Return Good For Good?—Experimental Study
Based on an Emotion Game

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Keywords: Emotion game, Emotion, Environment, Strategy.

Abstract. Payoff, emotion, environment and strategy will affect players’ actions in a game. An emotion game has the features of separating the payoff’s effect from an emotion’s effect on decision-making. In this study, the human subject played repeated emotion games with his computer opponents who were randomly selected according to a fixed probability in different altruistic environments, and the payoff for each human subject was not decided by his own action. We demonstrate the influence of emotion and environment on strategy. We find that altruistic actions will increase with the degree of environmental friendliness, but friendliness without punishment will not only play a positive role, but will also change people’s coping strategies and make people more prone to speculation and vengeance. An opponent’s unfriendly behaviour in a friendlier environment can make people feel more dissatisfied and retaliate more.

Instruction

In decision-making, human beings often pay attention to other people’s incomes or their income relationships and are triggered by different emotions affecting their decision-making. Social preference theory has partly explained the subjects’ boundedly rational behaviors in the ultimatum, dictator, gift exchange and public goods games. Social preferences, such as altruistic preferences, unequal aversion preferences (dissatisfaction or guilt), reciprocal preferences, and competitive preferences, among other types, all relate to the subjects’ emotions.

In the above game experiments, the combined effects of monetary payoffs and emotions on the subject’s decision-making were studied, because the game involved a trade-off between players’ own payoffs and those of others. To eliminate the influences of this trade-off, researchers proposed playing a generous game [1] and an envy game [2]. In those games, a player’s actions only affect his own or another’s earnings, and he can change one’s payoff without paying any monetary cost. The emotion game has the same features as these games and simple choice experiments [3]. Unlike the above games, in the emotion game, two players can make their decisions under the same conditions. The results of interaction between two players may trigger the subject’s emotions that influence his decision-making, making the subject’s choice focus on a particular option and highlighting the role of emotion.

The studies have shown that emotions [4] and environments [5] impact subjects’ actions. Social preferences are influenced by the environment. The previous experimental studies on social preferences mostly used one-shot games, and the actions of players are their strategies in the game. The influences of emotion and environment on behaviour also have an impact on strategy. In game theory, strategy refers to a complete set of action plans under all possible circumstances, which helps the player determine how to act. In repeated games, the strategy is the plan according to which the player decides to act based on the information available, including their own and other players’ previous actions, the gains and so on. What is the impact of emotion and environment on strategies in repeated games? We will study it in this paper.
Experiment Design

The payoff matrix of emotion game is as follows:

|       | Column player |   |
|-------|--------------|---|
| Row player | 1  | 2 |
| 1       | 1,1          | 2,1  |
| 2       | 1,2          | 2,2  |

In an emotion game, one player’s payoff is completely determined by the action of the other player, and one player can make his opponent receive more without paying any monetary cost. Choosing option 2 is called altruistic behaviour, in which the player behaves in a friendly way. However, it is impossible for the player to change his (or her) own income by his (or her) action. For the fully rational subject, he (or she) has no optimal strategy; he (or she) could choose option 2 with any probability at the individual level, but at the group level, there is a unique value of 0.5. However, if the emotions are taken into account, the game payoff structure will change, which is similar to Prisoner’s dilemma or the Stag Hunt game. The role of some emotion is highlighted.

Although the player’s payoff does not depend on his own action in a static emotion game, the player can change his own payoffs through reciprocity in the repeated game. This study focuses on the influence of emotion on decision-making where it is not possible to change one’s own payoffs by his own actions, so the possibility of reciprocity must be eliminated. To do that, we design human-computer experiments in which the human player’s opponent is a virtual computer player who is randomly selected according to a fixed probability, a framework which is more suitable for studying the evolution of emotion and strategy. Games with the computer opponents have been used in many studies to identify how people respond to a particular strategy in a specific game [6], to study the mismatch between individual human behaviour and a certain learning rules [7], to analyse the behaviour patterns of players [8] and to identify individual social preferences in some strategic environments [9,10,11,12,13,14,15].

In our previous studies, we have demonstrated that strong reminders can minimize a human player’s emotional involvement, whereas weak reminders can lead to more emotional involvement. Although initially knowing his opponent was a computer without emotion, the human player still unconsciously treated his opponent as a human player in repeated games. When interacting with a computer player with emotions on a group level, the human players acted differently in various altruistic environments. In this paper, we will further study the reason for different actions in various altruistic environments. When the computer opponent chose randomly, the human subject’s response to a different combination of the two players’ actions in last round was treated as his strategy. We will compare strategy with and without emotions and investigate the impact of emotion on strategy. We change the degree of friendliness (kindness) of the environment to study the impact of environment on strategy.

Experiment Hypothesis

In the experiments, the computer player has no emotions and it does not react to human behaviour, but the human players have emotions. Altruistic, unequal aversion, and competitive preferences, along with other psychological factors can affect a subject’s decision-making. The subjects with altruistic preferences will always choose option 2, those with competitive preferences will always choose option 1, and those with unequal aversion preferences will adjust their choices according to the combination of the two players’ choices in the last round to express their feelings of dissatisfaction, guilt and calm. This study focuses on the effects of dissatisfaction, guilt, calm and friendliness of environment on each subject’s strategy.

Studies showed that participants would express their feelings through their behaviours when their actions were costless. For example, the proponents were more generous with efficiency in the generous game [1]. Abbink and Sadrieh [4] found that approximately 40% of the participants
destroyed for the pleasure of destroying when they could simultaneously destroy each other without any destruction cost and did not fear retaliation. Therefore, we make the following assumption:

On the group level,
Hypothesis 1: When the player’s payoff does not depend on his own action, the players with unequal aversion preferences cope strategically to express their emotions.

Hypothesis 2: In different altruistic environment, the coping strategies of the human players with unequal aversion preferences are different.

Because friendly environments can make people feel more comfortable, they are conducive to the generation of positive emotions in a more altruistic environment; the negative emotions of subjects will be weakened and people will behave in a friendlier manner, so subjects’ coping strategies will change.

Experiment Procedure

There are three treatments in the experiments, each consisting of 96 subjects in each treatment playing 100 rounds of emotion games with his computer opponents. All the subjects were recruited from BBS of Beijing Normal University. All 288 subjects were randomly selected to participate in the experiment. In each treatment, different human subjects played with different virtual computer players, but the set of strategy choices for the different virtual computer players was the same. In each round, the computer player chose according to the fixed probability \( q \). A different probability of the computer choosing option 2 decides the altruistic degree of the environment under different treatments. The bigger the probability \( q \) is, the friendlier the environment is. The details of the experiments are shown in Table 1. The computerized experiments were programmed in Z-Tree software [16].

| Treatment | Altruistic | Value of \( q \) | Reminder | Number of subjects |
|-----------|------------|-----------------|----------|-------------------|
| WAWR      | Weak       | 1/3             | Weak     | 22 Male, 74 Female, 96 Total |
| MAWR      | Median     | 1/2             | Weak     | 24 Male, 72 Female, 96 Total |
| SAWR      | Strong     | 2/3             | Weak     | 24 Male, 72 Female, 96 Total |

Table 2. Summary of behavioural types in experiments.

| Treatment | Competitive | Unequal aversion | Altruistic | Total |
|-----------|-------------|------------------|------------|-------|
| WAWR      | 3           | 88               | 5          | 96    |
| MAWR      | 5           | 88               | 3          | 96    |
| SAWR      | 4           | 87               | 5          | 96    |

In the experiments, human subjects did not know the value of \( q \); they only knew that the computer would randomly select according to a fixed probability. In each round, when the human player was making his decision, he did not know his computer opponent’s choice, and vice versa. After two players chose, the two players’ choices, their payoffs for the current round, and their current accumulated payoffs were shown to the human subjects. After 100 rounds of experiments, the human player’s accumulated payoff of 100 rounds was converted to a real payoff according to the following equation: 5 points nominal payoff = 1 CNY. The experiment lasted approximately 40 minutes. After 100 rounds of experiments, the subject filled in a questionnaire asking for basic information and was paid 10 CNY. Each subject was paid 36~43 CNY in total.
Experiment Result

Even in different environments, individuals with altruistic preferences will always choose option 2 and individuals with competitive preferences will always choose option 1. In this study, the individual whose percentage of choosing option 2 in 100 rounds was less than 5% is defined as a subject with competitive preferences, the individual whose percentage of choosing option 2 was more than 95% is treated as a subject with altruistic preferences, and the remaining individual is a subject with unequal aversion preferences. In three treatments, the components of these three kinds of subjects are shown in Table 2. The Kruskal-Wallis nonparametric test shows that there is no difference among the three treatments (p-value= 0.283). In the following analysis of the influence of emotion and environment on strategy, we mainly aim at the subjects with unequal aversion preferences, while the subjects with altruistic preferences and competitive preferences are moved.

Result 1: The Subjects with Unequal Aversion Preference Did Not Select Randomly But Responded Strategically

We found that for the subjects with altruistic preference, as q decreases for the computer player, the probability that the human players choose option 2 also decreases. In SAWR, MAWR and WAWR, human players choose option 2 with probability 51%, 47% and 39%, respectively. Are the different results based on the same coping strategies? If the subjects’ unequal aversion preferences do not affect their actions, they will not change their choices according to the combinations of two players’ choices. Then, faced with all four possible combinations of the previous round of bilateral choices (the human player’s choice and the computer player’s choice)-11, 12, 21, 22, the four probabilities $p_{2|ij}$ ($i,j=1,2$) should be the same on the group level, $2|jj$, which means the human player chooses option 2 in the current round under the condition that the human player has chosen option i and the computer has chosen option j in last round. That is, $p_{2|11}= p_{2|12}= p_{2|21}= p_{2|22}=1/2$. Otherwise, because the subject with unequal aversion preferences cares about the payoff relationship between him and his opponent, $p_{2|11}$, $p_{2|12}$, $p_{2|21}$, $p_{2|22}$ will be different. When the outcome is 11 or 22, their payoffs are the same and the human player feels calm, but he will be more pleasant in state 22 and will choose option 2 with a bigger probability. When the outcome is 12, his own payoff is more than his opponent, he may feel guilt and will compensate his opponent, and the probability of choosing option 2 in the next round will be bigger than that in state 11. When the outcome is 21, his own payoff is less than his opponent’s payoff, so he may feel dissatisfaction and will pay his opponent back, and the probability of choosing option 2 in next round will be smaller than that in state 22.

We think that individuals with unequal aversion preferences will adjust their choice strategies according to the combinations of the two players’ choices. In each treatment, we take all human individuals with unequal aversion preferences as homogeneous individuals to study their group coping strategies. Therefore, the individual mixed strategy of a single round is the same as the group strategy. If the four probabilities are not all 1/2, it shows that different combinations of choices have impacts on the players’ upcoming choices.
In each round, we may count the four frequencies \( f_{2|11}, f_{2|12}, f_{2|21}, f_{2|22} \), which are the estimated values of \( p_{2|11}, p_{2|12}, p_{2|21}, p_{2|22} \). We calculate the 40 rounds moving average value of \( p_{2|11}, p_{2|12}, p_{2|21}, p_{2|22} \) and find that in each treatment these 4 values are not the same. The evolution of each \( p_{2|i} \) by round is shown in Fig. 1.

It shows that although the computer chose randomly, the human players still adjusted their actions according to the results that they faced. However, the four coping probabilities have the same evolutionary characteristics, and the fluctuation is not obvious with the increase of round. It shows that the subjects’ strategies are stable in the face of random situations.

The group strategy is stability, so we can analyse the evolution of group actions according to Markov transfer. For example, in WAWR, the first order Markov transfer matrix is shown in Table 3. From Table 3, we can obtain the estimated values of \( p_{2|11}, p_{2|12}, p_{2|21}, p_{2|22} \), as shown in Table 4. The sum of the absolute differences between the statistical results and the theory’s stable state is 0.006, which shows that our hypothesis of the human players’ group strategy can explain most of the human players’ group behaviours.

### Table 3. Transition probabilities of one-shot outcomes in WAWR.

| Choices of the two players | 11    | 12    | 21    | 22    |
|---------------------------|-------|-------|-------|-------|
| 11                        | 0.5371| 0.2543| 0.1422| 0.0663|
| 12                        | 0.4767| 0.2515| 0.1757| 0.0960|
| 21                        | 0.3080| 0.1506| 0.3632| 0.1782|
| 22                        | 0.1231| 0.0534| 0.5413| 0.2823|

### Result 2: Environments Change Coping Strategies

In the three treatments, the environment’s altruistic (friendliness) degree is controlled by changing the probability of the computer choosing option 2, and the 40-round moving average value of each coping probability is shown in Fig. 1. The four probabilities in different treatments changed by round, and we find that the influences of environment on strategies vary differently.

1. The human players’ strategies are more sensitive to environmental friendliness when their opponents are not friendly. Although there are differences in the three environments for both \( p_{2|12} \) and \( p_{2|22} \), Fig. 1 shows that the differences are much smaller than that of both \( p_{2|11} \) and \( p_{2|21} \) clearly. Moreover, the differences occur earlier for \( p_{2|11} \) and \( p_{2|21} \).

2. Although they are increasing by round, \( p_{2|11}, p_{2|12}, p_{2|21} \) all decrease. However, in the friendlier environment, the human players felt more optimistic, and in SAWR, \( p_{2|11} \) is always bigger than it is in the other two environments. It is worth noting that a friendlier environment can
breed the subject’s discontent when the human players benefit less than their opponents, so their retaliatory behaviours increase. The reason for this may be that a small number of unfriendly actions in a friendlier environment can make the human players more impressed, because “You could be friendly, but you weren’t friendly”. At the same time, the guilt of facing his own unfriendly behaviour when his opponent was being friendly will be slightly weakened, which results in a slight increase in speculation, and which may be related to the fact that the computer always chooses at random without punishing anyone’s unfriendly behaviour.

(3) In the more hostile environment, the human players may feel more discontent and pessimism. Even in the face of both players acting friendly, both the perceptions of environmental friendliness and pessimistic expectations will reduce the human players’ friendliness, and it is evident that p2|22 of WAWR decreased in the later stage of experiments, however that in both other environments still remain unchanged.

The combined effect of emotion and environment makes the human players’ coping strategies similar but different in different various altruistic environments, which makes the human players’ frequency of choosing option 2 different. As shown in Table 4, with the decrease of the degree of altruism in the environment, the human players’ frequency of choosing option 2 also decreases correspondingly on the group level. The experimental results are basically consistent with the theoretical analysis in WAWR, MAWR and SAWR according to the first order Markov transfer.

**Table 4. Summary of group coping probabilities, stable state and choosing probabilities of the human players with unequal aversive preferences.**

| Treatment | Coping probabilities | Stable state | Frequency of the human players’ actions |
|-----------|----------------------|--------------|----------------------------------------|
|           | Coping Probabilities | Option       | Theory | Outcomes | Option | Theory | Outcomes |
| WAWR      | 2|11 | 0.2086 | 11 | 0.412 | 0.410 | 1 | 0.613 | 0.610 |
|           | 2|12 | 0.2718 | 12 | 0.201 | 0.200 | 2 | 0.387 | 0.390 |
|           | 2|21 | 0.5414 | 21 | 0.257 | 0.260 | 1 | 0.535 | 0.532 |
|           | 2|22 | 0.8236 | 22 | 0.130 | 0.130 | 2 | 0.465 | 0.468 |
| MAWR      | 2|11 | 0.2233 | 11 | 0.269 | 0.268 | 1 | 0.491 | 0.487 |
|           | 2|12 | 0.2941 | 12 | 0.266 | 0.264 | 2 | 0.509 | 0.513 |
|           | 2|21 | 0.5548 | 21 | 0.232 | 0.233 | 1 | 0.491 | 0.487 |
|           | 2|22 | 0.8499 | 22 | 0.233 | 0.235 | 2 | 0.509 | 0.513 |
| SAWR      | 2|11 | 0.2820 | 11 | 0.162 | 0.161 | 1 | 0.491 | 0.487 |
|           | 2|12 | 0.2626 | 12 | 0.329 | 0.326 | 2 | 0.509 | 0.513 |
|           | 2|21 | 0.5182 | 21 | 0.167 | 0.168 | 1 | 0.491 | 0.487 |
|           | 2|22 | 0.8487 | 22 | 0.342 | 0.345 | 2 | 0.509 | 0.513 |

**Conclusion and Discussion**

In this study, we demonstrate when someone’s action cannot decide his payoff, how emotion, psychological factors and environment affect the strategies of subjects with unequal aversion preferences, though the situation they face occurs randomly. The majority of people have unequal aversion preferences. Repetitive interactions can make someone’s emotions work even when his opponents do not intend to act. Human perception of unfriendly environments and unfriendly behaviour is more immediate and intense. The friendly environment and the opponent’s friendly action will enhance the possibility of the subjects acting in a friendly way, but friendship without any punishment will provide more opportunities for speculation and, even a relatively friendly environment, will breed human revenge. The subjects do not entirely return good for good. It is impossible to influence and enhance human friendliness completely only through blind friendliness. This study excludes the effect of one’s own behaviour on his payoff. Then, if the subject’s payoff also depends on his own action, how will the human player’s response strategy change? Which
effect on the individual decision-making will be better between emotions and monetary payoffs? All of those will be studied later. It is believed that the game experiment in which the virtual computer will respond to the human player and the game experiment in which both players are human beings with emotions will help us know more.

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