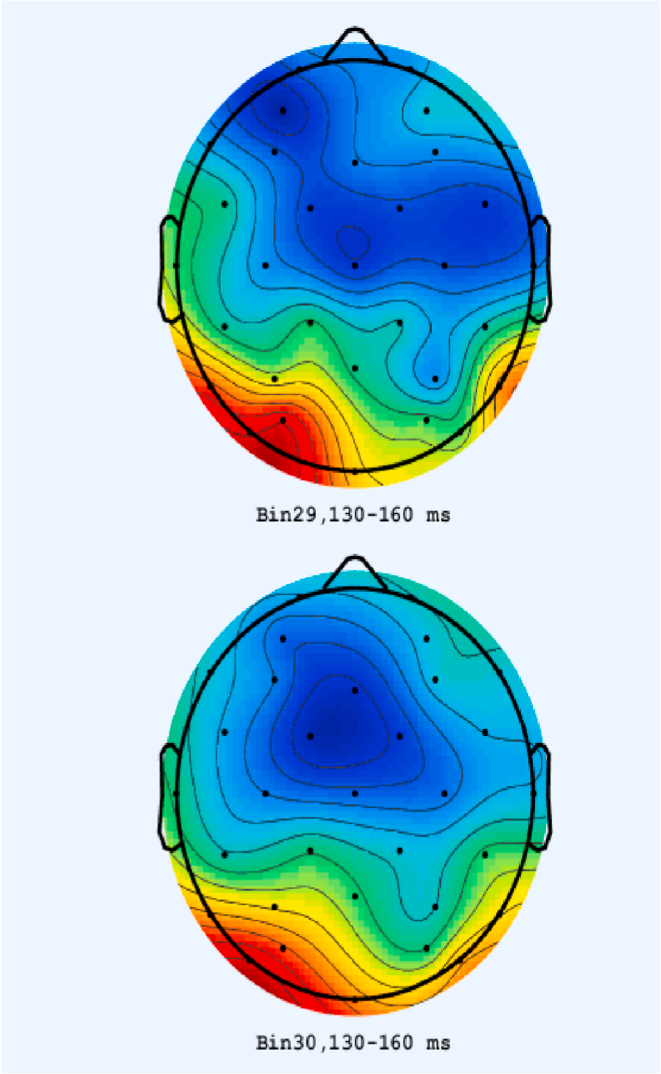


**Fig. 4.** Topographic scalp distributions for the unknown brands in the 130–160 ms time window (Bin 29 for purchased brands, Bin 30 for unpurchased brands) and the bar for the topographic map ranges from −3 to 3 μV.

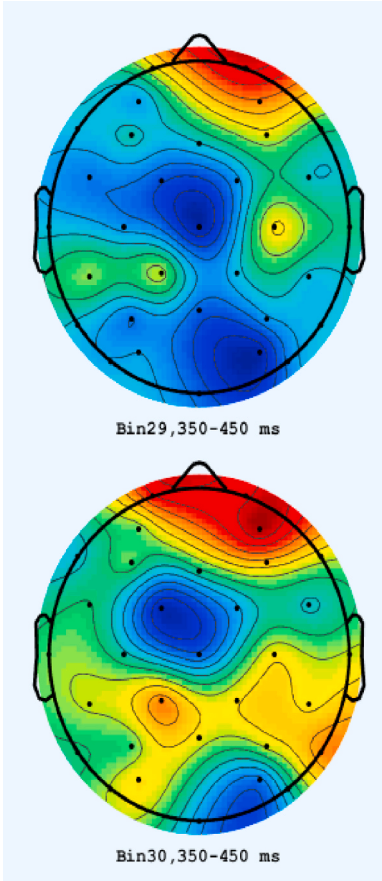


**Fig. 5.** Topographic scalp distributions for the unknown brands in the 350–450 ms time window (Bin 29 for purchased brands, Bin 30 for unpurchased brands) and the bar for the topographic map ranges from −3 to 3 μV.

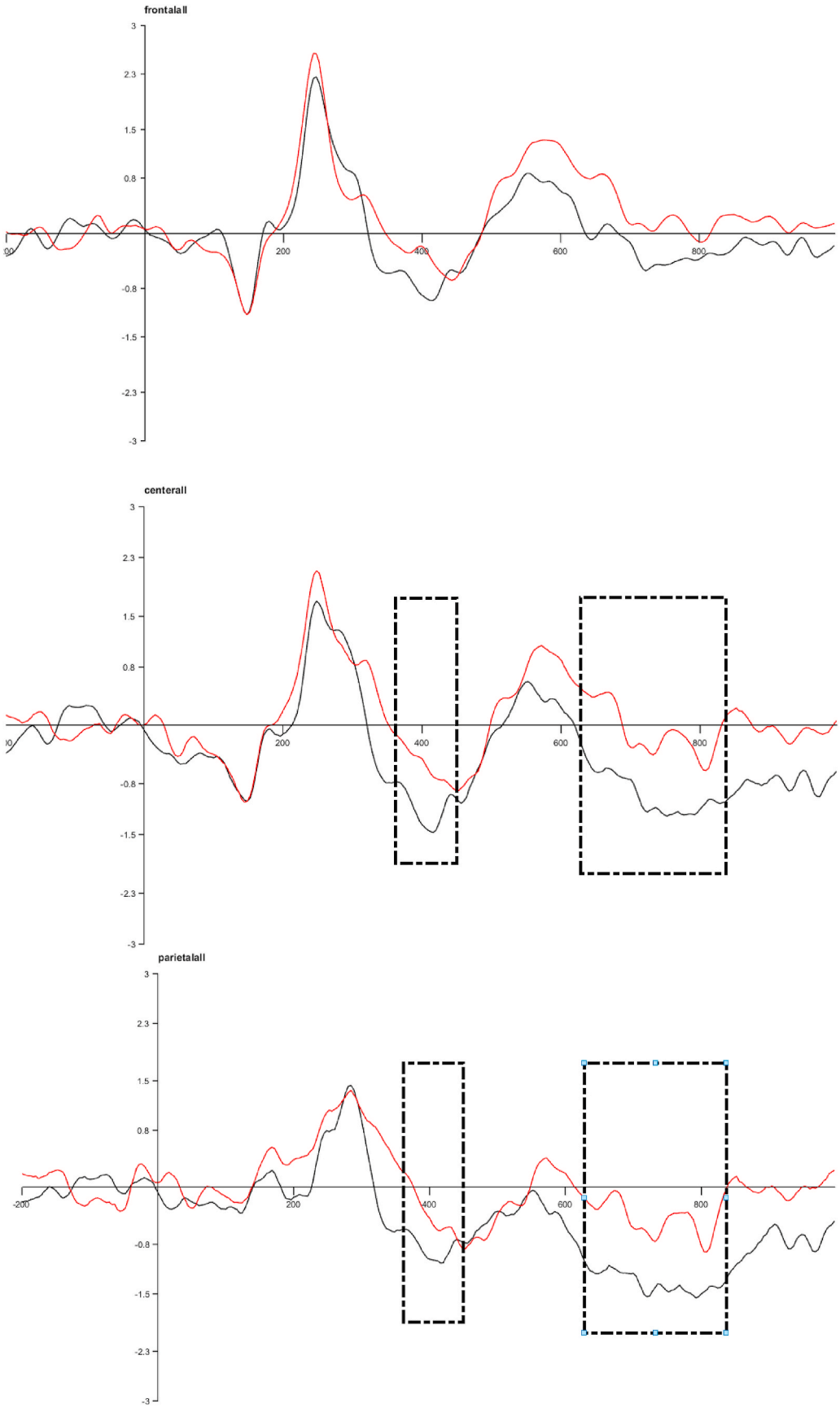


**Fig. 6.** Grand average event-related potential waveforms for reviewed brands at frontal, central and parietal sites – Black lines: Purchased brands – Red lines: Unpurchased brands – Dashed box areas indicate the significantly differentiated time windows.

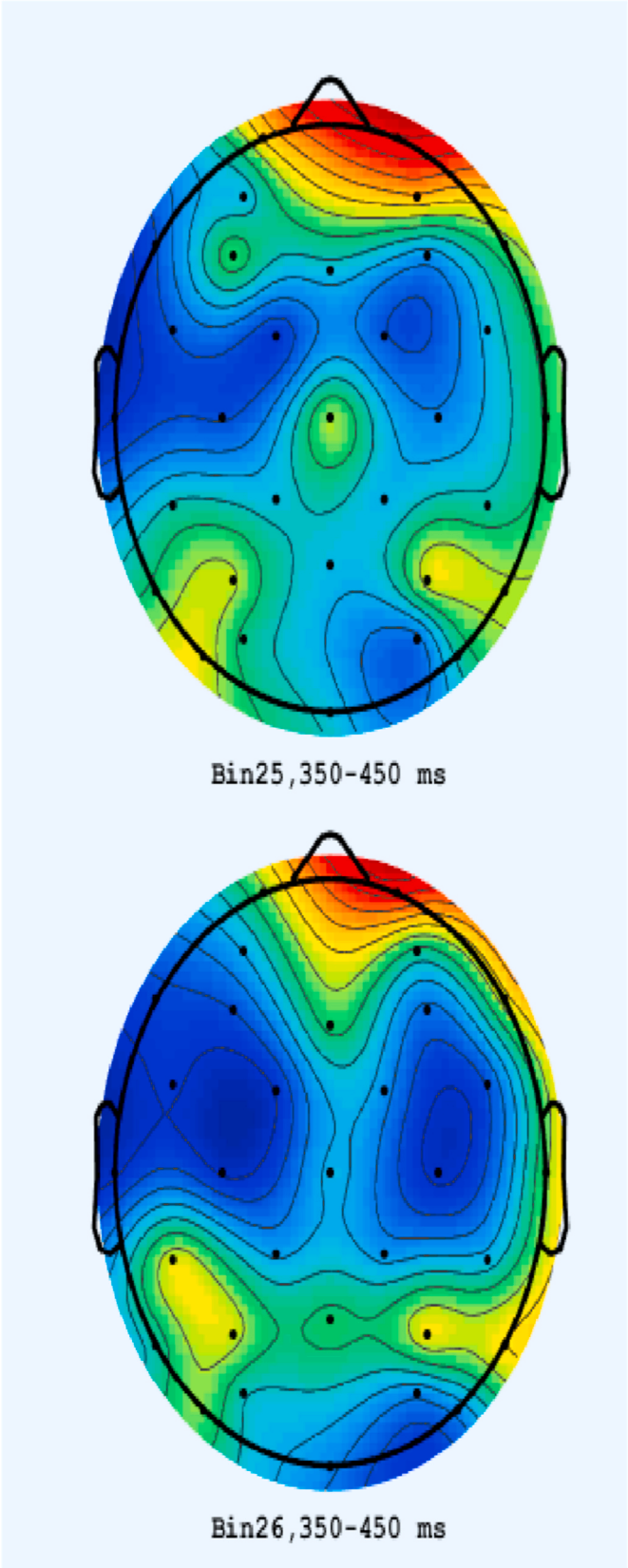


**Fig. 7.** Topographic scalp distributions for the reviewed brands in the 350–450 ms time window (Bin 29 for purchased brands, Bin 30 for unpurchased brands) and the bar for the topographic map ranges from −3 to 3 μV.

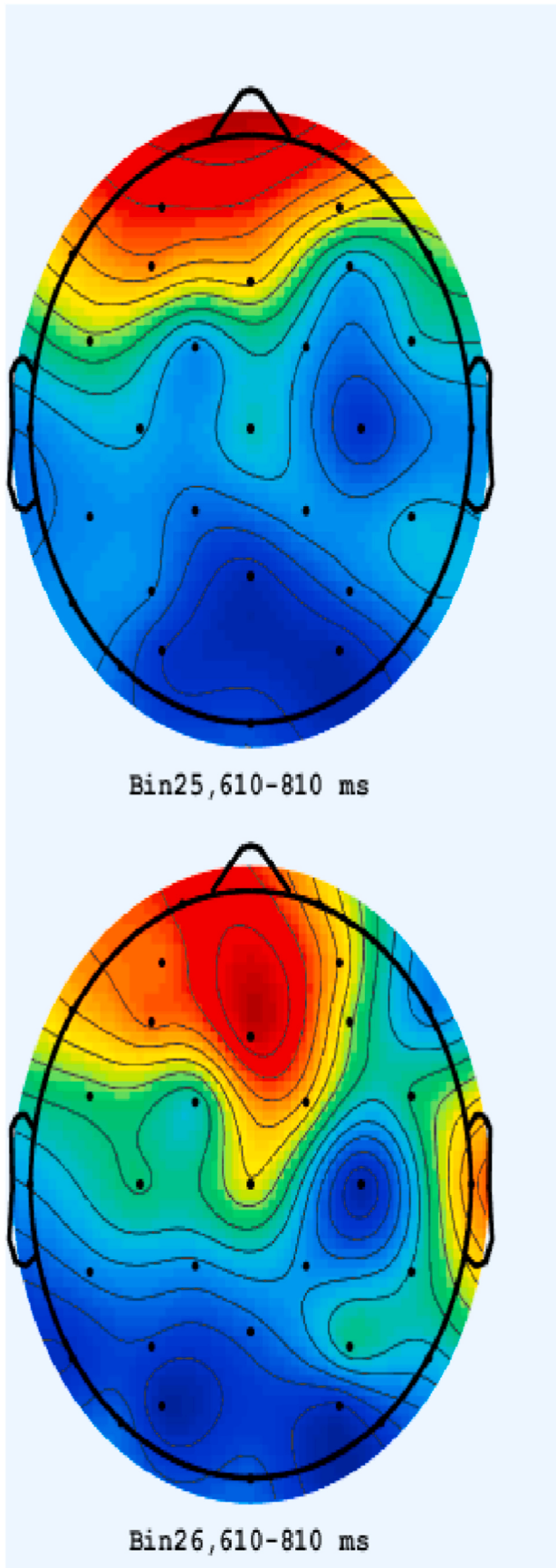


**Fig. 8.** Topographic scalp distributions for the reviewed brands in the 610–810 ms time window (Bin 29 for purchased brands, Bin 30 for unpurchased brands) and the bar for the topographic map ranges from −3 to 3 μV.

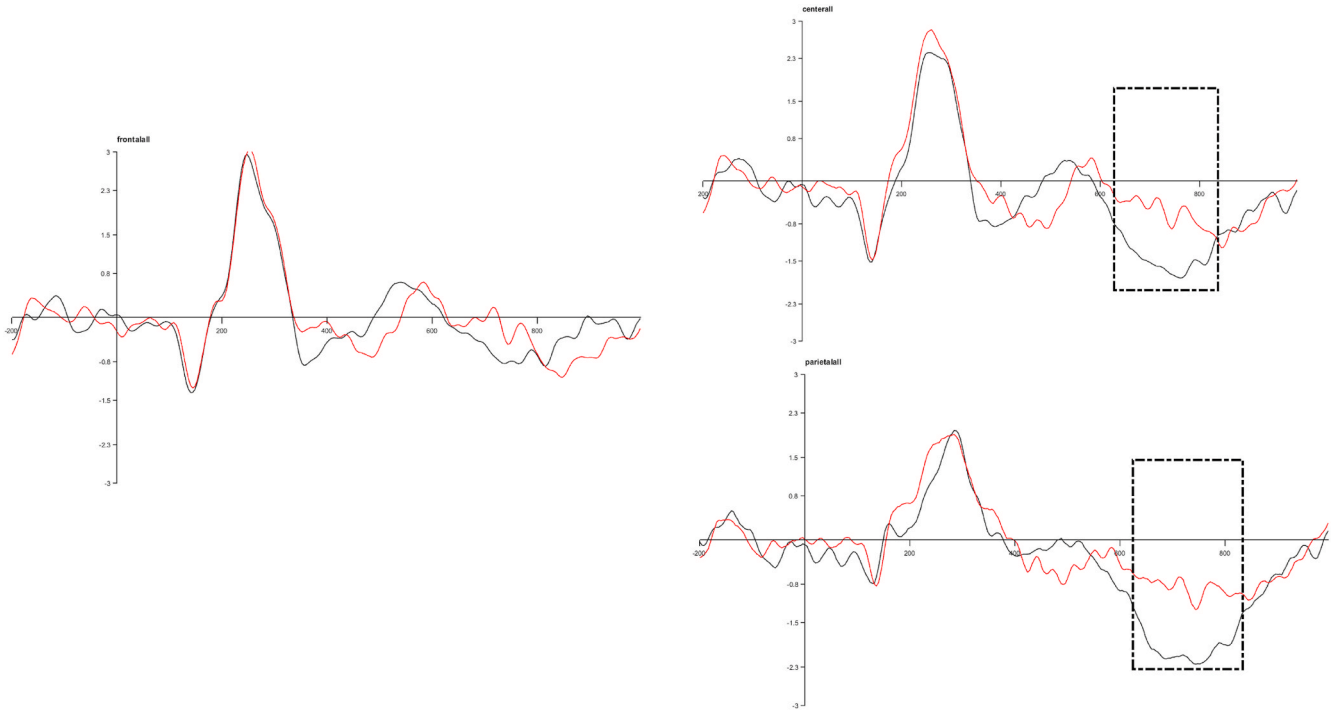


**Fig. 9.** Grand average event-related potential waveforms for the experienced brands at frontal, central and parietal sites – Black lines: Purchased brands – Red lines: Unpurchased brands – Dashed box areas indicate the significantly differentiated time windows.

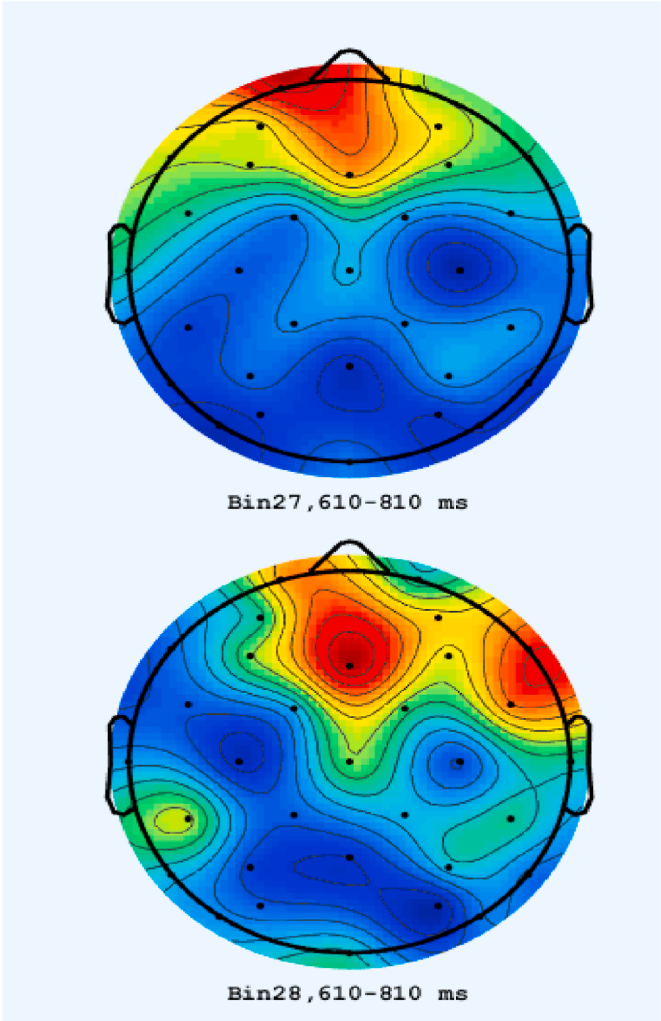


**Fig. 10.** Topographic scalp distributions for the experienced brands in the 610–810 ms time window (Bin 29 for purchased brands, Bin 30 for unpurchased brands) and the bar for the topographic map ranges from −3 to 3 μV.

## APPENDIX B. Brand Reviews

*FORNIA*

The average of the 263 reviews: 2.03 out of 5.

"I opened the box and put it back the same way as it was. I requested a refund but it was refused and they sent it back to me again. I didn't even touch the product though they said the product was not refundable, as it seems used already. Despite the several phone calls with FORNIA's customer service, the problem hasn't been resolved yet. The request I made through Fornia.com was deleted by the company. My request about the problem has never been fulfilled." 1/5.

"I ordered the product since FORNIA said it would be shipped within the day, but it wasn't. I told customer service that I wanted to cancel the product if wasn't shipped today but they sent it anyway. My refund was denied. They just ignored all of the complaints I made about this issue. Frauds!!! I would never recommend this brand to anybody." 1/5.

"If you have their product and it has flaws, don't go to FORNIA even if it is just next door. All they do is to make you wait and say tomorrow, tomorrow, tomorrow…Frustrating! You'd rather ask your mother to repair it." 2/5.

*COREN*

The average of the 140 reviews: 1.51 out of 5.

"This was the best experience I have ever had in my life. No company can succeed by fooling a customer in this professional way. How awesome to be swindled! No return! No refund!" 1/5.

"No pledge they made through the phone call was fulfilled. This poor brand must have been built to just rob people! They say all of the phone calls are being recorded. But if you ask them to re-listen to the conversation you had before, they say we don't have the authority to access them. The record is accessible when it comes to their work. When it doesn't come to their work, the record doesn't even exist." 1/5.

"Never seen such a clumsy brand. One day is enough to solve my request and I am still waiting. It has been 3 weeks now." 1/5.

*CHAMPI*

The average of the 621 reviews: 4.51 out of 5.

"I just love CHAMPI! You will never be disappointed about anything. Even if you are, they will resolve it right away!" 5/5.

"CHAMPI is the only brand that I haven't seen any problem. When I have trouble with the product, they care of it and resolve it immediately. They deserve 5 points!" 5/5.

"I submitted a request through the customer service number and they called me back and resolved it literally in realtime. I am very satisfied with their behavior and service." 5/5.

*FULIN*

The average of the 778 reviews: 4.61 out of 5.

"I found a little problem with the product and wanted to change it. I visited the nearest branch, but they didn't accept my request. However, my request was resolved in a very interesting way. The local representative came to my home in person and resolved problem. I respect this brand. Thank you so much." 4/5.

"I don't really care about brands. But I can say FULIN is a trustworthy brand with good quality. I have never encountered any problem with them. You will see the exact product they say. FULIN, you are my man.)" 5/5.

"I've heard that they send customers another shipment once they find even a very tiny flaw in the product. This is what differentiates FULIN from others. They never blame customers. Their only strategy seems to satisfy the customers." 5/5.

## APPENDIX C. Results of the Insignificant Paired Samples t-Tests

**Table 3**
Results of the paired samples t-Tests (insignificant potentials)

| Condition | ERP | Region | Purchased | | Not Purchased | | df | t |
|---|---|---|---|---|---|---|---|---|
| | | | M | SD | M | SD | | |
| | | Frontal | 0.140 | 1.072 | 0.037 | 1.079 | 31 | 1.092 |
| Unknown | LPN | Central | −0.284 | 1.009 | −0.389 | 0.733 | 31 | 1.044 |
| | | Parietal | −1.138 | 1.215 | −1.030 | 0.981 | 31 | −0.908 |
| | | Frontal | −0.908 | 1.342 | −0.940 | 1.399 | 34 | 0.215 |
| Review Based | N100 | Central | −0.899 | 1.302 | −0.898 | 1.286 | 34 | −0.010 |
| | | Parietal | 0.111 | 1.546 | 0.143 | 1.565 | 34 | −0.776 |
| | | Frontal | −1.167 | 1.094 | −1.066 | 1.835 | 34 | −0.420 |
| | N100 | Central | −1.250 | 1.064 | −1.204 | 1.378 | 34 | −0.222 |
| Experienced | | Parietal | −0.257 | 1.601 | −0.421 | 1.767 | 34 | 0.703 |
| | | Frontal | −0.531 | 1.191 | −0.200 | 1.875 | 34 | −1.025 |
| | N400 | Central | −0.684 | 1.177 | −0.353 | 1.633 | 34 | −1.523 |
| | | Parietal | −0.132 | 1.143 | −0.059 | 1.634 | 34 | −0.504 |

$^{*}p < .05$ $^{**}p < .01$.

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