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The Full Information Feedback in Minimum-Effort Game: An Experiment

Yang Huang, Yuhang Fu, Ya Zhou*, Keqiang Li

School of Systems Science, Beijing Normal University, Beijing, China
Email: *yzhou@bnu.edu.cn

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Abstract

We report an experiment designed to test for the impact of giving more information feedback about others' choices in the previous period on coordination in a repeated minimum-effort game. We consider full and limit feedback treatments. Our results indicate that full feedback group coordinates at higher level of effort and more group in full feedback treatment reach equilibrium and coordination success than limit feedback group. Compared to the previous studies, we can observe the coordination outcome in the long run by repeating the game 50 times and full feedback is giving the subjects full information about others' choices in this period and historical choices in last 10 periods in the group.

Keywords

Minimum-Effort Game, Coordination, Information Feedback, Experiments

1. Introduction

Minimum-effort game, also named weakest-link game or weak-link game, is proposed originally by Van Huyck [1]. As one of the coordination game, minimum-effort game has multiple Pareto-ranked Nash equilibria including payoff-dominant equilibrium and risk-dominant equilibrium. The payoff of the player in the minimum-effort game depends on his own choice and the worst choice of the group.

The experimental results in previous studies indicate that larger groups typically select lower coordination levels and even coordinate to the risk-dominant equilibrium which means coordination failure [2]. Henceforth, experimental researches on minimum-effort game mostly focus on the way of reducing the probability of coordination failure. Researchers try to find the way to overcome coordination failure, such as designating a leader [3], managing growth of group size [4], sharing more information [5], recommending a choice [6] and introduc-

*Corresponding author.

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ing competition between groups [7].

In the experimental researches on the impact of sharing more information on coordination, Deck and Nikiforakis study the real-time monitoring in the minimum-effort game [5], in which subjects can observe the concurrent choices of others. But what we concern is the ex-post monitoring, which means subjects can get some information feedback at the end of a period.

Several researches on the impact of giving more information feedback on coordination have reached different conclusions. In the critical mass game [8] and the corporate turnaround game [9], researchers find positive impact on coordination outcome by informing the subject of the distribution of others' choices of the previous period in the group. Berninghaus and Ehrhart [10] and Engelmann and Normann [11] study the coordination in different information feedback conditions in minimum-effort game. Berninghaus and Ehrhart find that giving more information feedback contributes to coordination in higher level than merely giving minimum effort in the group [10]. Engelmann and Normann [11] agree with and Ehrhart [10] in group of size 6, but disagree in group of size 4. By playing the critical mass game and minimum-effort game in turn, Devetag finds that informing the subject of the distribution of group members' choices of the previous period does not lead to the outcome of higher minimum effort [12]. To explain these, Engelmann and Normann [11] claim that there is high share of Danes coincidently in group of size 4 with not knowing the distribution of group members' choices. And in the experiment of Devetag [12], there is not a control group with not knowing the distribution of group members' choices.

In experiments of minimum-effort game, the game repeat less than 15 times, which is too short to get stable results in the long run. In most experiments the subject can observe the distribution of group members' choices of the previous period in information feedback, while in one experiment, the subject can observe the individual choices of each group member of the previous period in information feedback.

The purpose of this paper is to examine whether giving full information feedback raises the coordination level in minimum-effort game. In experimental design there are 2 treatments, that is, full feedback group (treatment I) and limit feedback group (treatment II). Full feedback group is the experiment group in which the subject is informed of his own payoff in the period, other group members' choices in this period and historical choices of last 10 periods, as well as maximum, minimum and average effort level of group in this period and last 10 periods. Limit feedback group is the control group in which the subject is informed of his own payoff and minimum effort of the group in the period. In each treatment, there are 10 groups in each of which 6 subjects play the minimum-effort game simultaneously, and the game repeats 50 times in each group to observe the coordination outcome in the long run. Our results indicate that full feedback group coordinates at higher level of effort than limit feedback group, thus, knowing others' historical strategies in the group contributes to overcome coordination failure.

2. Experimental Design

In the version of the minimum effort game in [1], players simultaneously select different effort levels. Player i's payoff depends on his choice and the minimum effort in the group. All the players are informed that the payoff function and strategy set are common knowledge, the game has 7 strict Pareto-ranked Nash equilibria, where each subject selects the same effort level with their counterpart. In the payoff-dominant equilibrium, all players select, while in the risk-dominant equilibrium all players select. With the lower equilibrium effort level, the equilibrium payoff decrease gradually.

Our experiment consists of 2 treatments, that is, full feedback group (treatment I) and limit feedback group (treatment II). In treatment I, each subject in the group is informed of his payoff in the previous period, group members' choices of the previous period and last ten periods, as well as the maximum, minimum and average effort level of the group in the previous period and last ten periods. In treatment II, each subject is merely informed of his payoff and the minimum effort level of the group in the previous period. Treatment I and II stays the same with other experiment conditions. In each treatment, there are 10 groups in each of which 6 subjects play the minimum-effort game simultaneously, and the game repeats 50 times in each group.

When subjects came to the lab, each one was randomly allocated a number which leads him to a seat with a computer. At the beginning of the experiment, the instructions were read aloud and displayed in the computer screen at the same time. All subjects were informed of making his decision alone and keeping silence all the time. These were common knowledge including the group size, fixed group members, the repetition times, the

strategies and the payoff table except group members' personal identity. In each period, the subject made his own choice. After all group members' choices were made, the computer system gave them information feedback which showed the payoffs and the choices. After the end of 50th period, subjects filled in a questionnaire and received the payment.

The computerized experiments were programmed in Z-Tree software and conducted in the Beijing Normal University. All 120 subjects were college students recruited from BBS on campus. The experiments continued about 45 minutes with standard procedures including reading instructions, playing the game, filling in a post-experimental questionnaire and paying the reward. Each subject was paid his accumulated payoff of 50 periods in RMB. The exchange rate was 1 yuan per EC (Experiment Currency), and they earned 45.53 yuan in average.

3. Results

According to the definition of Nash equilibrium, if all subjects select the same level of effort in the group for more than 5 periods continuously, we define that the group has reached the equilibrium. On the other hand, if the minimum effort of the group in the 50th period is more than one and the mode of minimum effort of 50 periods is not one, we define that the group has come to coordination success; otherwise, it is coordination failure. The results of whether the game reaches the equilibrium and coordination success is summarized as **Table 1**.

Our experimental results are summarized as follows.

1. Most groups in Treatment II finally coordinates at one, which mainly remain the same as the experiment in Van Huyck *et al*. (1990).

2. Contrast to Treatment II, groups in treatment I get easier to achieve equilibrium and coordination success, and get higher average minimum effort of coordination success. As shown in **Table 1**, 7 groups in Treatment I and 1 groups in Treatment II has reached equilibrium, while 7 groups in Treatment I and 4 groups in Treatment II has reached coordination success. In the groups which has reached coordination success, the groups in Treatment I coordinates at 6.57 in average while the groups in Treatment II coordinates at 4.25. In 2 of 3 groups in coordination failure in Treatment I, the subjects coordinate at 5 or 6 in first 10 periods but coordinates at 1 in the end. The reason is that one subject in the group suddenly decrease his effort due to revenge and the group never come back to coordinate at high level.

3. The initial outcome in the 1st period is not essentially different between two treatments. As shown in **Table 2**, the average minimum effort in 1st period of 10 groups in Treatment I is 3.50, which is close to 3.10 in Treatment II, and there is no significant difference between them.

4. However, the final outcome is significantly different between two treatments. As shown in **Table 2**, the average minimum effort in 50th period in Treatment I is 4.9, which is twice more than 2.3 in Treatment II.

5. Subjects in Treatment I select higher level of effort than in Treatment II. As shown in **Figure 1** and **Figure 2**, the average minimum effort and the average effort of 10 groups in each period in Treatment I is higher than

Table 1. Information about equilibrium and coordination.

		Treatment I	Treatment II
Number of groups	Equilibrium	7	1
	Coordination success	7	4
Average minimum effort	Equilibrium	6	7
	Coordination success	6.57	4.25

a. Treatment I means "full feedback group" and Treatment II means "limit feedback group" which only provides the minimum effort level in the previous period.

Table 2. Average minimum effort.

	Treatment I	Treatment II
Average minimum effort in 1st period of 10 groups	3.50	3.10
Average minimum effort in 50th period of 10 groups	4.90	2.30

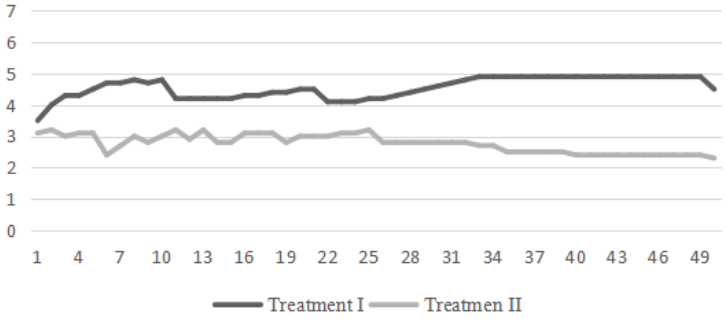

Figure 1. Average minimum effort of 10 groups in each period.

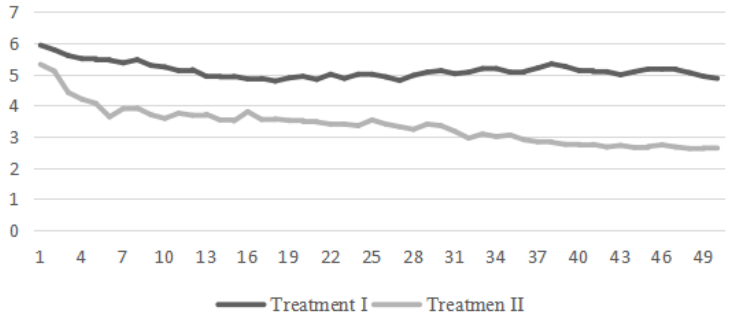

Figure 2. Average effort of 10 groups in each period.

Table 3. Groups in coordination success and failure.

			Coordination success	Coordination failure	Total
Treatment I	Minimum effort in 1st period < 4	Number	2	2	4
		Proportion	50%	50%	100%
	Minimum effort in 1st period ≥ 4	Number	5	1	6
		Proportion	83%	17%	100%
Treatment II	Minimum effort in 1st period < 4	Number	1	3	4
		Proportion	25%	75%	100%
	Minimum effort in 1st period ≥ 4	Number	3	3	6
		Proportion	50%	50%	100%

Treatment II. Besides, the average minimum effort of 10 groups in Treatment I does not show a downtrend as period number increases, on the contrary, the average minimum effort of 10 groups in Treatment II is slowly decreasing.

6. The initial outcome in the 1st period has a positive effect on coordination and the groups in Treatment I coordinates better than Treatment II no matter what initial outcomes. As shown in **Table 3**, the higher the minimum effort in 1st period, the more coordination success in 50th period. Besides, the initial state of groups in Treatment I is the same as Treatment II. No matter when minimum effort in 1st period is lower than 4 or otherwise, more groups come to coordination success in Treatment I.

The observation that the average minimum effort in the 1st period is close between two treatments but they are much different in the 50th period was also found in Berninghaus and Ehrhart [10]. They found that the average minimum effort and average effort in each period in Treatment I is higher than Treatment II. However, because in their experiment there are only 10 periods for the game, they did not find the outcome in the long run. In the 10th period, they already observed the downtrend in average minimum effort in the full feedback groups,

and no one would know the trend after 10 periods. Our results in average minimum effort in Treatment I show a slight uptrend from 27th to 33rd period.

4. Conclusions

Giving more information feedback about others' choices in the previous period in the group in minimum-effort game leads to less coordination failure and higher minimum effort level. It mostly has a positive impact on coordination for helping to form common belief in coordinating at high level of effort and gaining high payoff. That is, the disclosure of game history can help players to form a consistent expectation of the final result, which also seems to give them a costless opportunity to acclaim their different thought. Only if all group members' purpose are the same with others to maximum their own payoff, giving more information feedback will significantly contribute to coordination success.

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