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How consumers are affected by product descriptions in online shopping: Event-related potentials evidence of the attribute framing effect

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ABSTRACT

Due to the limitations of the human ability to process information, e-consumers' decisions are likely to be influenced by various cognitive biases, such as the attribute framing effect. This effect has been well studied by numerous scholars; however, the associated underlying neural mechanisms with a critical temporal resolution have not been revealed. Thus, this study applies the measurement of event-related potentials (ERPs) to directly examine the role of attribute framing in information processing and decision-making in online shopping. The behavioral results showed that participants demonstrated a higher purchase intention with a shorter reaction time under a positive framing condition compared to participants under a negative framing condition. Compared with positive framing messages, the results of ERPs indicated that negative framing messages attracted more attention resources at the early stage of rapid automatic processing (larger P2 amplitude) and resulted in greater cognitive conflict and decision difficulty (larger P2-N2 complex). Moreover, compared with negative messages, positive framing messages allowed consumers to perceive a better future performance of products and classify these products as a categorization of higher evaluation (larger LPP amplitude) at the late cognitive processing stage of evaluation. Based on these results, we provide evidence for a better understanding of how different attribute framing messages are processed and ultimately lead to the framing effect.

1. Introduction

In modern-day e-business, consumers process large amounts of information prior to making purchase decisions from a vast market of e-sellers (Cheng et al., 2014). Due to the limitations of the human ability to process information (Simon, 1956), making purchase decisions has become a difficult task for consumers of e-businesses (Cheng et al., 2014). Previous studies have specifically indicated that the quality of the decisions by consumers are likely to be negatively influenced by cognitive biases, such as cognitive bias among online gaming players (Decker and Gay, 2011), team member selection biases (D'Souza and Colarelli, 2010) and optimistic bias on privacy and piracy problems (Cho et al., 2010; Nandedkar and Midha, 2012).

Among the different types of cognitive biases in consumer behavior studies, the attribute framing effect is one of the most well-known decision biases. It refers to the phenomenon in which consumers show inconsistent preferences or choices when identical attribute information of products is differentially described (positively or negatively) (Tversky and Kahneman, 1974; Tversky and Kahneman, 1981). Numerous studies have found the effect of attribute framing on evaluation and\or preferences of people (Janiszewski et al., 2003; Levin and Gaeth, 1988; Levin et al., 1985; Zhang and Buda, 1999). For example, a study used the "80% lean meat" and "20% fat meat" method to describe ground beef, and participants in a positive frame had a better evaluation of the ground beef compared to those in a negative frame (Levin and Gaeth, 1988). Moreover, the perceived quality of an electronic translator was affected by attribute framing messages (Wu and Cheng, 2011), and similar results were obtained on the expressive aesthetics of

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web sites (Hartmann et al., 2008). In addition, numerous advertisement messages also tend to influence the consumer evaluation by describing the attributes of products in a positive framing manner (Cheng et al., 2014).

Although the attribute framing effect is a type of cognitive bias, most related studies have generally examined the attribute framing effect at the behavioral level. Thus, it is of great significance to further investigate the associated underlying neural mechanisms, particularly how the positive and negative frames influence information processing in our brain and subsequently affect the purchasing decisions of consumers, which is a question of fundamental importance in attribute framing effect studies. A few studies have recently applied methods of cognitive science and cognitive neuroscience to examine the cognitive processes and the neural basis of this effect. (Lin and Yang, 2014; Murch and Krawczyk, 2014; Yang, 2015; Zheng et al., 2010). For example, a study performed in 2014 employed an eye-tracking method to examine the attribute framing effect on observed eye movements and purchase intention in online shopping. The authors found that negative frames induced a greater number of active eye movements, and function attributes attracted a greater number of eye movements with higher intensity (Lin and Yang, 2014). A more recent study applied the Elaboration Likelihood Model (ELM) to examine the attribute framing effect in online shopping using an eye-tracking method. These results showed that attribute frames did not demonstrate a moderating effect on purchase intention but had a moderating effect on eye movements (Yang, 2015). In addition, a functional magnetic resonance imaging (fMRI) study also investigated the neural basis of the attribute framing effect (Murch and Krawczyk, 2014). The authors found that reflexive brain regions were associated with positive frames, while reflective areas were associated with negative frames. Region of interest analyses indicated that frame-inconsistent responses were associated with increased activation within reflective cognitive control regions, including the left dorsolateral prefrontal cortex (PFC), dorsomedial PFC and left ventrolateral PFC. Frame-consistent responses were associated with increased activity in the right orbitofrontal cortex (Murch and Krawczyk, 2014). However, these studies did not provide critical temporal information of brain activities that are related to the attribute framing effect due to the limitations of the applied methods (the eye-tracking method cannot provide any information of brain activities, while fMRI has a poor temporal resolution of approximately 2s). In contrast, the excellent temporal resolution of event-related brain potentials (ERPs) makes it a more suitable measure to track rapid temporal modulations in neural activity (Ma et al., 2012).

Thus, the present study is performed by measuring ERPs to directly examine the role of attribute framing in information processing and decision-making in online shopping. Considering that consumers are expected to experience a series of cognitive processes in online shopping, the present study focuses on three ERP components that have been frequently investigated in previous Decision Neuroscience studies, which are closely related to processing of attention distribution (P2), decisional conflict (N2) and evaluative categorization (late positive potential, LPP).

P2 is a relatively early positive ERP component over frontal regions that presumably reflects the early assessment of stimuli (Polezzi et al., 2008). It is an attention-related component that indicates early rapid automatic activity, followed by the progressive recruitment of slow, elaborative, and semantic processing under voluntary control (Correll et al., 2006; Ma et al., 2014). Previous studies have consistently found that more attention resources will be allocated to negative stimuli compared to positive stimuli, and larger P2 amplitudes will be elicited (Carretié et al., 2001; Huang and Luo, 2006; Wang et al., 2012). For example, P2 reflected the engagement of attention resources and was associated with the detection of hazard in the process of perception and evaluation for warning signal words (Bublatzky and Schupp, 2012). Furthermore, less beautiful pendants were found to attract more attention resources and elicit greater amplitudes of P2 compared to beautiful ones (Carretié et al., 2001; Huang and Luo, 2006; Wang et al., 2012). Because P2 is a reflection of greater automatic mobilization of attention resources to negative stimuli (Carretié et al., 2001; Huang and Luo, 2006; Wang et al., 2012), we infer that negative attribute framing messages, which highlight the negative aspect of the attributes of a product, will attract more attention and elicit a larger P2 amplitude (positive polarity) compared to positive attribute framing messages.

N2 is another frequently studied ERP component in decision studies that typically peaks at approximately 250–350 ms after the onset of a stimulus (Folstein and Petten, 2008). It generally arrives at the largest amplitude in the prefrontal and posterior region of the scalp (Folstein and Petten, 2008; Forster et al., 2010). Previous studies have consistently suggested that the amplitude of N2 is positively correlated with conflict (Folstein and Petten, 2008; Larson et al., 2012; Ma et al., 2007; Spapé et al., 2011). Decision conflict will be significant when a decision maker has two different decision tendencies or when one right decision outcome is needed to overcome another unsuitable outcome (Ridderinkhof et al., 2004). Recently, some studies have reported that N2 can robustly reflect decision risk (Ma et al., 2015; Yang et al., 2007) because higher perceived risk appears to increase decision difficulty, which will cause greater decisional conflict during decision-making (Ma et al., 2015; Wang et al., 2016). Considering that changes in N2 amplitude reflects the relationship between decision risk and decisional conflict, N2 has been proposed to directly reflect decision conflict and indirectly reflect decision risk (Ma et al., 2015; Wang et al., 2016; Yang et al., 2007). According to the existing literature on the attribute framing effect (Hartmann et al., 2008; Janiszewski et al., 2003; Levin and Gaeth, 1988; Levin et al., 1985; Wu and Cheng, 2011; Zhang and Buda, 1999), compared with negative framing messages, positive framing messages can reduce consumers' perceived risk and contribute to their evaluation of products. Thus, we speculate that negative framing messages will cause a greater decisional conflict during consumption decisions and elicit a larger N2 amplitude (negative polarity) compared to positive framing messages.

Late positive potential (LPP) is an ERP component maximal over central-parietal regions and typically peaks at approximately 600 ms after the onset of a stimuli (Herring et al., 2011). Previous studies have found that LPP can be elicited by implicit and explicit categorization of stimuli along evaluative dimensions (Chen et al., 2010; Ito and Cacioppo, 2000; Wang et al., 2016). Notably, studies on neuromarketing (also known as consumer neuroscience) have recently reported that LPP can reflect the cognitive process of evaluative categorization at the late stage of online purchase decisions (Chen et al., 2010; Wang et al., 2016). These studies indicated there was an obvious evaluation stage prior to the final purchasing decision of consumers and increased LPP amplitude was related to the stimuli of higher evaluation categorization (Chen et al., 2010; Wang et al., 2016). For example, products' extrinsic cues implying better future performance evoked greater LPP amplitude (Wang et al., 2016). In the current study, there are various framing messages, which can be categorized into two situations (positive framing messages and negative framing messages). Compared with negative attribute framing messages, positive framing messages are more desirable to the preferences of consumers (Cheng et al., 2014) and seem to result in a better evaluation. Thus, we speculate that a larger LPP amplitude (positive polarity) will be present in positive frames compared to negative frames.

As previously discussed, P2, N2, and LPP may reflect different facets of information processing and decision-making from the perspective of ERP components. The analysis of these components will

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