



Impact of Online Evaluation and Sales on Consumer Online Shopping Behavior based on Brain evoked potential

Tiantian Tang, Pei Hu

ABSTRACT

In order to solve the problem of information asymmetry between online consumers and sellers, and help consumers gain more clues as the decision basis for online shopping, this study selects two variables of assessment and sales volumes. Event-related potential method (ERP) is utilized to study the process and cognitive mechanism of consumers' brain activities under the influence of assessment and sales volumes. The study indicates that the above two clues may invoke consumers' brain potential. Behavioral data, obtained by ERP experiment, demonstrates main effects and interaction between assessment and sales volumes. Computer data indicates the categorization of four combinations between assessment and sales volumes. Hence, the research results verify the cue utilization theory, and provide effective explanation on inconsistency in the theory of cue consistency.

Key Words: Event-related Potential, Online Shopping, Behavioral Influence

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Introduction

Online shopping offers a special decision-making environment for consumers. It mainly lies in the information asymmetry and unfamiliarity between consumers and sellers of online shopping and transaction. Consumers are separated from products in terms of time and space. In the online shopping environment, information asymmetry is more prominent between buyers and sellers. As a result, it is difficult for consumers to correctly assess the product quality. Consumers can't directly touch or feel the products, so they have to rely on relevant external cues, presented by online stores, to assess the product quality and make purchase decision (Besson *et al.*, 2004). Most online stores are relatively small. Information asymmetry and unfamiliarity are rather significant between consumers and online stores. It prevents excellent online stores to demonstrate

their advantages, and makes it difficult for consumers to select high-quality products (Hsieh *et al.*, 2004).

Internet is providing an increasing amount of production information. In order to increase the efficiency of information processing and reduce efforts of cognition, online consumers tend to make decisions through the heuristic approach (Stroux *et al.*, 2004). According to the cue utilization theory, products offer a series of cues, and consumers use them to assess product quality (Zawiszewski *et al.*, 2004). The cues can be divided into internal cues and external cues. Internal cues are intrinsic to products. External cues are related to products, but they can be changed. In the online environment, consumers cannot directly observe internal cues, so they have to rely on external cues to assess product quality (Ruiz-Blondet *et al.*, 2004). Cue utilization theory was widely applied in traditional

Corresponding author: Tiantian Tang

Address: School of Economics and Management, Southwest Jiaotong University, Sichuan 610000, China

e-mail ✉ TianT28930@126.com

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marketing. In recent years, it was also used in electronic commerce. Different types of external information and cues may influence consumers' purchasing desires and perceptions on product quality, such as sellers' reputation, guarantee, the third party certification, website quality, product presence and comments, which have been identified (Guth *et al.*, 2004).

Cue consistency theory predicts the concurrence of different cues. Consumers make combined utilization of these cues during the process of assessing and decision making. To be more specific, according to cue consistency theory, when multiple information sources simultaneously occur in mutual corroboration, consumers tend to assess the information based on information integration models, such as linear average. In other words, when multiple consistent cues occur simultaneously, each cue will get more attention and weight from consumers' comments. If cues are inconsistent, negative or weak cues may dominate consumers' comments (Lagroix *et al.*, 2004). As for online stores, cues are important basis for consumers to make online shopping decisions. Researches on the cues of online stores are of great significance for us to understand the behavior patterns of online consumers, in order to propose useful suggestions on the online stores operation and online shopping (Nandrajog *et al.*, 2004).

Table 1. ERP (event-related potential) contents

Item	Instructions
Type 2	Near-field potential.
Purpose	Initiate participants' participation in the cognitive process.
Component	External components, internal components, and intermediate components.
Data	Scalp distribution, polarity and latency.

(Van *et al.*, 2014). (György, 2004)

Cue utilization theory has been widely adopted in research on consumers' online behaviors. But comments and sales volumes are seldom combined by researchers in research. The mechanism of their common influence remains to be tested (Vignapiano *et al.*, 2004). In addition, traditional approaches are used in current studies on online shopping environment. Cognitive neuroscience approach can help better understand the influence and internal mechanism of online stores and cues for consumers' behaviors (Macleod *et al.*, 2004). Therefore, the research adopts the Cognitive neuroscience approach (ERP, Event-related potential Method). Based on the background of online stores, it

studies the interaction between product reviews and sales volumes, as well as the internal mechanism of consumers' decisions. Table 1 shows the main contents of ERP method.

Methods

Subjects

The study released the information on recruiting subjects for ERP experiment on a university forum. 19 college students were recruited as the subjects. Their average age was 23.58 (22~25). They all volunteered for the experiment, and have signed the consent forms. All subjects are right-handed without psychiatric history. They also have normal eyesight or corrected eyesight. Due to staying up late one day before the experiment, two subjects couldn't focus attention during the experiment. Data were deleted. All subjects have experience in online shopping.

Experimental Materials

As for auxiliary materials, an simulated e-commerce website was set up in order to make the subjects fin in the context and to obtain data that is closer to that of their daily online shopping. As for ERP experiment materials, the experiment includes 320 decisions (each combination of the comment and the sales volume will appear 80 times. Different decision-making scenarios occur at random). Every decision contains three pictures of stimulation. It starts with the cross in the center of the screen (lasting for 1000ms) followed by the number of the headset at random (lasting for 1000ms). In the end, the corresponding comments and sales volume show up simultaneously (the maximum period of presentation is 3000ms, or it ends with the subjects' decision to purchase or not purchase). In order to offset the possible influence of reading orders (people tend to read from up to down), among one half of stimulation pictures, comments are placed above sales volumes. As for the other half of stimulation pictures, sale volumes are placed above comments. The research collects 320 earphone pictures from the e-commerce website, and numbers the pictures from 001 to 320. These numbers represent different earphones in the ERP experiment. Corresponding earphone pictures don't show up in ERP experiment.

The ERP laboratory is insulated from sound and magnetism. Subjects sit on the sofa by themselves. They conduct operation tasks on the 19-inch flat screen monitor. The experiment uses



64-conductor Ag/AgCl electrode caps, shown in Fig.1. Impedance is maintained below 10KD. The two electrodes at the upper and lower part of the left eye socket record the vertical EOG. The two electrodes besides the eyes record the horizontal EOG. Reference electrode utilizes the left mastoid. The grounding electrode is in the midpoint between FCZ and FZ.



Figure 1. 64-lead Ag/AgCl cap

Experimental Procedures

First, rectify the data of brain evoked potential and eliminate brain waves that are disturbed by muscle movement and other factors. Second, extract 1000ms epoch before and after the emergence of the stimulation, that is, 200ms before the stimulation and 800ms after it (-200~800ms). Therefore, -200ms to 0 was used as the pre-stimulus baseline to rectify the brain evoked potential. Epochs whose wave deviation exceeds 809V were eliminated. The average elimination rate of the experimental data was no more than 5%. Third, the low frequency channel of 12Hz (24dB, Octave) was used to filter the epochs. Finally, the baseline was again used to rectify the epochs. The brain evoked potentials under four kinds of stimuli were the averaged. The tested ERP data was then divided into 4 groups according to the stimuli, which correspond to scenario 1, 2, 3 and 4. The ERP data was finally classified and averaged to obtain the overall average ERP categorical data.

This study is based on the theory of clue utilization and the theory of clue consistency, and focuses on evaluation and sales, which are important online information. Specifically, the study used 2 (high evaluation VS. low evaluation) x2 (high sales VS. low sales) within-subject design. 4 scenarios are presented to the subjects as shown in Table 2: scenario 1 (high evaluation &

high sales), scenario 2 (high evaluation & low sales), scenario 3 (low evaluation & high sales) and scenario 4 (low evaluation & low sales).

Table 2. Four scenarios in experimental design

Situation	SS
Situation 1	HR&HS: High Evaluation High Sales
Situation 2	HR&LS: High Evaluation Low Sales
Situation 3	LR&HS: Low Evaluation High Sales
Situation 4	LR&LS: Low Evaluation Low Sales

Results and Discussion

Results of Behavioral Data

During the experiment, when the stimulating material containing earphone product evaluation and sales information appeared, subjects press the left button indicating that they would not buy it while press the right to buy. Table 1 shows the proportion of the participants' decisions on purchase or not to purchase the product as well as the average reaction time. HR stands for high evaluation; LR stands for low evaluation; HS stands for high sales; LS represents low sales. Purchase rate is the proportion of the purchase decisions to all effective decisions. The experimental results, the average purchase rate of the subjects in the four scenarios, are shown in Figure 2. The average response time of the subjects in the four scenarios is shown in Figure 3, and the variance of the response time is shown in Figure 4. The results of the behavioral data show that when the sales and the evaluation are both high, subjects tend to make a purchase decision. In scenario 1(HR&HS), the purchase rate exceeds 90%. When both the evaluation and the sales volume are low, the purchase rate tends close to 0. The variance analysis of the 2x2 within-subject repeated measurements in the evaluation and the sales volume shows that the main effect of evaluation and sales on the purchase rate is significant. The interaction effect of evaluation and sales volume on the rate of purchase is also significant.

In addition, the longer response time in scenario 2 may be due to the need for additional decision-making time under this scenario (HR&LS), indicating the extra effort made by the subject when both of the choices are fine. At the same time, the paired comparison showed that the average decision time needed by the subjects in scenario 4 was significantly lower than that of scenario 1, 2, and 3. Since the subjects do not want to purchase the earphones in scenario 4 (LR&LS), they can make "no purchase" decision without much consideration, therefore, the

response time of scenario 4 is shorter than that of other scenarios.

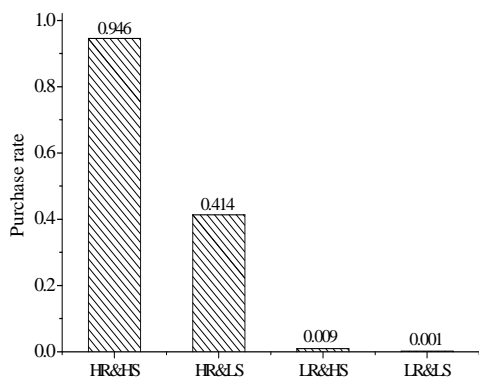


Figure 2. The average purchase rate of the subjects in the four experimental scenarios

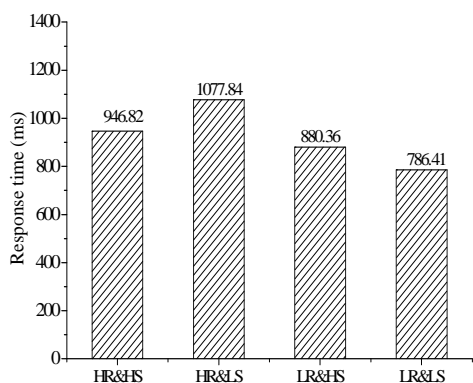


Figure 3. Response time of subjects in four experimental scenarios

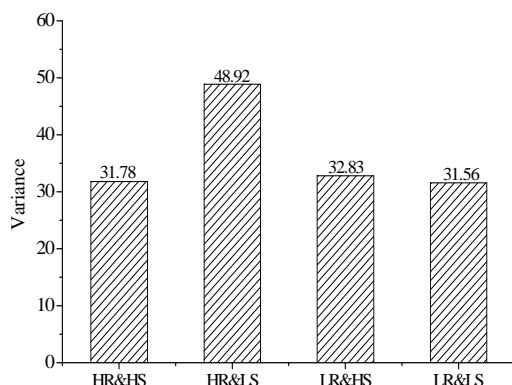


Figure 4. Variance of response time of subjects in four experimental scenarios

Results of ERP

According to the brain map obtained in this experiment, and take a reference to the existing literatures analyzing the choice of electrodes with P2, N2, N400 and LPP, this paper selects FZ, F3 and F4 in the forehead, and CZ, C3, C4 in the occipital region to analyze the ERP data. Appendix 5 is the electroencephalogram of the electrodes and the 9 electrode points studied in this paper are marked out.

The experiment revealed the time process of consumers' brain activity when shopping online. The study tends to explain the significant differences between the amplitudes of scenario 1 and scenario 4P2 from the perspective of attention resources. In the very early cognitive stage, about 220-260 milliseconds (P2) after the emergence of stimulus material, scenario 4 (low evaluation and low sales volume) was differentiated from scenario 1 (high evaluation and high sales volume). The smaller P2 amplitude corresponds to less attention resources, and the P2 amplitude of the subject in the scenario 4 (low evaluation & low sales) was significantly smaller than that in scenario 1 (high evaluation & high volume), showing that subjects in scenario with low evaluation and sales volume pay much less attention compared with what they do in scenario with high evaluation and sales volume. By combining ERP data with behavioral data, a possible inference is that the subjects unconsciously differentiate the product with low evaluation and low sale volume in the early stage of cognition, and take no interest in those products.

Conclusions and Prospect

This ERP research method provides more detailed evidence and explanation of cognitive neural process, and proves that in the specific stage of decision making (LPP), the input of subjects' attention resources is indeed consistent with the prediction of cue theory. This shows that the cognitive process of the subjects is accurate to the millisecond stage, deepening the understanding of the clue conformance theory. ERP results show that the classification process of different combinations of information clues may evoke brain potentials including P2, N2, N400 and LPP, whose amplitudes reflect the response time of consumers in making decisions when online shopping and that different scenarios are distinguished in different stages of cognition.

To sum up, evaluation and sales volume are important information cues in online



shopping. Evaluation affects consumers' purchase intention by influencing perceived risk and benefit of online consumers, and sales volume influences purchase intention by influencing perceived benefits of online consumers. The influence of evaluation and sales volume on the cognitive activity and decision-making of online consumers is reflected in components brain evoked potentials. It shows that there are significant differences in the amplitudes of the components when the clues have different valence. In the future studies, researches can be carried out according to the study on the evaluation and sales cues. Other clues, such as reputation, price, the third party certification mark, can be taken into consideration. Researches on the common effects of these clues can contribute to the theoretical framework of the interaction of multiple information clues.

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