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Testing Social Preferences Through Differential Attention to Own and Partner's Payoff in a Prisoner's Dilemma Game

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Cooperation in one-shot public good games, where future returns are unavailable, is observed in numerous experimental studies. Economists and psychologists explain such behavior as a reflection of social preferences—utilities deriving from payoffs to others as well as to themselves. We tested validity of this explanation by measuring how long cooperators and defectors looked at payoffs to themselves and to the partner with an eye tracking device. Cooperators spent more time than defectors looking at payoffs to the partner only when the payoff matrix was difficult for the players to perceive as an instance of social exchange. When the matrix was easy to comprehend as an instance of social exchange, cooperators paid less attention to payoff to the partner than did defectors. The results indicate that the deliberate processes assumed in social utility models take place only when the other, faster and cue-driven process is unavailable.

Keywords
cooperation, prisoner's dilemma, attention, eye tracker, social preference

Introduction

Both social utility models in economics (Ledyard, 1995; Rabin, 1993) and social value orientation models in psychology (Liebrand & vun Ran, 1985; Messick & McClintock, 1968) state that game players derive utilities not only from their own payoffs but also from payoffs to their partners. Despite differences in specifics concerning how various sources of utilities combine to generate the overall utility, those researchers agree that players compare utilities associated with outcomes of their and their partner's decisions and choose the behavioral alternative that yields the highest overall, social utility. These models imply that cooperators are more concerned with and pay more attention to the partner's payoffs than do defectors who do not care about partner's payoffs. We tested this prediction by measuring how long game players gazed at each payoff on the payoff matrix.

An alternative explanation of cooperation in one-shot games comes from dual-process models of information process (Chaiken, 1980; Metcalfe & Mischel, 1999; Petty & Cacioppo, 1986). According to these models, judgment and decision-making often involve two, separate but parallel information processes. One is fast, automatic, unconscious (i.e., does not require attention), and intuitive (heuristic decision-making), whereas the other is slow, intentional, conscious, and rational (reasoned decision-making). Either process can be used for a specific decision making task, and different conclusions can be made by the two processes. The reasoned process can supersede the heuristic process. However, since the heuristic process works faster, we often draw our conclusion before the reasoning process can catch up. In many cases, reason is invoked simply to "justify" a decision that has already been made (Haidt, 2001). The heuristic information process is often the default option, automatically operating without conscious allocation of attention. We thus expect that social preferences models explain game players' behavior especially when operation of heuristic process is prevented so that players are "forced" to resort to deliberate process to make their decisions.

We designed an experiment, in one condition of which we suppressed the operation of heuristics and in the other we did not. Specifically, we used two types of payoff matrix – simple matrix and complex matrix. The simple matrix is the kind of matrix normally used in experimental Prisoners' Dilemma games, in which T = 1,800, R = 1,200, P = 600, and S = 0 JPY (cf. Kelley & Thibaut, 1978). The complex payoff matrix has been created by multiplying each entry of the simple matrix by 0.93 and adding 165 JPY to each in order to make it harder for the player to understand the nature of the game (T = 1,839, R = 1,281, P = 723, and S = 165). We used these two games to manipulate the ease with which players perceive the game as an instance of social exchange.

Our main hypothesis is that comparisons of social utilities are involved only when game players do not perceive the game as an instance of social exchange such that heuristic process for social exchange is unlikely to be activated. When they perceive the game as an instance of social exchange, we expect that game players will follow a domain-specific – specific to the domain of social exchange – decision heuristic that Yamagishi and colleagues call social exchange heuristic (Yamagishi, Terai,

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Kiyonari, Mifune, & Kanazawa, 2007). When this happens, comparisons of utilities will not be involved. We presented two forms of payoff matrix to randomly assigned participants, and measured, with an eye-movement tracking device, fixation of the players' eyes' on each entry of the payoff matrix. Eye-tracking data have been used in many studies to investigate allocation of attention (Rayner, 1998). We use fixation time on a particular entry in a payoff matrix as an index of game player's attention to the particular outcome while she is making a decision in the game.

Methods

A total of 62 (32 male and 30 female) freshmen recruited from a large subject pool at Hokkaido University, Japan, participated in the study. Thirty-three of them were assigned to the simple matrix condition and 31 to the complex matrix condition. The game player was led to a sound-proof room (230 cm x 190 cm), and was seated on a chair facing a computer display. The player first went through a calibration task in which the player's eye movements following a white point moving on the display were tracked. Once the calibration task was over, they were asked to read the instructions for the next task while staying in the same posture. The instructions for the prisoners' dilemma game (presented as a trading task to the player) were presented on the computer display used for the calibration task. On the last page of the instructions, the frame of the payoff matrix was presented and the player was told that the entries of the matrix will be shown as both of the players pressed the "start" button. A new display showing the payoff matrix with the entries was presented as the player pressed the "start" button. The players were explicitly told that they would play the game only once. They were also explicitly told that they would never meet the other player either during or after the study. After they made the decision, they were asked to answer a post-experimental questionnaire. The study protocol had been approved by the Ethics Committee of the Department of Behavioral Science, Hokkaido University.

Apparatus

The instructions and the payoff matrix were displayed on a 19" monitor (360 mm x 268 mm) with a resolution of 1028 x 768 (EIZO FlexScan T766). A non-contact type of eye movement tracing device, FreeView DTS by Takei Instruments, with a sampling rate of 30 Hz, was used to track players' eye movement. Participants' head movements were restricted by a chin rest, located 64 cm from the display. The video data of eye movement was continuously recorded from the calibration period to the end of the experiment. We analyzed the time the player's eye was fixated on each of the eight entries of the payoff matrix. We excluded saccade movement of which the velocity was 5° per sec or faster. We also excluded the first 5 sec. of the data from analysis, since players' attention was not so much focused on the payoff matrix for that period. Gaze at a particular entry was defined when eye's fixation point stayed inside a rectangular (either the right half or the left half of the 2 x 2 matrix) for 166 msec or longer. Two participants (both were females in the simple matrix condition) showed no fixation on any point on the payoff matrix according to the above definition, and thus was excluded from the data analysis.

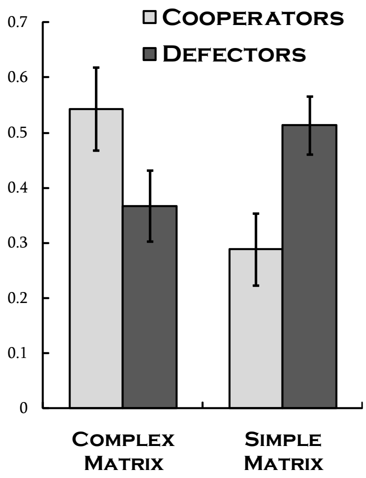

Figure 1. Proportion of the eye gaze on the partner's payoffs over the total duration of eye gaze. Error bars represent standard errors.

Results

We first used a pair of post-experimental questions to demonstrate that game players in the simple matrix condition perceived the game as an instance of social exchange, more strongly than did those in the complex matrix condition. We asked the game players how strongly they perceived the game as a situation in which they provide mutually needed help (exchange situation), and a situation in which each cares about their own benefits (non-exchange situation) on a 7-point response scale. Responses to the first question minus responses to the second represent how strongly players defined the game as an instance of social exchange. Players in the complex game condition defined the game as an instance of social exchange ($M = 0.26$, $SD = 3.19$) to a lesser degree than did players in the simple game condition ($M = 1.79$, $SD = 2.87$), and the difference was statistically significant, $t(60) = 2.07$, $d = .50$, $p = .043$.

Twenty-six players (43.3%) cooperated and 34 defected in the PD game. On average, players spent less than 50% (42.7%), $t(59) = 2.15$, $p = .036$, of their gaze time on payoffs to the other player. Results of our experiment supported the social utility models' prediction only in the complex payoff matrix condition, in which the cooperators spent more time gazing at payoffs to the other player longer than did defectors (Figure 1). Neither the main effect of the matrix type or the player's type (cooperators versus defectors) was significant in the matrix type by player's type ANOVA. The interaction effect of the two was significant, $F(1, 56) = 9.51$, $p = .003$, $\eta^2 = .145$. Planned comparisons between cooperators and defectors show the following results. In the complex matrix condition, cooperators spent more time gazing at the other player's payoffs (in proportion to the total time gazing at payoffs) than did defectors, $F(1, 55) = 4.24$, $p = .044$. In the simple matrix condition, on the other hand, cooperators spent less time gazing at the other player's payoffs than did defectors, $F(1, 55) = 4.83$, $p = .032$. Further analysis shows that the reversal of the gaze pattern by cooperators in the simple matrix condition occurred mostly in the mutual cooperation cell. Cooperators in the simple matrix spent 47.7% of their gaze on the mutual cooperation cell, most (75.4%) of which on their own payoffs. In contrast, cooperators in the complex matrix condition spent only 29.3% on the mutual cooperation cell, and only 46.4% of that on their own payoffs.

Additional evidence that comparisons of utilities were involved only in the complex matrix condition comes from their responses to post-experimental questions. We asked players how satisfactory each of the four outcomes of the game to them ("How satisfactory will it be to you if you chose … and the other person chose …, and as a result you earned … JPY and the other person earned … JPY?") on a 7-point scale. We subtracted the sum of satisfaction scores for the mutual defection cell and the unilateral defection cell from the sum of satisfaction scores for the mutual cooperation cell and the unilateral cooperation cell to calculate the "satisfaction in cooperation score." This measure of satisfaction in cooperation was positively correlated with the time players gazed at the partner's payoffs in the complex matrix condition ($r = .433$, $p < .015$); those who derive satisfaction from outcomes of cooperation paid more attention to the other player's payoffs. Furthermore, cooperators in the complex matrix condition derived a greater satisfaction from cooperation ($M = 2.00$, $SD = 2.77$) than defectors ($M = -0.44$, $SD = 2.57$). In contrast, the satisfaction score was not related to the gaze time in the simple matrix condition ($r = .188$, ns.), and the difference on this scale between cooperators and defectors was in the opposite direction ($M = -1.38$, $SD= 3.04$, vs. $M = 0.44$, $SD = 2.50$). The Matrix Type by Player Type interaction effect on this scale was significant, $F(1, 56) = 9.16$, $p = .004$, $\eta^2 = .145$. No other effect was significant. Planned comparisons show that the difference between cooperators and defectors is significant in the complex matrix condition, $F(1, 56) = 6.17$, $p = .016$, but not in the simple matrix condition, $F(1, 56) = 3.26$, $p = .077$.

Discussion

The results shown above are strong and consistent. Players perceived the game as an instance of social exchange more strongly when they faced a simple matrix than a complex matrix. As predicted by social preference models, cooperators paid more attention to the partner's payoffs, and those who derived more satisfaction from the outcomes of cooperation were more cooperative than those who did not. However, this pattern was observed only when game players were shown a complex matrix. When the payoff matrix was simple so that players could easily appreciate it as an instance of social exchange, how much attention they paid to the payoffs of the other partner or how much satisfaction they derived from cooperation did not affect their behavior. Fast and rule-based decision heuristics catered to social exchange, not comparisons of social utility, provide a better explanation for the latter behavior. In a situation that does not subjectively represent social exchange (i.e., in the complex matrix condition), such heuristics are not likely to operate. As a consequence, players in the complex matrix condition resort to the deliberate and general purpose information process that is consistent with social utility models.

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