Understanding Online Produce Cue Effects on Consumer Behavior: Evidence from EEG Data

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Abstract

The more information the linguistic symbol can convey, the better the effectiveness of communication will be. Thus, this study strived to explore the dissimilar use of product information cues in product evaluations of online shopping sites. We conducted different experiments with three product cues: country of origin, ranking, and sales. In addition, an electrophysiological monitoring method was used to measure neurophysiological states while customers assess the diagnosticity of cue usage in decision making. The valid data collected from 160 customers provide strong support that different extrinsic cues can stimulate different emotional responses at specific sites. The insights from the findings can benefit designers and marketers in implementing more effective marketing strategies.

Keywords

EEG, cue utilization theory, cognitive processing, positive and negative emotions.

Introduction

In today's society, online shopping has become an indispensable part in people's daily life. According to Forrester Research, online sales will account for 17% of all US retail sales by 2022, up from a projected 12.7% in 2017 (Keyes, 2017). Moreover, global B2C e-commerce is expected to increase to $1.84 trillion in 2017, and global online retail is increasing rapidly with a forecasted growth rate of 17% in 2017 (NVC, 2017). Obviously, online shopping has become a prevalent part of the average consumer's shopping experience.

One of the disadvantages of online shopping is that consumers cannot directly touch or observe the products to learn about their function and content. Therefore, it is critical that online sites present products in a way that embodies all kinds of cues in order to facilitate consumers' decision-making (Cox, 1967). For example, consumers are able to locate their desired products within a short period of time if the shopping platform has the function to quickly filter information, compare both products and prices, and display the products in detail (Chen and Dubinsky, 2003). Easterbrook (1959) proposed cue utilization theory to further illustrate that the attention will be focused primarily on the arousing details (cues) of the stimulus, so that information central to the source of the emotional arousal will be encoded while peripheral details will not. Hence, this study adopts cue utilization theory to examine the effects of product-related cues on consumers' purchase decisions.

Behavior intention refers to an individual's response to stimulation from their external environment. From the perspective of the consumer market, it can be mainly interpreted as the behavioral tendency of the customer before purchasing a product (Dimoka et al., 2012; Blackwell, Miniard, and Engel, 2001). However, past online consumer behavior research (Peter, Olson and Grunert, 1999; Foxall, 2003) has focused on the impacts of explicit factors, which are perceptual, mainly measured by self-reported data,
generally overlooking implicit factors (Baxter Magolda, 2004), which are spontaneous, unconscious, and difficult for others to observe or individuals to express.

Past studies have indicated that electroencephalogram (EEG) signals can be used to determine implicit antecedents in behavior intention (Cook and Campbell, 1979; Berka et al., 2007). Electroencephalography measures the response of brain waves by placing devices with electrodes on subjects’ scalps and scanning the signals generated by these electrodes (Vokorokos et al., 2014). Zald and Pardo (2000) pointed out the possibility of understanding an individual’s invisible sense of smell and taste through the measurement of brain reactions. Wang et al. (2016) further demonstrated, through electroencephalography, that online information can make subjects aware of risk, which is one kind of implicit antecedent. Therefore, the purpose of this study is to use EEG to understand the impacts of consumer emotions on judgments, evaluations, and decisions when browsing online product information. The insights from the findings can benefit designers and marketers in implementing more effective marketing strategies.

**Theoretical Background**

**Cue Utilization Theory**

Media richness refers to the communication capability of the media within a given period of time (Daft et al., 1987). Communication media conducts communication with multiple cues, such as language variety, to improve customer satisfaction. Language variety refers the availability of data in multiple languages depending on the location and environment. The more information the linguistic symbol can convey, the better the effectiveness of communication will be.

Multiple cues mean that the data will provide a variety of information cues (including text, numbers and graphic symbols). According to the cue utilization theory by Easterbrook (1959), people tend to take into account the cues related to surroundings in addition to the direct cues of the product itself. Olson and Jacoby (1972) further explores the application of cues in the consumer field and puts forward that the cue of the product itself can be divided into intrinsic cue and extrinsic cue where intrinsic cue is used to describe the properties of the product (such as color, composition) and extrinsic cue is the additional attributes by people (such as price, evaluation). As it is impossible for the consumers to directly observe the intrinsic cues of packaged products, they tend to take advantage of the evaluation of explicit values (Wells, Parboteeah, and Valacich, 2011). Therefore, for the enhancement of the media communication ability, this study designed a shopping webpage available in different languages and containing different explicit product cues to explore the impact of consumer emotions on consumer purchase decision.

**Emotional frontal asymmetry**

EEG (electroencephalography) is a method of studying the response of the brain by scanning the signal of the electrode point carried on the scalp (Liberio, 2014). The discovery of electroencephalography (EEG) by Berger (1929) was a historical breakthrough providing a new neurologic and psychiatric diagnostic tool at the time. Berger further stated that epileptic seizures had an abnormal EEG signature, and that between the seizures (interictal) there were also transient epileptiform abnormalities not seen in controls (Gloor, 1969). Moreover, the brain’s cerebral cortex is the outermost layer that gives the brain its characteristic wrinkly appearance. The cerebral cortex is divided lengthways into two cerebral hemispheres connected by the corpus callosum. Traditionally, each of the hemispheres has been divided into four lobes (Gazzaniga, 2008): frontal, parietal, temporal, and occipital, in which frontal lobe is responsible for the implementation of the brain, language formation, and the control of autonomy.

Davidson and Fox (1989) proposed an emotional prefrontal asymmetry hypothesis, which suggests that the brain stimulates positive and negative emotional responses at specific sites. They measured using the brain wave instrument β wave (13-30Hz). Davidson et al. (1990) further design experiments showed that the subjects are watching the positive content of the film, the right frontal lobe is more active than the left during negative emotions; the other hand, the right frontal lobe less than the left, which means the generation of positive emotions. Based on the above, this study analyzed the customer’s left and right prefrontal β-wave data to explore the customer to watch a variety of online product information clues on the impact of emotions.
Research Methodology

Framework of Online Extrinsic Cue Design

Generally, consumers tend to make their decision based on three to five product attributes rather than all information (Olson and Jacoby, 1972; Brady et al., 2005). Therefore, this study chose three extrinsic product cues to explore the cognitive decision-making of customer. Firstly, we regarded ranking and sales as the first two dimensions of the extrinsic product cues based on Wang et al., (2016) and divided them into High Ranking (HR) / Low Ranking (LR) and High Sales (HS) / Low Sales (LS). Next, according to the concept of Country of Origin Effects (COO) by Ahmed and Machold (2004), we took language as the third dimension of the extrinsic product cue to explore the difference between countries of origin images with different languages. After making the product information on the webpage available in simplified Chinese and English, we further divided the two shopping websites respectively into four situations of external cues: HR / HS, HR / LS, LR / HS, and LR / LS. The four situations with three dimensions were thereby designed in order to explore the impact of factors on the consumer cognitive processing under stimulation of different information cues of certain product as well as their impact on the enhancement of purchase desire.

Table 1 lists the demographic information of the respondents.

<table>
<thead>
<tr>
<th>Variable</th>
<th>HR-HS (N=39)</th>
<th>LR-HS(N=38)</th>
<th>LR-HS(N=38)</th>
<th>Total(N=160)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>27</td>
<td>31</td>
<td>30</td>
<td>119</td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>8</td>
<td>8</td>
<td>41</td>
</tr>
</tbody>
</table>

Table 1. Demographic profile of respondents.

Data Analysis

In this study, EEGLAB was used to compare the brain waves, and the position was determined and matched. This study found that subjects watched the page, β wave (13-30Hz) are concentrated in the brain prefrontal position. Figure 1 is the average power graph of the beta-wave distribution of the brain while the subjects received different language websites. We can realize the cue effects of four different scenarios on the average power.

In Figure 1, gray lines are as right-brain waves, and black lines are as left-brain waves. If the gray line is higher than the black line, the subjects’ emotions are inclined to be negative. On the contrary, they have more positive emotion. The results show that in the high ranking/high sales, high ranking/low sales and low ranking/ high sales, the subjects on the simplified website are inclined to have more negative emotions. Besides, only in the low ranking/low sales, the subjects on the English site are inclined to have more negative emotions.

Conclusion

This paper reports the preliminary findings of the experiment design using four different kinds of shopping websites and two extrinsic cues—ranking and sales—to explore the effects of implicit variables, explicit variables, and cognitive processing on consumer impulsive purchase intention. The valid data collected from 160 customers provide strong support for the research model. A fair comparison of four research models was presented, and the key conclusions were:

First, consumers are simultaneously exposed to multiple extrinsic cues, and they usually process each product cue in relation the others. We designed the measurement of two different cues (sales and ranking) with high- or low-scope in order to test the positive or negative inferences evoked by the high- or low-scope cues. Second, past research has typically only used explicit antecedents to design measurement. This study uses explicit as well as implicit antecedents, combining EEG data and questionnaire data to explore the explicit and implicit antecedents of cognitive processing and their effects on online impulse purchase intention. This provides a more holistic explanation of consumers’ cognitive processing than using explicit antecedents alone. Third, we used eye movement (gaze) data in the measurement of cognitive processing. Eye movements are typically analyzed in terms of fixations and saccades. We used these data to support implicit engagement effect on cognitive processing.
Figure 1. Spectral analysis results for different language sites.

REFERENCES


