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Emotional–motivational responses predicting choices: The role of asymmetrical frontal cortical activity

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ABSTRACT

We examined (a) how emotional attachment to a choice option as indexed by state-related changes in electroencephalographic (EEG) asymmetry over the prefrontal cortex and electrodermal activity predicts choices and mediates the endowment effect and (b) the emotional–motivational responses to trade-off choices. Thirty-eight participants made choices between three 4-product packages, in which the frequency of each of the products varied. Greater relative left frontal activation and high peak skin conductance level (SCL) elicited by a previously selected choice option predicted a stronger endowment effect, suggesting that approach motivation and emotional attachment mediate the endowment effect. Not selecting a choice option with high emotional attachment elicited relatively greater right hemisphere activation, supporting also the role of loss aversion in the endowment effect. In addition, high trade-off difficulty was associated with increased withdrawal motivation (or less approach motivation) and negatively valenced arousal. We conclude with a discussion of practical implications of our findings.

1. Introduction

The economic rationality has been challenged, for example, by the Prospect Theory stating that perceived utility is dependent on a reference point and that people tend to strongly prefer avoiding losses over acquiring gains (Kahneman & Tversky, 1979). A mounting body of evidence shows that emotional processes play an important role in economic decision making (e.g., Bernheim & Rangel, 2004; Kahneman, Ritov, & Schkade, 1999; Loewenstein & Lerner, 2003; Shiv & Fedorikhin, 1999; Slovic, Finucane, Peters, & MacGregor, 2004). For example, emotional attachment to goods has been suggested to underlie the endowment effect (i.e., people value an item more highly after they come to feel that they own it; Ariely, Huber, & Wertenbroch, 2005; Thaler, 1980). Likewise, a choice between two or more options involving trade-offs has been posited as being emotionally taxing, thereby leading to trade-off aversion (e.g., Luce, Bettman, & Payne, 2001).

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The role of brain activity in economic decision making has recently gained increased attention (e.g., Fox & Poldrack, 2008; Plassmann, Ramsøy, & Milosavljevic, 2012). However, although the relationship of electroencephalographic (EEG) asymmetry over the prefrontal cortex (relative activity of the left and right hemispheres) with emotional-motivational processes is well established (Coan & Allen, 2004; Davidson, 2003), there is a paucity of studies examining whether it (especially frontal asymmetry as a state, as opposed to a trait) predicts choices (but see Ravaja, Somervuori, & Salminen, 2013). Accordingly, the present study was designed to examine (a) how emotional attachment to a choice option as indexed by EEG asymmetry over the prefrontal cortex and electrodermal activity (EDA; an index of emotional arousal) predicts choices and (b) what are the emotional-motivational responses to trade-off (difficult) and win–win (easy) choices.

We examined these issues using an experiment where choices were made between three 4-product packages (i.e., base package and two new product packages), in which the frequency of each of the four products varied from 0 to 4. In win–win trials (i.e. easy choices), the two new product packages dominated the base package (but not each other), whereas in trade-off trials (i.e., difficult choices), they did not.[1] In addition, in the high-emotional-attachment condition, the product package selected in a given trial was the base package for the next trial, whereas in the low-emotional-attachment condition, the base package was randomly assigned in each trial.

1.1. Frontal EEG asymmetry and approach/withdrawal motivation

Davidson's influential approach–withdrawal motivational model of emotion posits that the left- and right-anterior brain regions are part of two separate neural systems underlying approach and withdrawal motivation, respectively (e.g., Davidson, 1995, 2004). Greater relative left frontal activity, either as a trait or a state, indicates a propensity to approach or engage a stimulus, while greater relative right frontal activity indicates a propensity to withdraw or disengage from a stimulus (for reviews, see Coan & Allen, 2004; Davidson, 2003; Demaree, Everhart, Youngstrom, & Harrison, 2005). Frontal asymmetry in the alpha frequency band (i.e., the index of frontal asymmetry in EEG studies) has been shown to reflect activity in the dorsal prefrontal cortex (PFC; Pizzagalli, Sherwood, Henriques, & Davidson, 2005). There is evidence that trait (resting) prefrontal EEG asymmetry predicts state-related emotional changes and responses (e.g., affective responses to emotional film clips; Wheeler, Davidson, & Tomarken, 1993) and is associated with psychopathology or risk for psychopathology (e.g., depression and anxiety; e.g., Gotlib, 1998; Wiedemann et al., 1999), although inconsistent findings also exist (see e.g., Coan & Allen, 2004). A relationship between increased resting left-lateralized activity and a stronger bias to respond to (monetary) reward-related cues has also been found (Pizzagalli et al., 2005). In addition, resting-state hypoactivity in the right lateral PFC has been shown to predict higher monetary risk taking (Gianotti et al., 2009) and a lower willingness to punish in the ultimatum game (Knoch, Gianotti, Baumgartner, & Fehr, 2010).

Emotional states have also been shown to be associated with concomitant changes in frontal EEG asymmetry; that is, approach-related emotions (e.g., joy and anger) are related to greater relative left frontal activation, whereas withdrawal-related emotions (e.g., disgust and fear) are related to greater relative right frontal activation (e.g., Coan & Allen, 2003; Davidson, Ekman, Saron, Senulis, & Friesen, 1990; Ekman & Davidson, 1993; Harmon-Jones, Sigelman, Bohlig, & Harmon-Jones, 2003). Gable and Poole (2014) also found that dispositional behavioral activation system sensitivity predicted greater left-frontal asymmetry to anger pictures. According to Davidson, Marshall, Tomarken, and Henriques (2000), anterior asymmetry is associated with pre-goal attainment emotion elicited while attempting to achieve a goal (e.g., enthusiasm), but not with post-goal attainment emotion (e.g., contentment; cf. the distinction between wanting and liking; see also Tomarken & Zald, 2009). Research has also related greater left-sided frontal activity to the state engagement in approach-related behaviors (Amodio, Devine, & Harmon-Jones, 2007; see also Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006). In general, the interpretation of frontal alpha-asymmetry is complicated by the fact that alpha-band oscillations have been associated with many different processes, such as motor preparation (Babiloni et al., 1999) and the active inhibition of task-irrelevant information (Roux & Uhlhaas, 2014; see also Buzsáki, 2006).

1.2. Endowment effect

Reference dependence and loss aversion are important components of prospect theory (Kahneman & Tversky, 1979; Tversky & Kahneman, 1992), the leading behavioral model of decision making under risk. The theory has also been extended to riskless choice (see Korhonen, Moskowitz, & Wallenius, 1990; Tversky & Kahneman, 1991). Empirical studies have established that people's preferences are reference-dependent. That is, people understand choice options as gains or losses relative to a reference point that is normally the "current asset position" of the individual (Bateman, Munro, Rhodes, Starmer, & Sugden, 1997). Loss aversion, in turn, refers to the tendency for individuals to weigh losses from a reference point more heavily than equal-sized gains (Tversky & Kahneman, 1991). In the domain of riskless choice, loss aversion has been invoked to explain the endowment effect, which refers to the tendency for people to value objects more highly after they come to feel that they own them. For example, Knetsch (1989) randomly endowed students with either a mug or a bar of Swiss chocolate and then allowed them to either keep the item they possessed or trade it for the other item. Although, by chance, half of the students should receive the item that is of lower value to them and therefore should choose to trade their item, a trading rate of approximately 10% was observed, indicating a notable tendency to stay with the currently possessed item.

[1] In the marketing literature, when a so-called decoy is introduced, it is dominated by one of the alternatives, but not all of them (e.g., Hedgcock & Rao, 2009).