

Free-riding and Intergroup Mobility

—A Social Dilemma Experiment—*

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Abstract

How does intergroup mobility affect free-riding? In modern societies, we enjoy increasing mobility, such as in job change, move, and immigration. This applies especially in this age of globalization and internet. Still, it is yet to be clarified whether such mobility benefits cooperative behavior or free-riders. This is because mobility provides chances to create new cooperative groups, but at the same time it breaks current ones. To specify these effects, we conduct an experiment with 100 participants in six sessions. Three conditions are compared, each with two sessions: high mobility, low mobility, and no mobility. Data provide two findings. (i) We observe a U-shaped curve of cooperation as intergroup mobility changes. This implies that mobility first breaks cooperative groups, and then creates them. (ii) Nevertheless, we also find a decline of cooperation when mobility is introduced. This supports a prediction based on the breaking effect.

Keywords and phrases: Free-rider, mobility, social dilemmas, exit option, experiment.

1 Introduction

1.1 Free-riding and Mobility

We examine *how free-riding is prevented in social dilemmas with intergroup mobility*. We test hypotheses in a well manipulated laboratory experiment.

In modern societies, intergroup mobility is increasing. Compared to pre-modern societies, we have options to exit from one group to another. For example, we can move, change jobs, divorce, and immigrate. Especially in this age of globalization and internet, group boundaries become more and more fragile, and hence we can more and more easily change affiliations.

As a result, the free-rider problem becomes more complicated and sometimes more serious, such as in net fraud. If we do not pay attention to the free-rider problem with intergroup mobility, such conflicts may spread more and more.

If, on the other hand, we successfully find solutions to the problem, it will contribute to clarifying the effect of mobility on organizational decision making in general. March and Simon (1958) suggest that “intraorganizational” decisions to cooperate depend on “interorganizational” mobility.

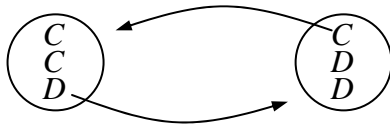
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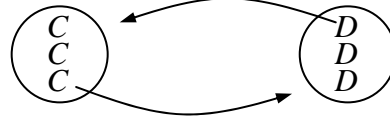
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Note that the effect of mobility is unclear since it has two adverse effects.

1. The exit option provides chances to “create” new cooperative groups. This happens if cooperators successfully escape from free-riders, or free-riders leave cooperative groups. Let us call this “the creating effect.”
2. At the same time, mobility also “breaks” current cooperative groups. This happens when cooperators leave cooperative groups, or free-riders invade such groups. Call it “the breaking effect.”



Creating Effect



Breaking Effect

Which effect dominates is an empirical question. Therefore, we study it *empirically* in a laboratory experiment.

1.2 Social Dilemmas

The free-rider problem occurs in groups or even in more structured organizations. Shirking in workplaces, not donating, tax evasion, environmental pollution, and so on. Those people are called “free-riders.” Sometimes we suffer from free-riders, while sometimes we more or less benefit from free-riding.

Such situations are generalized to “social dilemmas.” Social dilemmas depict conflict between individual rationality and collective efficiency. In a social dilemma, rational persons would free-ride on others’ contributions rather than cooperate to contribute. Yet if many people free-ride, serious dissonance will result.

So far, social dilemmas have been studied mostly for fixed groups without mobility. However, as Hirschman (1970) correctly points out, we often have options to “exit” from a group to another in the real world. This holds true especially in modern societies. We cannot neglect such options.

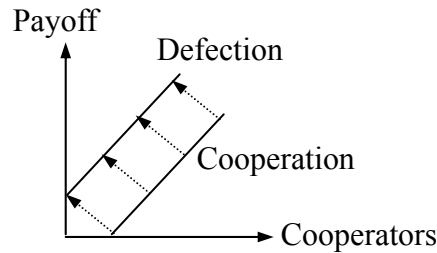
1.3 Literature

In the literature, social dilemmas has been studied theoretically and empirically. However, the effect of mobility is yet to be fully investigated.

Theoretically, Olson (1965) and Hardin (1968) first notice the problem of social dilemmas. Then, Dawes (1980) gives a formal definition to social dilemmas. A situation is a social dilemma if

1. Persons have options of “cooperation” (voluntary contribution) and “defection” (noncontribution);
2. For anyone, noncontribution always provides higher payoff than contribution;
3. But if no one contributes, they receive less payoff than if everyone contributes.

If two persons are involved in a social dilemma, it is called “the prisoners’ dilemma.” With three or more persons, it is called “multiple-person dilemma” (Kollock 1998). We are interested in multiple-person dilemmas. Here is an example of payoff functions in a four-person dilemma.



To social dilemmas, Yamagishi, Hayashi, and Jin (1994) introduce the exit option. They show, by simulations, the effectiveness of “escaping from free-riders.” They generalize the idea of tit-for-tat, which is proposed by Axelrod (1984). Still, their argument is limited to two-person dilemmas. We investigate social dilemmas with any persons.

Empirically, Van Vugt and De Cremer (1999) conduct a laboratory experiment of social dilemmas with the exit option. Yet his primary concern is to analyze the effect of loyalty on cooperative behavior. Instead, we focus on the effect of mobility on cooperation.

In Section 2, we raise hypotheses. To test them, we design a laboratory experiment in Section 3. In Section 4, we report results. Implications and future directions will be discussed in the final section.

2 Hypotheses: Creating and Breaking Effects

2.1 Situation

What may happen in social dilemmas with the exit option? Does mobility promote cooperation or free-riding? To specify the situation, we assume:

1. Persons repeat a social dilemma game in groups at least twice but finitely;
2. Then they have an option to move to another group;
3. After the exit option, they again repeat the social dilemma game;
4. This process is finitely repeated.

For example, in the experiment participants repeat a social dilemmas game five times. Then, they have a chance to move. After this, they restart the game. In total, they play the game for 50 times with nine chances to exit.

In this study, the independent variable is “the moving cost.” The dependent variable is “the cooperation rate.” This is because we focus on the effect of mobility on cooperative decisions in social dilemmas. Participants need to pay some moving costs when they want to move to another group. As the moving cost increases, mobility naturally decreases.

$$\text{Moving Cost (as Mobility)} \rightarrow \text{Cooperation Rate}$$

In the experiment, we compare two levels of moving costs: “low cost” as high mobility and “high cost” as low mobility. In addition, to specify the effect of mobility, we collect data with “no mobility” as the baseline. Therefore, we compare three conditions: high, low, and no mobility.

2.2 Creating New Cooperation/Breaking Current Cooperation

In such a situation, what can we expect? We compare two conflicting hypotheses. Because mobility may create new cooperative groups while it may break current ones.

The first hypotheses is based on the creating effect. If intergroup mobility provides persons more chances to newly create cooperative networks, cooperation rate will increase

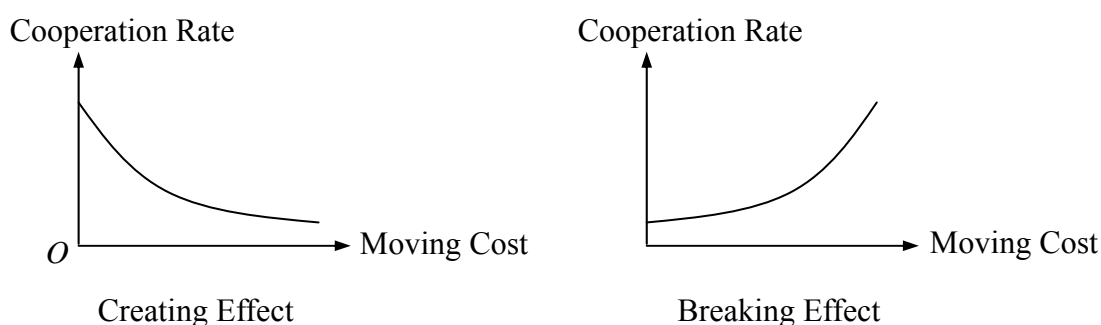
as mobility increases (i.e., as the moving cost decreases).

Hypothesis 1 (Creating Effect) Cooperation will decrease as the moving cost increases.

However, an alternative hypothesis can be addressed, based on the breaking effect. If mobility more help break present cooperative groups, cooperation rate will decrease as mobility increases (i.e., as the moving cost decreases).

Hypothesis 1' (Breaking Effect) Cooperation will increase as the moving cost increases.

This hypothesis agrees with Koyama, Ooura, and Kobayashi's (2004) results from simulations. They suggest that escaping from free-riders becomes more effective as the moving cost increases



3 Data: Experiment

3.1 Experimental Design

To test these alternative hypotheses, we conduct a laboratory experiment. It well controls conditions that may affect the dependent variable of cooperation rates.

In a session, participants play *a social dilemma game with the exit option*. Since we are interested in social dilemmas, we collect group data instead of data on individually isolated decisions.

Participants: Undergraduate students are recruited as participants. The experiment is announced in classes and by advertisements on campus. There is no experienced participant, nor any deception.

Procedure: (i) Seats are assigned to participants by a lottery. (ii) They are seated in a large room with no partition. (iii) An instruction is given by an experimenter. (iv) Before the experiment, they are asked to answer to pre-experiment questionnaire. (v) The experiment is conducted. (vi) After that, participants answer to post-experiment questionnaire. (vii) Debriefing is provided by the experimenter. (viii) Rewards are given.

Rewards: Participants receive rewards of exactly how much payoff they earned in the session. The payoff is measured by yens in the experiment. rewards They are notified of this before the experiment. Still, if one's reward goes below 1,000 yens, she receives 1,000 yens as a minimum reward. They are unaware of this adjustment. The average reward is 1293.35 yens with the standard deviation of 62.45 yens (100 yens is about 90 cents).

Sites: The experiment is conducted in Japanese four universities in December 2003. In a session 16 or 17 participants are enrolled, with total 100 participants. It ranges four sites because we need to recruit many participants at a time.

Sessions: We conduct six sessions. Three conditions are examined, with two sessions

for each condition.

Session	Condition	Number of Participants	Site	Date (2003)
1	Low Moving Cost	17	University A	12/10
2	Low Moving Cost	17	University B	12/17
3	High Moving Cost	17	University A	12/10
4	High Moving Cost	17	University C	12/6
5	No Mobility	16	University B	12/17
6	No Mobility	16	University D	12/15

Time: A session lasts in an hour and a half. The instruction and pre-experimental questionnaire take 30 minutes, the experiment takes 40 minutes, and post-experimental questionnaire takes 20 minutes.

Equipments: Participants are connected by a local area network. We use computers since we need to deal with huge calculations. They make decisions on computers only by clicking mouses.

Instruction: An instruction handout is distributed. Participants keep it through a session. The experimenter explains how the experiment proceeds by reading it. After that, participants are asked to answer two confirmation tests. Solutions are provided.

Matching: Participants are randomly assigned to groups by computer. Each group has four or five participants at the beginning.

3.2 Game Structure

In a session, participants play a social dilemma game with the exit option. Sixteen or seventeen participants are randomly assigned to one of four groups: Groups *A*, *B*, *C*, and *D*.

We compare three conditions:

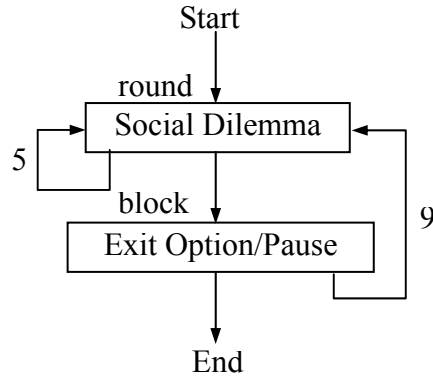
1. exit option with “low” moving costs as the high mobility condition;
2. exit option with “high” moving costs as the low mobility condition;
3. and “no exit option” as the no mobility condition”

The first and second conditions have the same game structure. In the “no mobility” condition, participants experience “pauses” instead of the exit option.

The game consists of two stages:

1. In a round, participants play a social dilemma game in a group for *five* rounds.
2. In a block after five rounds, they have an option to exit (in the high and low mobility conditions) or face a pause (in the no mobility condition).

This process is repeated. Participants play the game for 50 rounds with *nine* blocks. They know the structure of the game, but are uncertain of when it ends.



3.3 Social Dilemma Game in a Round

In each round, participants receive 20 yens as a resource. They decide whether to “provide” it to a group as investment (cooperation) or keep it (defection). The investment is multiplied. Then, it is distributed equally to all the group members.

Payoff functions: The rate of return depends on the group size. In a group with one participant, the return is equal to the investment. This is because there is no “social” dilemma here.

$$u(C) = u(D) = 20,$$

where $u(C)$ denotes the payoff of providing 20 yens while $u(D)$ means that of keeping 20 yens.

In a group with two participants, the investment is multiplied by 1.5.

$$u(C) = 30 \frac{m}{2}, u(D) = 30 \frac{m}{2} + 20,$$

where there are m providers in the group.

In a group with three or more participants, the investment is multiplied by 2.

$$u(C) = 40 \frac{m}{n}, u(D) = 40 \frac{m}{n} + 20,$$

where n is the group size.

Note that these payoff functions, except that in one-person groups, satisfy the conditions of social dilemmas.

Information: Participants make such decisions anonymously. In each round, a participant knows on the computer display:

1. number of providers in the group in the round;
2. her decisions and payoffs in the block;
3. her group name and its group size;
4. average payoffs of each group in the previous round, and those in the block;
5. the size of each group.

3.4 Exit Option/Pause in a Block

Once in a block after five rounds, participants are simultaneously offered an exit option in the “high” and “low mobility” conditions. In the “no mobility” condition, they are required to take a pause.

Exit option: Participants decide which group to spend the next five rounds in. They can stay at the same group. If another group is chosen, participants pay 20 yens in the “low” moving cost condition. They pay 50 yens in the “high” moving cost condition.

$$u(E) = -20, u(S) = 0,$$

$$\text{or } u(E) = -50, u(S) = 0,$$

where $u(E)$ expresses the payoff of exiting and $u(S)$ does that of staying.

Pause: In the “no mobility” condition, participants make a pause for a minute. During this time, they see the same information as shown in the high and low mobility conditions.

$$u(S) = 0.$$

Information: In any conditions, after a block participants are provided with information of:

1. her group name and the payoff she earned in the last block;
2. the average payoffs of each group in each round;
3. the average payoffs of each group in the previous block;
4. the size of each group.

In sum, a participant earns payoffs in a session as

$$\sum_{t=1}^{50} u(a^t) + \sum_{T=1}^9 u(b^T),$$

where $a^t = C, D$ (cooperation or defection on dilemma in rounds) and $b^T = E, S$ (exit or stay in blocks).

4 Results

4.1 Descriptive Statistics

We obtain two major findings.

1. Combining sessions into the three conditions, we observe a significant “U-shaped curve” of cooperation.
2. Combining sessions into “with mobility and without mobility” conditions, there is a significant “fall” of cooperation when mobility is introduced.

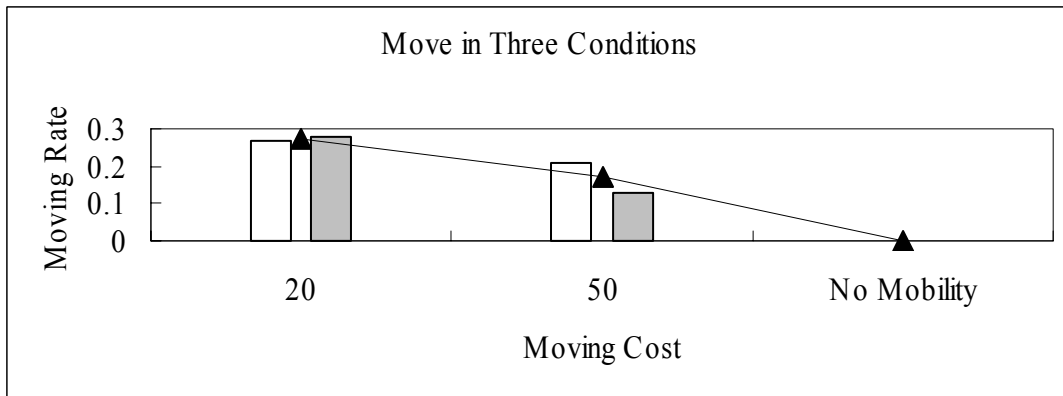
Here is the descriptive statistics of each session. “Cooperation” (providing 20 yens) and “move” (exiting to another group) are measured in proportion. Payoff is in yens. We checked that there was no effect of universities. The standard deviations are measured between rounds in cooperation, between blocks in move, and between participants in payoff.

Condition	Session	Cooperation		Move		Payoff (yens)	
		Mean	S. D.	Mean	S. D.	Mean	S. D.
Low Cost	1	0.286	0.095	0.268	0.094	1218.8	90.8
	2	0.395	0.188	0.281	0.109	1331.8	205.5
High Cost	3	0.256	0.093	0.209	0.094	1145.3	187.4
	4	0.268	0.126	0.131	0.077	1202.9	146.4
No Mobility	5	0.351	0.120	N/A	N/A	1351.3	151.3
	6	0.510	0.113	N/A	N/A	1510.0	268.3
total		0.345	0.154	0.222 [†]	0.108 [†]	1290.6	214.9

†: For Low and High costs conditions.

4.2 Moving Costs and Mobility

Let us start from the moving rate. As we expected, mobility significantly decreases when the moving cost increases.

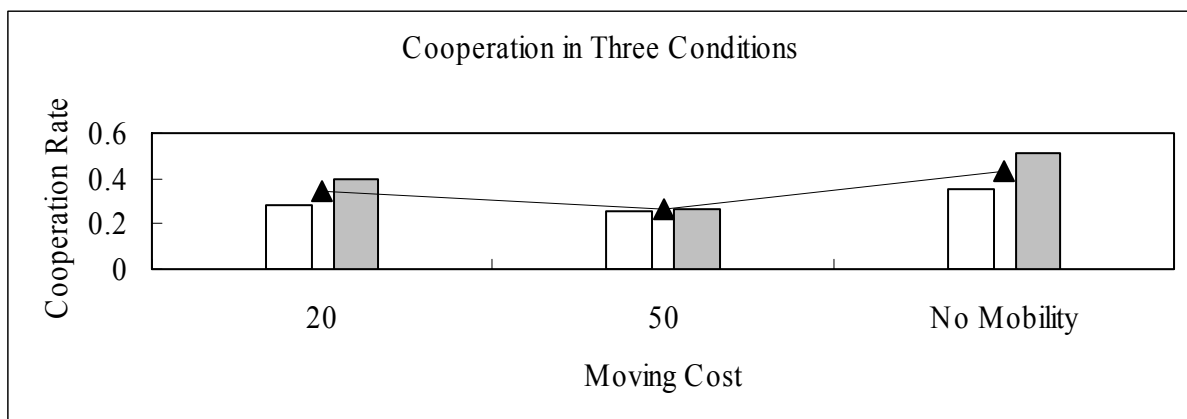


4.3 U-shape of Cooperation in Three Conditions

Now, do the three conditions have differences in the cooperation rate? They do. The first finding is controversial.

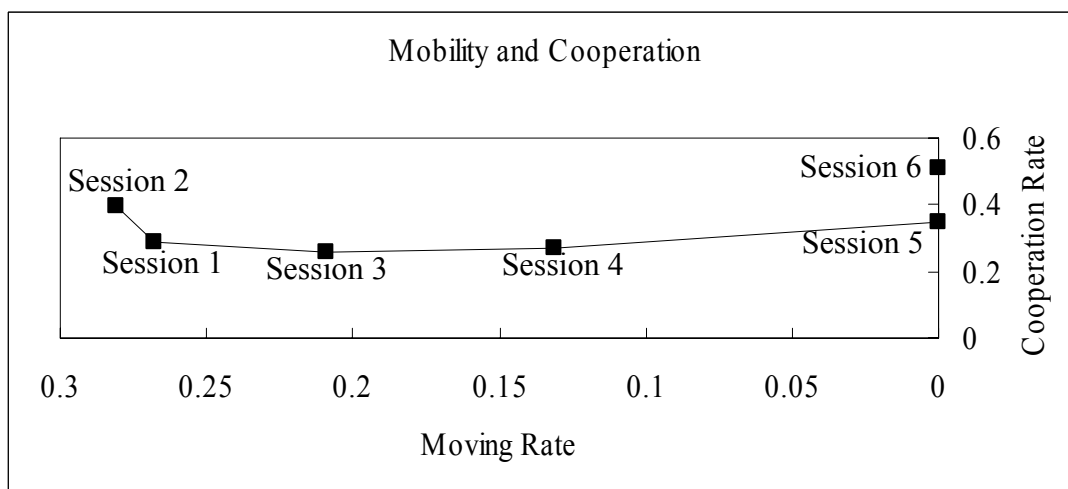
The cooperation rate has a “U-shaped curve” as the mobility increases. This may imply a mixture of our two hypotheses.

Condition	Session	Cooperation		Move		Payoff (yens)	
		Mean	S. D.	Mean	S. D.	Mean	S. D.
Low Cost	1, 2	0.341	0.159	0.275	0.099	1275.3	166.6
High Cost	3, 4	0.262	0.110	0.170	0.092	1174.1	168.2
No Mobility	5, 6	0.431	0.141	N/A	N/A	1430.6	228.9



As the moving cost increases, we predicted two cases. If people behave based on the creating effect of new cooperation, cooperation will increase as mobility increases. If the

breaking effect of current cooperation matters, cooperation will decrease. We can confirm it in the relationship between mobility and cooperation.



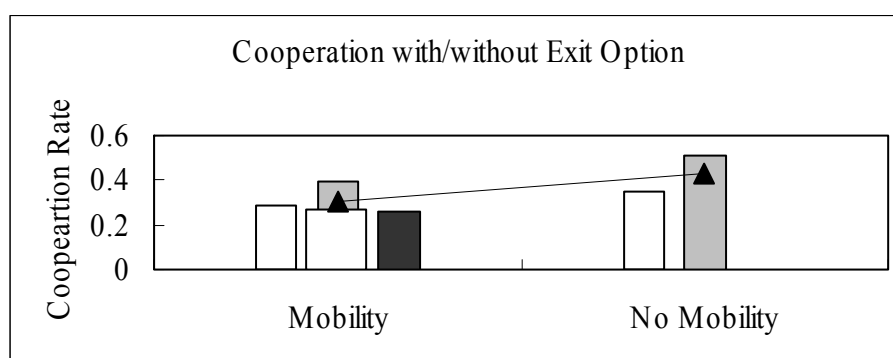
The data shows that as the mobility rises, cooperation first declines. Then it rises. This U-shaped curve indicates that

1. when mobility is low, the breaking effect applies;
2. when mobility is high enough, the creating effect is prioritized.

4.4 Decline of Cooperation with Mobility

Nevertheless, our second finding reveals a significant decline of cooperation when mobility is introduced. This suggests dominance of the breaking effect over the creating effect as a whole.

Condition	Session	Cooperation		Move		Payoff (yens)	
		Mean	S. D.	Mean	S. D.	Mean	S. D.
Mobility	1, 2, 3, 4	0.301	0.142	0.222	0.108	1224.7	173.8
No Mobility	5, 6	0.431	0.141	N/A	N/A	1430.6	228.9

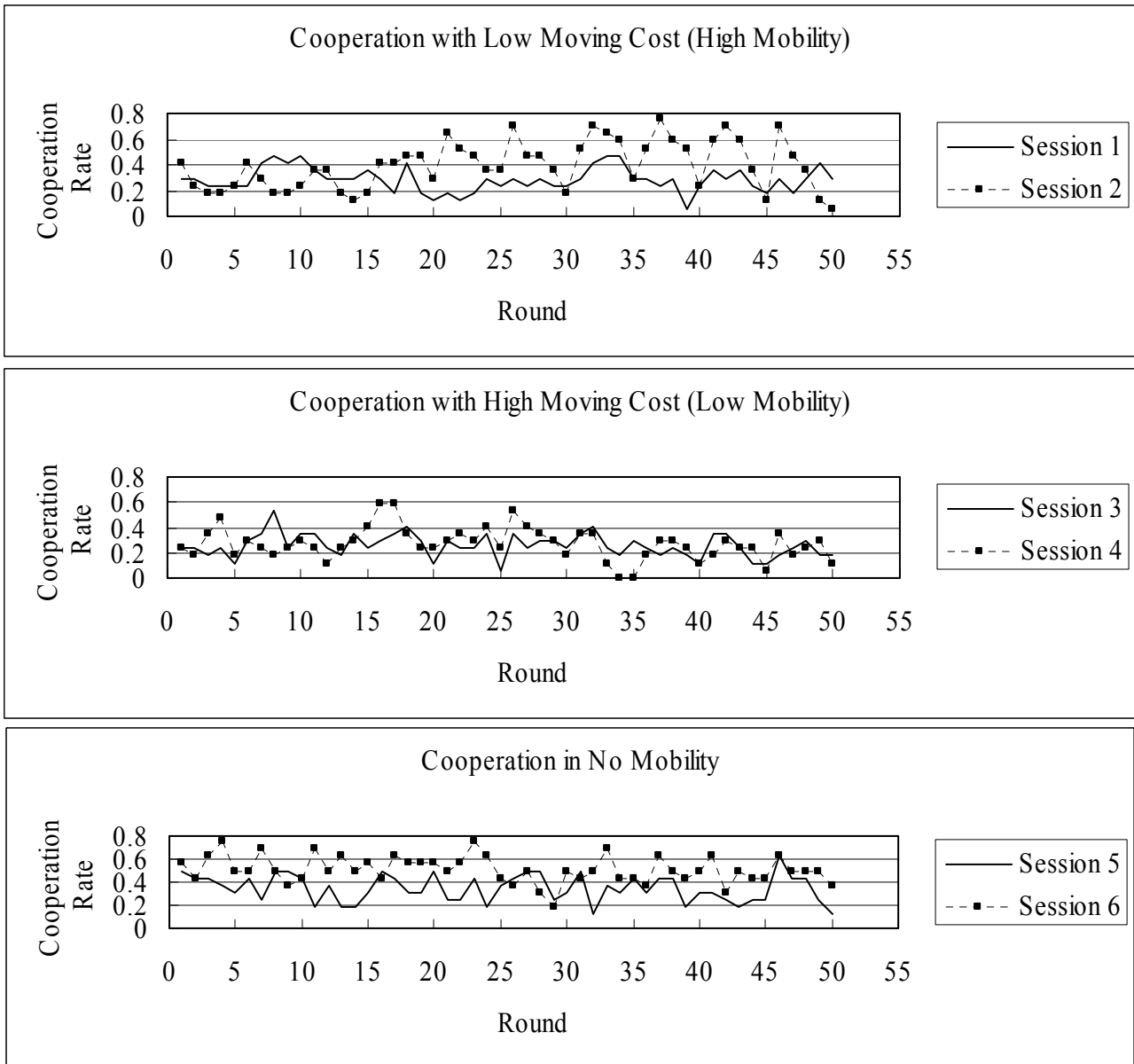


4.5 Refreshment Effect

We also observed refreshment effects at the beginning of blocks in each session. After an

exit option or a pause, participants significantly start cooperating. Then cooperation gradually declines.

Dawes and Thaler (1988) report this “refreshment effect” in social dilemma experiments. After a pause, participants start cooperating. This may be because they are psychologically refreshed.



5 Conclusion

5.1 Summary

We have examined the effect of mobility on free-riding. For this purpose, we conducted a laboratory experiment of social dilemmas with the exit options.

Three conditions were compared: the low moving cost as high mobility, the high moving cost as low mobility, and no exit option as no mobility. Each condition has two

sessions. In a session, 17 participants play a repeated social dilemma game.

From the experiment, we obtained two findings.

1. A U-shaped curve of cooperation as mobility changes.
2. A decline of cooperation as mobility is introduced.

The first result tells us that cooperative decisions depend both on the creating effect of new cooperative groups and the breaking effect of current ones. Nevertheless, the second result supports a prediction based on the breaking effect.

Therefore, our findings provide a practical lesson: avoid halfway mobility. Either “high mobility” or “no mobility” should be introduced if we expect cooperative behavior in business, communities, or social movements. Halfway measures may lead to undesirable results.

5.2 Future Topics

(i) No cost condition: To specify the effect of mobility in more detail, we should investigate social dilemmas with no moving cost. Kobayashi, Ooura, and Ishihara (2003) provides a preliminary result on such case, although their experiment uses a slightly different design.

Their data reinforce our finding of the U-shaped curve. Cooperation was high with no moving cost in two sessions (0.340 and 0.513, with the average of 0.427). These results support Wilson’s (1975) prediction. He argues that cooperation rises when there is no moving cost (perfect mobility) or infinitely high cost (no mobility).

(ii) Fairness: The pre- and post-experimental questionnaires will provide how individual fairness affects free-riding. Messick and McClintock (1968) reveal that people sometimes have fair motivations rather than selfish ones. Kobayashi (2001) argues that if such fairness is well shared, cooperation can be attained.

(iii) Network formation: This experiment may clarify the process of cooperative network formation. Marwell and Oliver (1993) show that dense and centralized networks will promote cooperative decisions. We can examine the reverse causality from cooperative behavior to cooperative networks.

(iv) Sanction mechanism: We can introduce sanction mechanisms into the experiment. In the experiment, we assumed no such mechanism. Still, in the real world we have already developed sanctions, either positive or negative, in well structured organizations. This means that we have overcome the second-order free-rider problem (pointed out by Heckathorn 1989).

(v) Survey: Our experimental findings can be supplemented by surveys on free-riding. We are planning a survey in workplaces. We focus on the effect of mobility, but such effect has been unclear in previous surveys (i.e., Ostrom 1990 on communities and Takahashi 2001 on workplaces).

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