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The influence of self-construal type on outcome evaluation: Evidence from event-related potentials

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ABSTRACT

Recent studies have revealed a close relationship between the self and reward networks. One of our previous studies has found that outcome evaluation (including the processing of reward and punishment) is modulated by self-reflection. A question remaining unclear is how different types of self-construal influence outcome evaluation. Self-construal refers to the way in which people perceive themselves to be linked (or not) with other people. Two subtypes of self-construal have been identified: independent self and interdependent self. In the present study, 27 normal adults read essays that contained independent or interdependent pronouns (i.e., I or we) and then performed a gambling task while brain event-related potentials (ERPs) were recorded. The ERP analysis focused on the feedback-related negativity (FRN) and the P3 component. Outcome feedback evoked a larger FRN in the independent self-priming condition than in the interdependent self-priming condition. In contrast, the P3 amplitude was insensitive to self-construal manipulation. The present findings suggest that different types of transient self-construal manifest differently in outcome evaluation processes, supporting the existence of a close link between the self and reward networks.

1. Introduction

The self and reward are two topics in the literature that have been largely explored independently. However, recent studies have shown that self processing and reward processing in humans are tightly related structurally and functionally. Recent studies indicated that the neural networks that underlie the processing of self and that of reward substantially overlap (de Greck et al., 2008; Enzi et al., 2009; Ersner-Hershfield et al., 2009; Grady et al., 2012; for a review, see Northoff and Hayes, 2011), mainly in the cortical midline system (Northoff and Bermpohl, 2004; Qin and Northoff, 2011). Tamir and Mitchell (2012) found that self-related processing is intrinsically rewarding. For example, when participants discussed their own opinions, brain activations were observed in the same regions that are often associated with reward, such as food, money, and sex (Tamir and Mitchell, 2012).

The present study explores the ways in which different kinds of self-construal influence the outcome evaluation process. Generally, people tend to treat the construct of "self" as an independent entity that is separate and distinct from other people (Geertz, 1975). However, the self for each individual develops in a specific socio-cultural context. In many cases, the construal of self depends largely on social variables. Self-construal is conceptualized as a constellation of thoughts, feelings, and actions with regard to one's relationship to others and the self (Markus and Kitayama, 1991). The current literature on self-construal mainly focuses on two distinct orientations, that is, independent self-construal and interdependent self-construal (Markus and Kitayama, 1991). According to Markus and Kitayama (1991), the independent self is characterized as a self-contained and autonomous entity that is context-independent and includes salient internal attributes. On the other hand, the interdependent self is treated as a member of a group and highlights belonging to and being dependent on a context. The comparison between independent self-construal and interdependent self-construal is a prominent topic in social psychology (Cross et al., 2011).

Cross-cultural research has found that both interdependent and independent self-construal can coexist in the same individual (e.g., Gardner et al., 1999; Trafimow et al., 1991), and self-construal that is salient at one particular moment can influence the way in which people interpret incoming information. Evidence to date has suggested that transient self-construal can modulate self-processing at both the behavioral and neural levels (van Baaren et al., 2003; Colzato et al., 2012; Kühnen and Oyserman, 2002; Obhi et al., 2011; Sui et al., 2013). For

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example, Lin and Han (2009) found that independent self-construal priming in a global/local attention processing task promoted greater focus on individual elements, whereas interdependent self-construal priming promoted greater focus on the global target. With regard to social cognition, Sui and Han (2007) found that neural activity that subserved self-face processing was also modulated by self-construal priming.

A recent functional magnetic resonance imaging (fMRI) study found that self-construal priming can also modulate reward processing. Varnum et al. (2014) manipulated participants' self-construal (independent vs. interdependent) and found that participants were more sensitive to winning when gambling for the self than when gambling for a friend after independent self-construal priming. In contrast, when participants were primed by interdependent self-construal, winning money for themselves and for a friend evoked comparable activation of the same brain regions. The study of Varnum et al. (2014) provides novel insights into the way in which self-construal priming modulates reward processing. One of our previous studies also found that individuals were more sensitive to outcome feedback in a gambling task after a self-reflection task than after an other-reflection task (Zhu et al., 2015). Therefore, we proposed that individuals should be more sensitive to reward processing in the independent self-construal condition than in the interdependent self-construal condition.

Reward processing can be divided into two sub-processes: the anticipation of reward and the outcome evaluation process (Schultz, 2006). The present study focused on the outcome evaluation process. Feedback-related negativity (FRN) is a key event-related potential (ERP) component that is associated with outcome evaluation, which is a medial frontal negative-going component that peaks approximately 250 ms following feedback presentation. Feedback-related negativity is larger after negative performance feedback than after positive performance feedback (Miltner et al., 1997) and also larger after monetary losses compared with wins (Gehring and Willoughby, 2002). An influential theory proposes that the FRN reflects a reinforcement learning signal that is associated with prediction errors, which is more prominent when outcomes are worse than expected (Holroyd and Coles, 2002). This theory suggests that the FRN is an index of the activity of the midbrain dopamine system (Foti et al., 2011; Holroyd et al., 2006).

The P3 component is another important aspect of the ERPs that is associated with outcome evaluation (San Martín, 2012). This positive-going component peaks ~400 ms after feedback onset and typically increases in magnitude from frontal to parietal sites (Yeung and Sanfey, 2004). With regard to outcome evaluation, the P3 component is sensitive to reward valence in monetary gambling tasks, with larger amplitude for positive feedback than for negative feedback, suggesting a role in differentiating good from bad outcomes (Leng and Zhou, 2010). To explain this phenomenon, previous studies suggest that the P3 encodes the emotional significance of the current event (Polezzi et al., 2010). Many studies have explored the ways in which self-construal affects the ERPs, which suggest that self-construal priming modulates empathic neural responses. Specifically, these studies found that temporal self-construal priming can influence the early automatic components of empathy (e.g., the N1 component) but does not affect the later controlled component of empathy in the P3 time window (Jiang et al., 2014; Wang et al., 2013). More relevant to the present study, one of our previous ERP studies found that the P3 was not modulated by the type of reflection (self-reflection vs. other-reflection). The insensitivity of the P3 to self-reflection priming indicates that the self-reflection priming effect occurred at an early stage of outcome evaluation (Zhu et al., 2015).

Based on the aforementioned observations, we further explored the ways in which outcome evaluation is influenced by temporary self-construal at the electrophysiological level. Previous studies have demonstrated the primacy of the individual self vs. the collective self or relational self (Zhu et al., 2016; Chen et al., 2013). According to the literature, independent self-construal would highlight the uniqueness of the personal self compared with interdependent self-construal. Accordingly, we predicted that participants should be more sensitive to reward processing in the independent self-construal condition than in the interdependent self-construal condition, which would manifest as a larger FRN in the former condition than in the latter condition. Moreover, we predicted that the P3 would be unaffected by self-construal priming.

2. Methods

2.1. Participants

Twenty eight college students participated in this study. The experiment was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Department of Psychology, Henan University, China. Informed consent was obtained prior to the experiment. All participants had normal vision (with correction), and none had a history of neurological disease or brain injury. All of them were right-handed. The participants were paid for their participation. One male participant was excluded due to excessive artifacts in the ERP data (>50% bad trials). Consequently, the final sample consisted of 27 participants (22.4 ± 0.7 years of age, ranged 21–24, 13 males).

2.2. Procedure

There were two self-construal priming conditions. Four Chinese essays were used in the priming procedure, with each condition contained two essays (Sui and Han, 2007). The contents of the paragraphs were not the same between the two conditions. Each essay consisted of two paragraphs describing a trip to the countryside (about 300–350 words). The independent self-construal essays contained independent pronouns (e.g., I, mine), and the interdependent self-construal essay contained interdependent pronouns (e.g., we, ours). Participants were required to read each paragraph and circle "we" and "our" in the interdependent self-construal condition, and circle "I", "me" and "my" in the independent self-construal condition.

The formal experiment was a forced-choice gambling task (Gu et al., 2011). Stimulus display and behavioral data acquisition were conducted using E-Prime software (Version 1.1, Psychology Software Tools, Inc.). During the task, the participants sat comfortably in an electrically shielded room approximately 80 cm from a computer screen. Each trial began with the presentation of two white rectangles (2.5° × 2.5° of visual angle) in which two Arabic numbers ("9" and "99") were individually presented to indicate two alternative options on the left and right sides of a fixation point. The positions of the two numbers were counterbalanced across trials. The participant was asked to make a selection by pressing the "F" or "J" key on the keyboard with the left or right index finger, respectively. The alternatives remained on the screen until the participant chose a rectangle, which was then highlighted by a thick red outline for 500 ms. Thereafter, the outcome feedback of the participant's choice was presented such that its valence information was displayed (see Fig. 1).

There were four kinds of outcomes: "+9", "+99", "−9", and "−99". Each indicated the points the participant won (when the outcome valence was "+") or lost (when the outcome valence was "−") in the current trial. Unbeknownst to the participant, outcome feedback was provided according to a pre-determined pseudorandom sequence, such that each participant received exactly 64 wins and 64 losses. The gambling task consisted of two blocks of 128 trials each. Before the beginning of each block, one essay was presented and another was presented in the middle of the task (the two essays were in the same type). The experiment was a within-subject design, that is, each participant finished the gambling task twice under different self-construal priming conditions, the sequence of which were counterbalanced across participants.