

Low-Order Webpage Layout in Online Shopping Facilitates Purchase Decisions: Evidence from Event-Related Potentials

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Introduction: In online shopping, the webpage layout plays an important part in the consumer's experience. The present study aims to investigate whether the webpage order and which order level (high order vs low order) facilitate consumers' instant purchase decisions for products.

Methods: Fourteen right-handed healthy undergraduates and graduate students participated in the experiment as paid participants. In the experiment, participants were presented with daily products in different online shopping webpages (high-order vs low-order) and reported their purchase intentions between purchase and not purchase. Meanwhile, Electroencephalogram (EEG) was recorded from the participants throughout the experiment. In the analysis process, two event-related potentials (ERP) components, P2 and late positive potential (LPP) were mainly focused to examine the cognitive mechanism underlying the purchase decisions.

Results: The behavioral data found that the low-order shopping webpage facilitated participants' purchase intentions compared with the high-order one. Neurophysiologically, increased P2 amplitudes and increased LPP amplitudes were revealed for the low-order webpage compared to the high-order webpage. The P2 indicates the early stage of attention engagement and discordant perception, while the LPP can be taken as a reflection of the late stage of the emotional self-control process.

Conclusion: These results provided evidence that webpage order influenced people's purchase decisions. Low-order webpage design invoked more attention engagement and discordant perception and consumed more self-control resources than the high-order webpage design, which contributed to the higher purchase intentions.

Keywords: online shopping, webpage order, purchase decisions, event-related potentials, P2, LPP

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Introduction

Instant purchase, which is defined as “a sudden, often powerful and persistent urge to buy something immediately”, plays a major part in marketing management especially in the context of supermarkets and online shopping sites.^{1,2} Given its importance, a substantial body of research has investigated the influencing factors of intention to purchase. The shopping environment has been identified as a crucial factor influencing consumers' instant buying tendencies and behaviors. For example, Youn and Faber (2000) indicated that instant buying could be significantly influenced by environmental factors such as atmospheric cues in a retail setting, marketer-controlled cues, and marketing mix stimuli.³ Parsad et al (2018) demonstrated that the retail shopping

environment (e.g., display of the goods, crowd inside the store) considerably influenced consumers' instant buying tendency.⁴ This environmental effect on instant buying did not appear only in the physical store. In fact, the online shopping environment, which transcends time and space plays a more important role in instant buying. For example, Adelaar et al (2003) proposed a theoretical model that demonstrated that the online shopping environment could trigger consumers' emotional responses and then predict consumers' behavioral responses to instant buying.⁵ Akram et al (2018) showed that website quality in an online shopping environment positively affected consumers' instant purchase behavior.⁶

In the online shopping environment, two main dimensions—webpage order and webpage complexity—are strong determinants of users' perceptions and satisfaction.^{7–10} The webpage's order is related to the logical organization, coherence, and clarity of the webpage's content and layout.^{8,9,11} Generally, people believe that an orderly arranged environment can promote a positive emotional perception.¹² Meanwhile, consumers' emotional responses are positively related to their purchase intentions.^{5,13} Thus, it is hypothesized that the higher the order of the online shopping site's layout is, the greater the purchase rates.

However, other researchers have shown that a visually disorder or uncertain environment might yield negative emotional perceptions (e.g. threatening sense) and diminish the user experience.^{14,15} When people attempt to modulate a negative emotion or suppress an emotional expression, many self-control resources are occupied, leading to reductions in self-control capacity.^{16–18} Self-control resources are general (cognition control, emotion regulation, etc.) but finite.^{16,19} Self-control capacity is defined as one's ability to manipulate one's emotions and behaviors using self-control resources.^{2,20} Many researchers have found that a decrease in self-control resources and capacity tends to be accompanied by instant buying.^{16,19,21,22} Fenton-O'Creevy et al (2018) suggested that people's instant buying could be understood as a failure of self-control in relation to long-term goals and as a strategy for emotional regulation.²¹ Efendi et al (2019) also showed that consumers' self-control had a negative and significant influence on their purchase decisions, and good self-control would reduce consumptive behavior.²² Based on this perspective, a low-order webpage layout might also trigger buying tendencies that would facilitate purchase decisions.

Whether a high- or low-order layout of an online shopping webpage evokes higher purchase rates remains

controversial. Therefore, to solve this issue, this study explores the underlying cognitive mechanism by which webpage layout design affects consumers' purchase decisions. We adopt the measurement of event-related potentials (ERP), a noninvasive neuroscience technology that can directly detect people's brain cognitive activity underlying their behaviors.²³ ERP is the electrophysiological activity from the brain scalp in response to stimulus, reflecting the summed activation of excitatory postsynaptic potential and inhibitory postsynaptic potential elicited by a stimulus.^{24,25} Meanwhile, ERP has an excellent temporal resolution in milliseconds that it can record the cognitive activity during behavior and decision-making process in real time, which cannot be obtained by traditional consumer research methods.²⁶ Thus, in our study, examining subjects' brain activity while they perform purchase tasks under different webpage order stimuli can help deeply understand how people evaluate webpage order stimuli and make purchase decisions during the cognition process. Based on prior researches on stimulus evaluation and decision-making, two important components (P2 and Late positive potential (LPP)) were focused on in the present study.

Literature Review

P2, an ERP component, is a positive potential that peaks approximately 200 ms after stimulus presentation.^{27,28} Numerous studies indicate that the P2 reflects the rapid automatic activity of attention capture.^{27,29–31} For example, Carretié et al (2001) found that P2, which is related to attention engagement, demonstrated larger amplitudes in response to negative stimuli than in response to positive stimuli.²⁹ Upon exposure to warning signal words, P2 reflects the attentional negativity bias to detect the hazard of warning signal words.²⁷ Wang et al (2019) showed that negative emotion-label words (e.g., angry) and negative emotion-laden words (e.g., selfish) could elicit larger P2 components than did neutral words (e.g., natural) in a lexical decision task.³¹ In these studies, the enhanced P2 amplitude suggested an attentional bias to emotionally negative stimuli.

Moreover, recent evidence has shown that P2 is related to the cognitive activity of incongruent judgment.^{32–35} For example, when presenting subjects with a target that was either congruent or incongruent with the semantic category of items, Freunberger et al (2007) found that P2 demonstrated top-down semantic regulation with larger amplitudes for incongruent targets compared with congruent

ones.³² In the research of Zioga et al (2019), a larger P2 component was response to incorrect notes than correct notes, which reflected the information processing of incorrect associated with learning.³³ A semantic deductive experiment by Lei et al (2010) showed a greater P2 for the atypical members of target semantic categories than the typical members, which was involved in the early detection of category classification.³⁴ Ma et al (2014), using a prime–probe paradigm to investigate brand extensions, demonstrated that P2 was sensitive to early low-level and similarity-based evaluation.³⁵ In the current study, we hypothesized that a low-order webpage was more likely to induce negative emotions and appear atypical, which might attract more attentional resources and incongruent judgment demands compared to a high-order webpage, as reflected by a larger P2 amplitude.

In addition to P2, LPP reflects the later stage of the stimulus evaluation. LPP mainly reaches its maximum amplitude between 300 and 800 ms after stimulus presentation.^{36,37} A line of evidence has shown that LPP is sensitive to the cognitive process of emotion regulation.^{38–42} In an experiment by Huang and Luo (2006),³⁸ negative pictures were found to elicit a higher LPP component compared to positive and neutral pictures, thus suggesting a negative bias of cognitive regulation resources in the later evaluation activity. Dennis and Hajcak (2009) showed that LPP was larger in the condition of unpleasant picture-negative interpretation than in the condition of unpleasant picture-neutral interpretation, suggesting that LPP represents a neural marker for emotional regulation and mood disruption.³⁹ When subjects were required to increase versus decrease their emotional response to an unpleasant picture, a larger LPP magnitude was observed, thus reflecting a self-regulation process of emotional stimuli.⁴⁰ In an affective-cueing experiment consisting of cues (red squares and blue circles) signaling the likely valence of following target images (negative or neutral), Brudner et al (2018) revealed increased LPP responses to negative than neutral cues and cued targets.⁴¹ Moreover, Dunning and Hajcak (2009) implied that LPP was a useful tool in identifying similarities and differences across emotional regulation strategies.⁴² Thus, given the functional sensitivity of LPP, we proposed that LPP represented an emotional regulation process for the stimulus materials in the later evaluation stage. We predicted that the LPP amplitude might be larger for the low-order webpage than for the high-order one, suggesting a higher occupation of emotion-regulation resources.

In the current study, we used ERP to explore the underlying cognitive mechanism of how webpage order in online

shopping affects consumers' purchase decisions. The participants were presented with daily products in a webpage environment with different order levels and instructed to evaluate their purchase decisions. We tested the following two presumptions: (1) a low-order webpage increases people's purchase decision, and (2) this underlying cognitive mechanism of a low-order webpage is reflected in two stages: P2 (occupying more attention resources and discordant perception) and LPP (emotional self-control resource allocation).

Methods

Participants

A total of fourteen right-handed, 19- to 23-year-old healthy undergraduates and graduate students (8 females) from university voluntarily participated in our experiment as paid participants (see Table 1). One participant's data were excluded because of many invalid trials. All participants were native Chinese speakers, had normal or corrected-to-normal vision, and did not report a history of having a neurological disorder or mental disease. All participants signed informed consent to participate in the study. Experiments were conducted according to the guidelines of the institutional ethics committee of the Zhejiang University Neuromanagement Lab, which approved all experimental protocols.

Experimental Stimuli

A total of 35 daily products worth approximately ¥30 (approximately \$5) selected from the famous Taobao Marketplace (<http://www.taobao.com/>) were adopted in our experiment. These products were separately placed into two groups of online shopping webpages as the target stimuli. One group was the high-order webpage layout (the contextual information in the online shopping site was arranged in an orderly layout like that normally used in online shopping; i.e., all labels and buttons were arranged in an orderly manner in a two-end alignment format, while the other group was the low-order one (the online shopping site was designed in a low-order layout; i.e., most of the labels and buttons were staggered and were neither horizontally nor

Table 1 Description of Experimental Participants

Participants Sex	Number	Age Range (Year)	Mean Age (Year) M±SD	
Female	8	19–23	21.25±1.30	21.28±1.39
Male	6	19–23	21.33±1.49	

vertically aligned. All stimuli were displayed as visual pictures on a 19-inch computer monitor (1280×1024 pixels), and the size of each picture was 300×400 pixels.

Before the formal experiment, we performed a pretest with 7-point items to evaluate the order level (1, very disordered, and 7, very orderly) of the stimuli and collected 91 valid data (see [Appendix 1](#)). Statistical analysis using the *t*-test revealed a main effect of order level between the high-order group ($M=5.52$, $SE=0.02$) and the low-order group ($M=2.99$, $SE=0.01$) [$t_{(90)}=100.84$, $p=0.00$ ($p<0.01$)] (see [Appendix 2](#)).

Experimental Procedure

The entire experiment included 70 trials, which were divided into two blocks. The participants were seated 90 cm from a controlled computer that was used to display the experimental stimuli. The stimuli were presented using the Stim2 system (Neurosoft Labs, Inc., Sterling, VA, USA). During the presentation, purchase intention was required to report by using a keypad (press button “1” or “3” to purchase or not purchase). The response-to-hand assignments were counterbalanced across individuals; i.e., half of the participants were required to press “1” for “purchase” and “3” for “not purchase”, while the opposite pattern was used for the other half of the participants.

Before the experiment, the participants were told that they were going to be taking part in an online shopping experience and that they had no preplanned products to buy. Each trial (see [Figure 1](#)) started with a fixation cross (500 ms) in the center of the screen, which was followed by a target stimulus. The target stimulus could be either a high-order condition or a low-order condition and appeared for

1000 ms. To prevent the subjects from predicting the type of upcoming stimulus, all stimuli appeared randomly. For each target stimulus, the participant was instructed to make a decision on whether they would buy the product. They had a maximum of 2000 ms (including the time of target presentation and interval between trials) to give their response by pressing a button. The sequential stimuli were separated by blank screens that lasted for 400–600 ms. We balanced the assignment of the response hand across participants to eliminate the interference of this parameter. The formal experiment began after 10 separate test trials, which were provided to allow the participants to practice and become familiar with the experimental procedure.

EEG Recordings and Analyses

EEG was recorded continuously using a set of 64 Ag/AgCl electrodes according to the 10–20 system. The EEGs were sampled at 500 Hz with a 0.05–100-Hz bandpass using a Neuroscan Synamp2 Amplifier (Scan 4.3.1, Neurosoft Labs, Inc. Virginia, USA). The left mastoid was used as the reference during recording, and later the average of the two mastoids was calculated as the off-line reference. To monitor the electrooculograms (EOGs), two pairs of electrodes were separately placed above and below the left eye and the external canthi of both eyes. The electrode impedances were kept below $5k\Omega$.

During off-line processing, the EEG recordings were segmented for the epoch between -200 and 800 ms of stimulus onset. Baseline correction was conducted using the pre-stimulus of 200 ms as the baseline (i.e., subtracting the voltage measured during the pre-stimulus window). Ocular artifacts (such as eye blinks, eye movements)

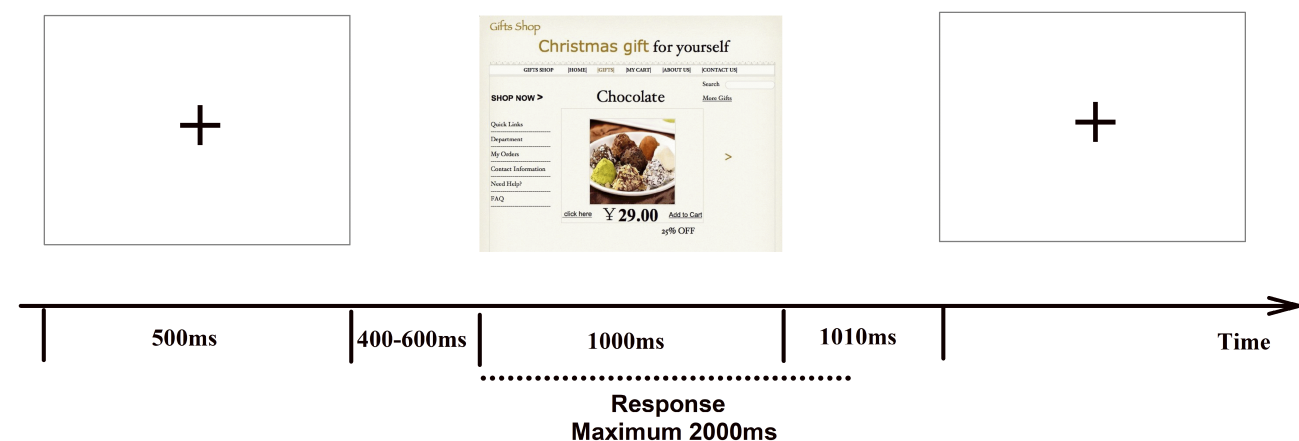


Figure 1 Experimental procedure. The subjects were presented with two types of webpage order [high order and low order]. They were instructed to report their purchase intentions. During the experiment, EEGs were simultaneously recorded.

were excluded from the NeuroScan software's regression-based algorithm. Other artifacts (such as amplifier clipping, bursts of electromyographic activity or peak-to-peak deflections exceeding 80 μV) were excluded from averaging. The ERP was digitally filtered with a low-pass filter at 30 Hz (24 dB/Octave). The data were averaged separately in both conditions (high order and low order).

According to previous ERP studies^{32,34,41,43} and the topographic map, we chose 14 representative electrodes (CP3, CPZ, CP4, P3, PZ, P4, PO7, PO3, POZ, PO4, PO8, O1, OZ and O2) in the statistical analysis of P2 and 6 representative electrodes (C3, CZ, C4, CP3, CPZ and CP4) to analyze LPP. Time windows of 150–250 ms and 580–800 ms were selected to average P2 and LPP, respectively. ANOVA was performed with two factors: webpage order (high order vs low order) and the electrodes. The Greenhouse–Geisser correction and Bonferroni correction were applied when necessary. The effect sizes were measured by both partial eta squared (η^2) and Hedges' g . Previous studies indicated that the effect size measured via η^2 of 0.01, 0.06, and 0.14 reflected small, medium, and large effects, respectively.^{44,45} For studies in social psychology, Hedges' g s of 0.15, 0.40, and 0.70 were recommended as small, medium, and large effects, respectively.^{46,47}

Results

Behavioral results

In the present study, we conducted statistical analyses of participants' purchase rates (PR) and reaction times. PR is defined as the ratio of purchase trials to total decision trials, and the reaction time indicates the time interval between stimuli presentation and the purchase response. PRs for different levels of webpage order (high order vs low order) were analyzed with a paired t -test. PR showed a main effect of webpage order [$t_{(12)} = -2.27, p=0.043$]. The PR was larger in the low-order condition ($M=0.33, SE=0.05$) than in the high-order ($M=0.31, SE=0.05$). For the response time, the paired- t test found no significant difference between the high-order condition ($M=703.28$ ms, $SE=44.56$) and the low-order conditions ($M=702.58$ ms, $SE=40.62$) [$t_{(12)} = 0.07, p=0.943$]. (see [Appendix 2](#)).

ERP Results

P2 Amplitude

The total average ERP for the two order levels of webpage layout (high order vs low order) are shown in [Figure 2](#). The within-subject ANOVAs of P2 amplitude with two factors (webpage order and electrode) revealed a main effect of webpage order [$F_{(1,12)} = 13.22, p = 0.003$ ($p < 0.01$), partial

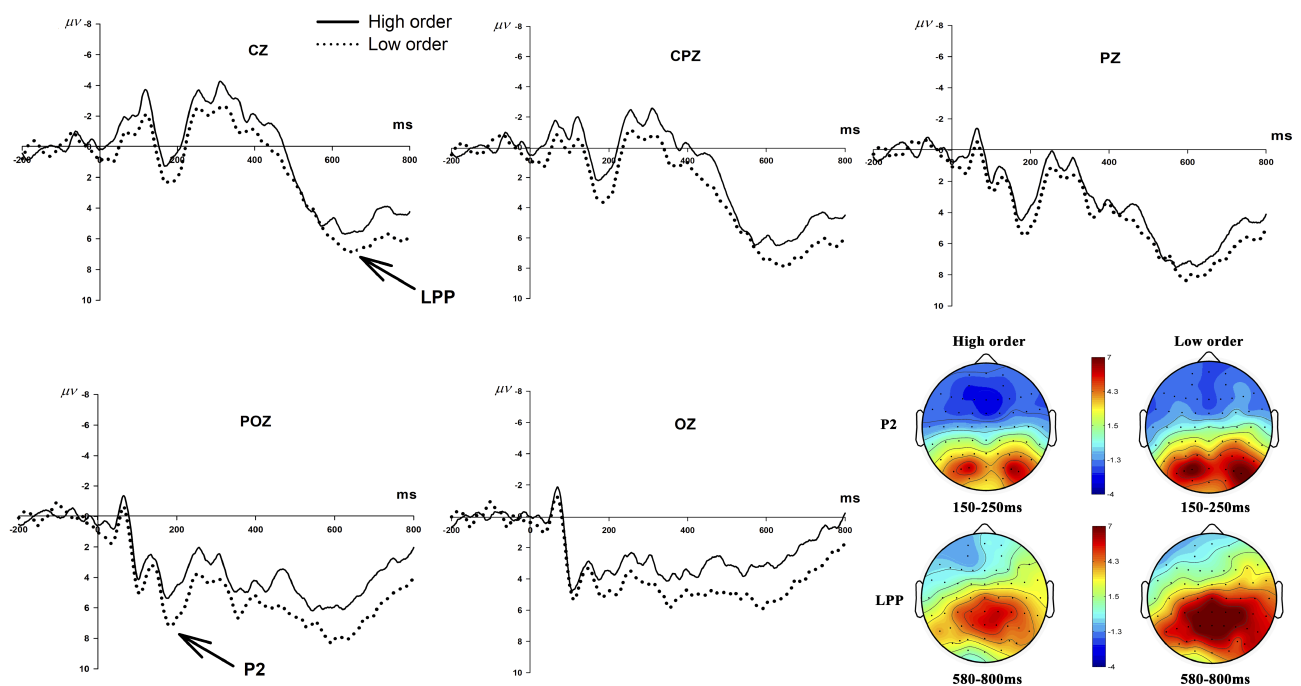


Figure 2 ERP data. Total averaged P2 and LPP evoked by the two webpage orders [high order and low order] from typical electrodes [CZ, CPZ, PZ, POZ and OZ]. The scalp topographic distributions of the P2 and LPP were provided.

eta squared (η^2) = 0.52] and of electrode [$F_{(13,156)} = 5.90$, $p = 0.000$ ($p < 0.01$), $\eta^2 = 0.33$], which showed a large effect size of η^2 . The low-order condition ($M = 4.92 \mu\text{v}$, $SE = 0.66$) showed a higher P2 amplitude than the high-order condition ($M = 3.62 \mu\text{v}$, $SE = 0.73$), Hedge's g effect size = 0.51, which showed a medium effect size of Hedge's g . Webpage order was found to have no interaction effect with the electrode [$F_{(13,156)} = 1.07$, $p = 0.387$, $\eta^2 = 0.08$]. (see [Appendix 2](#)).

LPP Amplitude

The statistical results for the LPP amplitude for the two factors (webpage order and electrode) exhibited a significant main effect for webpage order [$F_{(1,12)} = 5.37$, $p = 0.039$, $\eta^2 = 0.31$, large effect size of η^2], indicating that LPP amplitude was higher for the low-order webpage ($M = 6.03$, $SE = 0.86$) than the high-order one ($M = 4.40$, $SE = 1.08$) [Hedge's g effect size = 0.46, medium effect size of Hedge's g]. The main effect of electrode was significant [$F_{(5,60)} = 8.98$, $p = 0.000$ ($p < 0.01$), $\eta^2 = 0.43$, large effect size of η^2]. The interaction effect between webpage order and electrode was not significant [$F_{(5,60)} = 0.43$, $p = 0.825$, $\eta^2 = 0.04$]. (see [Appendix 2](#)).

Discussion

By applying ERP, this study aimed to examine how a consumer's purchase decision was affected by the order of the webpage's layout in online shopping. The behavioral and the ERP results showed that the low-order layout could promote consumers' instant purchase during the decision-making process. Regarding the participants' behaviors, higher purchase intents were found for the low-order webpage compared to the high-order one. Moreover, the ERP results indicated that the P2 and LPP components were larger for the low-order webpage than for the high-order condition, thereby providing a cognitive mechanism for the facilitation effect of the low-order webpage on an instant purchase.

Behavioral and Cognitive Mechanism

The present study discovered a PR effect on the online shopping webpage order. In the low-order condition of the online shopping webpage, the participants showed a higher purchase rate than in the high-order condition. This finding might be attributed to the negative emotional perception and self-control mechanism. As described in the Introduction, a low-order environment might arouse negative emotional perceptions and worse user experiences.^{14,15} In the current study, when the products were presented in a low-order

online shopping webpage, people tended to have negative emotional perceptions and tried to use extensive self-control resources to regulate these emotions. Self-control resources are general resources (emotion regulation, cognition control, etc.) that people can employ to manage various situations, such as emotions, incongruencies or behaviors.¹⁹ However, self-control resources are finite. If one process consumes a large amount of self-control resources from the general resources pool, people are less able to engage in the further process of self-control.¹⁶ A substantial body of empirical researches supports this self-control theory. For example, Vohs & Heatherton (2000) demonstrated that when dieters expended too much self-control resources to resist the temptation of candy compared to the condition of no temptation, they showed less self-control ability to persist in a difficult puzzle task.⁴⁸ In a dual-task experiment, when participants were required to control their attention away from a series of words appearing on a computer screen, they were found to be more likely to engage in impulsive buying than participants in the condition of no attention-control.¹⁹ These findings indicated that a temporary reduction in self-control resources and capacity can result in impulsive purchases.^{16,19,21,22} Thus, consistent with these studies, our experiment suggests that a low-order online shopping webpage occupies much more self-control resources to regulate emotions, leading to higher instant purchase relative to the high-order condition. However, there are also some differences between this study and previous experimental researches.^{16,19} In those studies, participants were generally required to complete an explicit task that consumes self-control resources, and then evaluate their purchasing decisions. For example, in experiment 3 of Vohs and Faber (2007), the participants were told that they should smile and convey happiness and enthusiasm using amplified facial expressions and multiple hand gestures in a reading task, which was used to consume participants' self-control resources before performing a purchasing decision task.¹⁶ In contrast, in our experiment, the participants only needed to complete the purchase decision task in different environments of webpage order, therefore, the information processing of webpage order that consumed self-control resources was implicit rather than explicit. Thus, in addition to explicit tasks, our research found that implicit information processing can also consume self-control resources and promote purchase decisions.

In the cognitive process, the P2 component represents the early activity of attention capturing and incongruent judgment.^{27,29–32,34,35,49} As elaborated in the Introduction,

negative emotional stimuli (e.g., threat words, warning signal words, and negative pictures) seem to have the priority to attract more attentional resources, which could be reflected by the enhanced P2 amplitude.^{27,29} For instance, Carretié et al (2001) demonstrated that negative stimuli could induce a larger P2 amplitude compared to positive stimuli, which reflected increased attention engagement for negative stimuli.²⁹ Ma et al (2010) showed that high hazard of warning signal words attracted more attentional resources.²⁷ The attentional priority toward emotionally negative stimuli might be attributed to evolutionary theory, which indicates that people usually give priority to detecting negative stimuli for survival and self-protection.^{50–52} In this study, the ERP results found larger P2 amplitudes for the low-order online shopping webpage compared with the high-order one. The low-order webpage might induce a negative emotion perception and, consequently, increase attention engagement. Our findings suggested that even if the low-order webpage stimuli only implicitly evoke negative emotions, it could also lead to the negativity bias and increased attention-resource allocation at the early processing stage. It was supported by a recent study of Wang et al (2019), which showed that both negative emotion-laden words (implicitly express emotion, e.g., selfish) and negative emotion-label words (explicitly express emotion, e.g., angry) could elicit larger P2 components than did neutral words (e.g., natural) in a lexical decision task, reflecting attentional resource allocation.³¹ Moreover, previous studies have indicated that P2 is also involved in incongruent and atypical processing.^{32,34,35} Compared with a high-order online shopping webpage, processing the low-order layout must require a higher visual information integration demand. It is also supported by the previous study of Zioga et al (2019), in which P2 was linked to the neural activity of learning that involves much information processing resources.³³ Thus, in this study, we suggest that the P2 revealed the early stage of attention engagement and integration processing of discordant information in the cognitive process of online instant purchase.

Following P2, a late LPP component was discovered in the current experiment. Previous studies have indicated that the LPP component can be considered a neural marker for the emotional regulation process in the later evaluation stage.^{38–40,42} The present study showed that when people are presented with a product in a low-order online shopping webpage, they might perceive a negative emotion and try to recruit more cognitive resources to evaluate and

regulate these emotions. Emotional management plays an important role in survival and daily life.³⁸ Making rational decisions to achieve a specific goal requires people to call upon self-control capacity to manage emotions.^{18,19} In our experiment, in addition to the early automatic process of attention engagement and discordant perception (reflected by P2), a deeper and controlled process was also involved in negative emotion management. This process was reflected by the LPP component, with a larger LPP amplitude in the low-order condition relative to the high-order condition. In this stage, when people perceived negative emotions in the low-order online shopping webpage, they tended to invoke much more evaluation and control resources to manage these emotions because of their importance for survival. These findings are consistent with previous studies that have found that LPP is greater in response to negative stimuli than positive and neutral ones, thereby indicating a negative bias of emotion-regulation resources in the later evaluation stage.^{38–41} For instance, in an affective-cueing experiment by Brudner et al (2018), it revealed greater LPP responses to negative versus neutral cues and negatively cued versus neutrally cued target images, which reflected the emotional processing.⁴¹ However, there are also some differences between the present study and these previous studies. In the previous studies mentioned above,^{38–41} emotional pictures were generally used directly as stimuli that induced LPP components. In contrast, the stimuli in the current study were not explicitly emotional pictures but implicitly emotional stimuli of a webpage order environment that evoked emotions, which could also significantly induce LPP components for emotional processing. Therefore, in this study, we suggested that LPP involves the process of emotional evaluation and regulation and reflects an allocation bias of self-control resources toward different webpage orders in online shopping.

Theoretical and Practical Implication

The present study provides a new perspective on the impact of environment order in online shopping on an instant purchase. First, many people usually believed that a high-order designed environment in online shopping was more beneficial to consumers' buying experience. This belief was attributed to a positive emotional infection mechanism.⁵ That is, when products are placed in a high-order environment, they can elicit consumers' positive emotional perceptions¹² and thus promote their buying intent or behavior.^{5,13} However, a shortcoming of these

studies was that no research was carried out on the direct impact of webpage order factor on consumers' purchasing decisions. One part of previous researches explored the impact of webpage order on consumers' emotional experience, and the other part of researches showed that consumers' emotional experience could influence their purchase decisions. These studies could only provide indirect rather than direct evidence of the impact of webpage order on purchasing decisions. In contrast, the current study carried out an experimental research to explore the direct impact of the webpage order on consumers' purchasing decisions, which made up for the deficiency of previous researches. Moreover, in the present study, we demonstrated a totally different phenomenon in which the low-order shopping webpage showed an advantage over the high-order one in promoting consumers' instant purchase intent. We supposed that this effect was due to a negative emotion regulation mechanism. In the low-order shopping environment, consumers tended to perceive a negative emotion, consistent with the previous findings that a visually uncertain or disorder environment might cause negative emotional perceptions and diminish the user experience.^{14,15} For instance, Wu et al (2016) showed that the disorder of user interface significantly increased user's cognitive load and decreased their experience and satisfaction.¹⁴ Based on the importance of survival value, more self-control resources were occupied to regulate or suppress the negative emotional expression. However, this decrease in self-control resources resulted in consumers' instant purchase. Our findings are supported by previous research, indicating that people's self-control resources and capacities are limited and that depleting self-control via one response results in less self-control for another.^{17,18,20} Gailliot et al (2007) found that self-control resource could be reflected by blood glucose level, and the low level of blood glucose after an initial self-control task predicted poor control of subsequent thought and behavior.²⁰ Regarding the purchase decision-making process, a temporary reduction in self-control resources could also lead people to purchase more impulsively.^{19,21,22} In the experiments of Vhos and Faber (2003, 2007), it demonstrated that participants were more likely to be impulsive buyers, buying more items and spending more money when they were required to control their thought or behavior in an initial task.^{16,19} In contrast, good self-control would help reduce consumers' purchase intention that it could be used as a strategy to manage consumers' consumptive behaviors.^{2,22} Second, we found

the underlying cognitive mechanism of the purchase decision process using ERP method, which has not been studied in previous researches. In this study, ERP method revealed deep sources of consumers' behavior in the brain, which could not be obtained by traditional self-reporting methods. The participants' purchase decision was affected by the order factor in two stages: P2 and LPP. We found larger P2 and LPP amplitudes for the low-order webpage than for the high-order one. The P2 component reflects the early stage of attention engagement processing and discordant perception, and the LPP component reflects the late stage of self-control resource allocation. These neural indexes provided preliminary cognitive evidence for the facilitation effect of a low-order webpage on instant purchase.

This study also has practical implications for marketing. First, designing an effective webpage layout to promote consumers' purchase decisions is an important issue for online shopping. This study found that the low-order online shopping webpage designing compared to the high-order online shopping webpage designing promoted consumers' purchase rate during the decision-making process. We suggest that online marketers should pay more attention to the factor of webpage layout order and can use appropriate low-order webpage layout to facilitate consumers' purchase behavior. Second, using neuroscientific methods in the current study, we found that low-order webpage design invoked more attention engagement and discordant perception, and consumed more self-control resources than the high-order webpage design, which contributed to the higher purchase intentions. Therefore, we suggest that online marketers should focus on more factors that can attract attention, discordant perception and occupy self-regulating resources when designing the webpage.

Limitations and Future Directions

Our study has some limitations that need to be improved in future research. First, the current study mainly examined the effect of webpage layout order on people's purchase decisions. There are also some other factors of the webpage (e.g. brand, musical situation) that have important impact on consumers' experience and behavior. For example, researchers found that website brand equity had an influence on consumers' online experience and online loyalty.⁵³ Interactive music in the design of an e-commerce website could create a more engaging consumer experience and influence consumer's behavioral intention.⁵⁴ These factors need to be further researched

in the future studies. Second, the ERP experiment has the inherent limitations of experimental design, which may not perfectly simulate the real online shopping situation. Future study can consider more measurements to improve it. For example, we can carry out field experiments with portable EEG equipment to record people's brain activities in more real situations outside the laboratory.⁵⁵ Third, the effect size was not large enough in the current study which may be due to the fact that the sample size of electrophysiological studies in general is relatively small. A larger sample size should be considered in future studies to further increase the effect size.

Conclusion

In conclusion, this study investigated how instant purchase by consumers occurs when consumers are presented with online shopping webpages with different levels of layout order. ERP was used to examine the cognitive process underlying the purchase decision for products in the low-order online shopping webpage designing. We found that the low-order shopping webpage facilitated participants' purchase decision, with a higher purchase rate compared with the high-order webpage. At the neural level, it revealed larger P2 and LPP components for the low-order webpage than the high-order webpage. We suggest that a low-order webpage design invokes more attention and consumes self-control resources, as reflected by P2 and LPP. Generally, these findings imply that appropriately low-order designed webpages can give rise to increased instant purchase in online shopping. These findings will be beneficial for future E-commerce studies.

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Disclosure

The authors report no conflicts of interest in this work.

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