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When "Your" reward is the same as "My" reward: Self-construal priming shifts neural responses to own vs. friends' rewards

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ABSTRACT

Is it possible for neural responses to others' rewards to be as strong as those for the self? Although prior fMRI studies have demonstrated that watching others get rewards can activate one's own reward centers, such vicarious reward activation *has always been less strong* than responses to rewards for oneself. In the present study we manipulated participants' self-construal (independent vs. interdependent) and found that, when an independent self-construal was primed, subjects showed greater activation in the bilateral ventral striatum in response to winning money for the self (vs. for a friend) during a gambling game. However, priming an interdependent self-construal resulted in comparable activation in these regions in response to winning money for the self and for a friend. Our findings suggest that interdependence may cause people to experience rewards for a close other as strongly as they experience rewards for the self.

Introduction

Vicarious reward, a sense of pleasure derived from watching others gain rewards, has been implicated in a number of basic processes from altruism (Ainslie, 1995) to learning (Bandura, 1977). The experience of vicarious reward may also be a psychological mechanism that is necessary for the evolutionary process of kin selection to occur (Campbell-Meiklejohn and Frith, 2012; Mobbs et al., 2009). Although vicarious reward has been described as "a raw feel, as robust as food or pain", (Ainslie, 1995, p. 395), no evidence suggests that people experience others' rewards as strongly as they experience those same rewards directly. In fact, a review of the neuroimaging literature failed to find any published study in which vicarious rewards produced equal or stronger activation in the reward network than rewards for the self.

That said, there have been a handful of functional magnetic resonance imaging (fMRI) studies that have demonstrated that social factors can modulate vicarious reward. For example, Mobbs et al. (2009) found that people show greater activation in the ventral striatum (VS) when watching socially desirable others (as opposed to socially undesirable others) win at a card-guessing game. In addition, connectivity between the VS and the anterior cingulate cortex (ACC) while watching others' win was positively correlated with perceived similarity between oneself and the target. In another study in which participants played a card-guessing game where they shared their rewards either with a friend, a stranger, or a computer, Fareri et al. (2012) found greater VS activation in response to winning rewards when their partner was a friend, though this effect was confined to participants who were high in subjective closeness to that friend.

Given that similarity and closeness to the other party appear to strengthen neural response to vicarious reward, perhaps if subjects are induced to construe the self in an interdependent fashion (that is interconnected with and encompassing close others) as opposed to an independent fashion (that is autonomous and bounded; Markus and Kitayama, 1991; Varnum et al., 2010) then vicarious reward and reward for the self might produce comparable activation in neural regions involved in reward. fMRI studies have demonstrated comparable activation in the medial prefrontal cortex (mPFC) involved in representation of one's own traits and a close other's traits in a society where interdependent self-construal is common (Zhu et al., 2007), and that priming interdependence has a similar effect (Chiao et al., 2010; Ng et al., 2010). Here we tested whether vicarious reward and reward for the self might produce comparable activation in the neural regions involved in reward when interdependence is primed.

The present study tested the prediction that priming an interdependent self-construal will lead to equal response to rewards for the self and a friend, whereas priming an independent self-construal would lead to greater responses to own rewards vs. a friend's rewards. Given the fact that previous research on reward has consistently shown that

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the VS responds to rewards for the self (e.g. Bjork and Hommer, 2007; Delgado et al., 2000; Fareri et al., 2012; Mobbs et al., 2009; O'Doherty et al., 2003) and to vicarious rewards (Fareri et al., 2012; Mobbs et al., 2009), we predicted that this effect would be present in the VS.

Methods

Participants

Fifteen students from Southwest University (after excluding 4 participants with excessive motion; age ranging from 19 to 24, 10 females) participated in the main study. An independent sample of 16 students (age ranging from 18 to 25, 9 females) participated in the localizer study. All were Chinese, right-handed, had normal or corrected-to-normal vision, and reported no abnormal neurological or psychiatric history. Participants provided informed consent, and the study was approved by a local ethics committee.

Stimuli and procedure

All materials were presented in Chinese. For the main study, 10 pairs of sex-matched friends were recruited for the main study. The two friends that comprised each pair were scanned successively (except for one participant whose friend, unbeknownst to her until the completion of the study, was precluded from scanning due to a metal implant). That is, participants actually believed that their friend was also participating in the study (and with one exception this was the case). Participants were told that the study involved a card-guessing game, and that they would have a chance to win extra monetary rewards for themselves and their friends in addition to their basic payment (CNY ¥70, ≈USD $11.2). Adapting our procedure from Delgado et al. (2000), each trial of the card-guessing game began with a 2-second presentation of a "?" in the center of a card against a black background, during which the participant guessed whether the number on the card would be smaller or greater than 5 by pressing the left or right button using her right index or middle finger. The number on the card was then revealed by replacing the cue with one of the following numbers: "1", "2", "3", "4", "6", "7", "8", and "9". The number was colored green if the participant had made a correct guess and red if the guess was incorrect. A correct guess resulted in a monetary reward of CNY ¥1.00 (≈USD $0.16), and an incorrect one resulted in a loss of CNY ¥0.50 (≈USD $0.08) (Outcome: Win/Loss). Simultaneously, a square or rhombus was shown below the number to indicate that the participant had won or lost for either herself or her friend (Target: Self/Friend). Unbeknownst to participants, the game was programmed so that there would be an equal number of win and loss trials for the self and one's friend in all conditions. We also included neutral trials (not linked to monetary outcomes) in which only the letter "N" was presented (Fig. 1). All characters were presented at a distance of 25 cm subtending a visual angle of 1.12° × 1.12°. After each trial, the outcome was followed by a fixation cross which was presented for 8 s before the next trial. The main study involved 8 functional runs of the card-guessing game. Each run contained 25 randomly ordered trials consisting of 5 trials of each of the following outcomes: Self Win, Self Loss, Friend Win, Friend Loss, as well as 5 neutral trials.

For approximately half of participants (N = 8, 6 female), each of the first 4 runs was immediately preceded by independent self-construal priming, and each of the last 4 runs was preceded by interdependent self-construal priming (Prime: Independent/Interdependent); for the other participants the priming order was reversed. Each prime consisted of 16 sentences that made up a short story about traveling. Following a similar procedure as in Sui and Han (2007), participants judged whether pronouns were present in sentences containing first-person singular pronouns in the independent priming condition (e.g., 'I lay on the chair and relaxed with my eyes closed'), or first-person plural pronouns in the interdependent condition (e.g., 'We lay on the chairs and had a chat'). Each sentence was shown on the screen for 5 s and followed by a "?" for 1 s during which participants pressed the left or right button to indicate the presence of the pronoun.

At the conclusion of the main study, participants were debriefed and paid CNY ¥90 (≈USD $14).

After scanning, participants completed a measure of the degree of closeness they felt to their friend (adapted from Aron et al., 1992), the Self-Construal scale (SCS; Singelis, 1994), and the Horizontal and Vertical Individualism and Collectivism scale (HVIC; Triandis and Gelfand, 1998). They also completed four 7-point Likert scales (−3: very unhappy; 3: very happy) to indicate how happy they felt when they/their friends won/lost rewards.

A localizer study served to pre-localize the loci of the bilateral VS that encode monetary reward. Participants were scanned for two functional runs while playing the same game used in the main study, except that they played only for themselves and no priming was administered. In addition to their basic payment CNY ¥20 (≈USD $3.2), they had a chance to win CNY ¥2.00 (≈USD $0.32) or lose CNY ¥1.00 (≈USD $0.16) on each trial. Each run contained 10 Win trials, 10 Loss trials, and 10 Neutral trials. After scanning, participants completed the SCS and the HVIC. At the conclusion, they were debriefed and paid CNY ¥40 (≈USD $6.4).

fMRI data acquisition and analysis

Scanning was performed using a 3T Siemens TRIO MRI scanner. Gradient-echo T2*-weighted echo-planar images (EPI) covering the

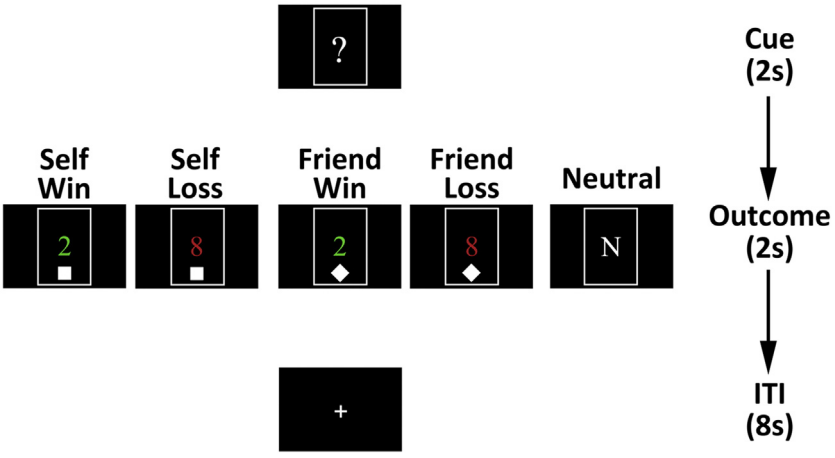

Fig. 1. Trial structure. ITI: inter-trial interval.