COOPERATIVE BUSINESS GAME WITH FRAMING EFFECT

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ABSTRACT

Cooperation between economic entities is necessary for economic activities. For example, supply chain needs cooperation between more than one company. When the firms cooperate enough to build appropriate cooperative relationship, profit is provided mutually. The cooperation is not enough, however, all the firms under cooperation cannot profit and other company may gain profits, or suffer a loss. In such a situation, there can be a same structure as the social problems such as the environmental pollution and an economic problem. In particular, environmental problems become more serious for the firms' economic activities. For the corporate social responsibility issue, firms must tackle with environmental problems and such a cooperative business situation increases in real world. We introduce design and implementation of cooperative business gaming simulation in which the framing effect is critically appeared. Framing effects is one of the psychological problems argued in economics. Learning by framing effect encourages objective decision for cooperation. The game we proposed here provides students deeper understanding of the importance of appropriate cooperation.

INTRODUCTION

Cooperation is one of the key concepts in economic activity. Because economic activities must be connect with many entities. So far there has been a lot of work about cooperative behavior of economic entities. In particular, game theory contributed a new understanding about cooperative behavior between persons or companies. "Prisoner di-lemma" is a one of the major result of a game theoretic analysis.

Cooperation problem occurs in real economic or business situation. Supply chain is one of the examples of cooperation problem in business area. Supply chain is a system composed of organizations, individuals, processes, technologies, information and other resources, and each element is involved in activities related to moving a product or service from supplier to customer. The flow is very complicated; intricately-intertwined with many companies (supplier, maker, retailer and so on). In Such cooperative situation, if firms can appropriately implement cooperative relationship profit will be provided mutually. However, if firms are unable to cooperate with each other, profit could not be provided mutually, or some firm undertakes profit, and other firm may suffer a loss.

Same situation occurs in the real world. Environmental problems, international cooperation and regional social problems need to be considered cooperation of related party and stakeholder. In particular, environmental problems become more serious for the firms' economic activities. Firms would face to restrictions such as environmental regulation, and they would be required cooperate social responsibility. Therefore firms must tackle with environmental problems, and also needs of cooperative business situation such as environmental problems increases in real world. In gaming simulation research field, players' behavior such as competition, negotiation, and collaboration is very big interest. In previous studies, many authors emphasized importance about cooperative learning (Markulis and Strang, 1997), it is also important in business gaming simulation. Even cooperation learning has been discussed on previous study, there are little study considering a situation such as cooperation problem mentioned above (Sauaia et al., 2003).

In this paper, we introduce design and implementation, and experiments of cooperative business gaming simulation applying public goods concept with framing effect. Public Goods is a framework which has its high generality and applications to analysis cooperative behavior. In economics, a Public Good is a good that is non-rivaled and non-excludable. This means, respectively, that consumption of the good by one individual does not reduce availability of the good for consumption by

others; and that no one can be effectively excluded from using the good. In short, Public Goods setting describe situation which is required person's contribution to get mature profit. On the other hand, there is a Public Bads frame work which has mean to the contrary Public Goods. In short, Public Bads setting describe situation which is required person's contribution to tackle with a bad influence on all people. Aforementioned environmental problem is one of the most typical examples of Public Bads.

Normal goods (private goods) can effectively provide each person to use market. But Public Goods cannot effectively provide each person. Because free riding occur in such market provision. So Public Goods provision problem is arguing for many years. One of an argument, Some Public Goods setting occur framing effects. Framing effect is an occurrence of irrationality behavior for some psychological factor. For example Prospect theory is a major theory which can explain person's behavior about risk and uncertainty (Kahneman and Tversky, 1979). But Framing effects are composed many factor. So prospect theory cannot explain all Framing effects. In particularly, such theory could not explain some Public Goods game result (For example, Sonnemans, 1998). When framing effect occurs, subjects may select other option in a different situation which is essentially same as the original. If there is a situation occurring framing effect, person loses a chance of cooperation which gives profit. Learning by framing effect encourages objective decision for cooperation. Therefore, such game have a possibility which can teach cooperative problem composed many psychological factors to students.

PUBLIC GOODS AND FRAMING EFFECTS

In this paper we address framing effects of voluntary contributions. Voluntary contribution mechanism is a simple repeat game to describe Public goods situation. When there are any person who has some tokens, they decide how much tokens pay for public goods (for all members benefit) and how much tokens consume for private good (for only own benefit). Past literature finds that framing effects are significant in a standard voluntary contributions mechanism (VCM), and their degree depends on the types of individuals based on value orientations (See, Andreoni(1995); Park (2000)). One distinct research on framing effects is Sonnemans et al. (1998) that employ a provision point mechanism (PPM). PPM is a mechanism which provides Public Goods if contributions exceed the required threshold level of contributions. They show that framing effects are present in such a setting as well. However, framing effects seem not to be well-established in the PPM yet. This is because the existing results might be compounded by strategic effects that are potentially caused by the experimental design. Sonnemans et al. (1998) employ a partner design of keeping the same group members for the entire rounds, and ask questions during experiments such as "how do subjects perceive the influence of others' choices on their own pay off?"

These designs invalidate the Nash equilibria in a static game as guidance for prediction. They in fact require us to derive many subgames perfects equilibria and induce strategic effects. Thus, it is difficult to distinguish whether the resulting outcomes obtained by Sonnemans et al. (1998) are solely derived from framing effects or from interplays between framing and strategic effects (see Andreoni (1988); Park (2000)). Given this state of affairs, the purpose of this paper is to examine robustness of framing effects in the PPM (See Cox et al. (2008) for more detailed analysis on people's preferences on cooperation). The distinct features of our game are (i) a random change of partners in each round (stranger design) and (ii) to ask no questions during experiments. These changes in game designs aim at controlling strategic effects and are parallel to those employed by Andreoni (1995) and Park (2000). Therefore, our experiment focuses upon testing framing effects and the results can be directly compared to these previous works.

We hypothesize that framing effects are not significant in the PPM when strategic effects are controlled. This hypothesis is motivated by recent evidences that people's social preferences may possess not only self-interest motivations but also efficiency concerns (Hichri(2004), Brekke et al. (2003)) and Engelmann and Strobel (2004)). If the efficiency concerns are important to some extent, there is no wonder that framing effects are mitigated by the existence of a socially efficient equilibrium that is created by an addition of a provision point. Although there is no systematic way to estimate the degree of efficiency concerns, an alternative method called value orientations theory can be applied as an approximation (Liebrand (1984)). In this paper, we also apply this theory and explore the difference of cooperative behaviors for each preference of individuals.

In Kotani et al(2008), we mention an interesting policy implication for Public Bads prevention. In this paper, we expand our game result and method to consider possibility which apply our Public Goods game to pedagogical method.

GAME DESIGN

In this section, we describe a design of public goods/bads game using framing effect concept. This game is consists of two stages. First stage is value orientation test, and second stage is public goods/bads game with framing effect.

In the first stage, subject (game player) will be categorized into following five types according to theirs' social goal:

1. Competitors those who want to be better than others;
2. Individualistic those who want to do best for themselves;
3. Cooperative those who try the best for both themselves and others;
4. Altruistic those who want to do best for others; and
5. Aggressive those who want to do worst for others.

This stage follows Park (2000). Value orientation concept is suggested by Liebrand(1984). Value orientation test is two person's game. In this stage each player's task is to make a series of 24 choices between two choices. For example, players are asked to chose between Option A = (3.90, 14.50) and Option B = (7.50, 13.00), where Option A allocates 3.90 points for self 14.50 points for the other and Option B allocates 7.50 points for the other. We can classify players according to player's 24 decisions. Most people are classified either as individualistic or cooperative (Liebrand, 1984; Offerman et al., 1996). By implementation this experiment, we can check each person's behavior which is affected by each social preference to cooperate.

In the second stage, players are set in a situation they treat public goods or public bads. Each participant should be randomly assigned to a group of five people. The game will be conducted for 10 rounds. 20 players are allocated to either goods or bads experiments setting. For each round, each subject will be asked to choose Yellow or Blue, where she/he does not identify group members but knows that group members are shuffled in each round. After each decision, each subjects will be informed about the number of Yellow choices in own group and the

Table1: Public Goods (upper) and Bads (lower) setting

Goods

individual earning with yellow choice: - 60
with blue choice: 0

Group Revenue						
yellow choices	0	1	2	3	4	5
Group Revenue	60	60	60	245	245	245

Bads

individual earning with yellow choice: 60
with blue choice: 0

Group Revenue						
yellow choices	0	1	2	3	4	5
Group Revenue	185	185	185	0	0	0

resulting payoff.

The upper sub-table in table 1 summarizes the game of public goods provision. Subjects should decide whether to contribute 60 cents (Yellow) or not (Blue). If there are more than three members who gave 60 cents (Yellow) in a same group, every players will be received a group-revenue of 245 cents; otherwise a group revenue is 60. The lower sub-table in table 1 summarizes the game of public bads prevention. The choice has to be made on whether to take 60 cents (Yellow) or not (Blue). If there are two or fewer members in a group took 60 cents, everybody received a group- revenue of 185 cents.

The incentives in the two treatments are identical, and the experimental design is the same as the one in Sonnemans et al. (1998) except that a stranger design was employed, and no questionnaire was asked during the game.

In this experiment, we use YBG(Yokohama Business Game) to make our game. YBG is a business gaming support system which has a game model description language and its processing system and provides game play environment by generation of execution system based on the description (Tanabu, 2008).

EXPERIMENTS AND RESULT

In the games, there can be two pure Nash equilibria: (i) one asymmetric Nash equilibrium in which exactly three players cooperate and (ii) one symmetric Nash equilibrium in which all players do not cooperate. Since we employ the stranger design, these Nash equilibria could be considered as a prediction of group decisions. It must also be noted that social efficiency is achieved only when the group contributions reach the threshold of Public Goods provision or of Public Bads prevention.

The experiments were conducted in the computerized experimental lab of Yokohama National University. For computerized experiment, we use YBG to design and implemented Public Goods and Bads game. Subjects were volunteers from undergraduate students in various fields except economics. We recruited 40 subjects in each condition of Public Goods and Bads settings for a total of 80 subjects. The data were collected in two separate sessions in each of which 40 subjects were recruited, randomly divided into two rooms of 20 each, and assigned to numbered desks. In each session, a value orientation experiment was first conducted, and a different condition of framing experiments was followed. Each session lasted about one hour. The average earning per subject was approximately $15, whose calculation is based on the sum of experimental earnings from 10 rounds of the experiment.

We first report the result of value orientations. Out of 80 subjects, 57 were classified as individualistic (71.2%): 27 in the Goods setting and 30 in the Bads setting. 19 subjects were classified as cooperative (24%): 10 in the Good setting and 9 in the Bads setting. Four subjects (3 in the goods setting and 1 in the bads setting) were classified as competitive. This distribution is similar in each of Goods and Bads setting as well as to the ones in the past literature. Most subjects are either classified as individualistic or cooperative, and thus our analysis focuses on these two types in what follows.

We now present the percentage of cooperative choices of subjects with different value orientations in each of the two treatments. Table 2 shows the percentage of cooperative choices with each value orientation and treatment. In the Goods setting, the percentage of cooperative choices is 38.6%, and its difference between cooperative and individualistic is negligible (See table 2 and 38:9 - 38:0 = 0:9% difference). In the bads setting, the percentage of cooperative choices is 35.5%, and its difference between cooperative and individualistic significant (See table 2 and 55:5 - 27:3 = 28:2% difference). From this result, we could say that the rate of cooperative choices between the two treatments seems not to be different, while it is significantly different per value orientation especially in the Bads setting. To confirm this observation, we will run a series of statistical testings in what follows.

Table2: Percentage of cooperative choices per value orientation

	% in public goods	% in public bads
Individualistic(27/30	38	27.3
Cooperative(10/9)	38.9	55.5
All(40/40)	38.6	35.5

Table3: Summary of results

Overall	Goods vs Bads		z = 1.220
Per condition	Goods	Ind.vs Coop.	z = 0.530
	Bads	Ind.vs Coop.	$z= 3.194_{**}$
Per condition	Individualistic	Gooods vs Bads	$z= 2.671_{**}$
	Cooperative	Gooods vs Bads	$z= 2.050_{*}$

Note: *Significant at 5% level, **Significant at 1% level. Ind. and Coop. stand for individualistic and cooperative, respectively.

Figure 1 displays the percentage of cooperative choices per period for both of the treatments. The slight difference appears to exist: cooperative choices are made more often in the goods setting than in the Bads setting, but its degree seems to be small. We apply a Mann-Whitney test using the percentage of cooperative choices per round as observation. Our results cannot reject the null hypothesis that the distributions are the same in both of the treatments even at the level of 10%. This statistical result suggests that framing effects are not significant, which is in contrast with the findings of Sonnemans et al. (1998) that show the existence of framing effects. Here we additionally note a few points in our results that differ from those in Sonnemans et al. (1998).

First, the percentage of cooperative choices (38:6%) for the Goods setting in our results is lower than that of 51.1% in their results (See table 2 for our results in the Goods setting). Second, for the bads setting, we do not observe any decay in the percentage of cooperative choices in later periods, that have been observed in Sonnemans et al. (1998).Given these differences, we could say that whether or not to control strategic effects through employing stranger designs as well as no questionnaires affect outcomes in the PPM. Figure 2 and 3 presents the cooperative choices per value orientation for each treatment over rounds. It is interesting to note that the trends are dissimilar between Goods and Bads setting. The difference between cooperative and individualistic in the Bads setting seems to be more obvious than that in the Goods setting.

To confirm this, we apply a Mann-Whitneytest by taking the percentage of cooperative choices per round as observation. It is not statistically significant for the goods setting (z = 0:530), while it is statistically significant for the Bads setting at the 1% level (z = 3:194). This result obtained under PPM is in line with those obtained by Park (2000), which shows that the difference in contribution rate between individualistic and cooperative under negative frames is more distinct than that under positive frames. We finally turn to the framing effects on the two different value orientations. Figure 4 and 5 presents the percentage of cooperative choices per treatment for each value orientation. For individualistic case, the percentage in the Goods setting are always above that in the bads setting over all of the rounds (See figure 4). In other words, individualistic subjects consistently exhibit the framing effects even though its difference is only 0.9% on average (See figure 4 and table 2).

On the other hand, for cooperative case, there is a surprising result: a cooperative type of subjects chooses the cooperative choices more often in the Bads setting than in the goods setting, and its difference per treatment is 28.2% on the average, although a clear trend all over rounds is not found (See figure5 and table 2). A Mann-Whitney test confirms that the difference is statistically significant at the 1% level (z = 2:671) for individualistic (see table 3). For cooperative case, it is not significant at the 1% level, but significant at the 5% level (z = 2:050).

DISCUSSION

In general, we found the qualitatively similar results with Park (2000) on the cooperative choices and the value orientations. One distinction is that more people cooperate in the bads setting than in the goods setting for cooperative" subjects. This is the main reason why framing effects are not significant in our study. In Park (2000), this effect is not present so that framing effects are significant in the VCM.

Unfortunately, we cannot provide a logical argument for this effect yet. However we conjecture some possibilities; (i) a cooperative type of individuals may feel more obliged to achieve efficient outcomes in the bads setting, (ii) some other concepts in game theory such as tit-for-tat strategies under randomly matched opponents could potentially rationalize the results in our experiment.

To play and analysis framing effects from our gaming result has high pedagogical means. With student consider about our gaming result, student can understand cooperative problem which has many complex factor. If one result shows low cooperative behavior, our game can consider several causes (For example, biasing value orientation, structure of game and so on). On the other hand, student cannot consider cause about detailed cooperative behavior in Prisoner di-lemma game. Because prisoner di-lemma gaming result cannot be consider each persons personality and mutual effects. As a result, we think our Public Goods and Bads game have a high possibility to use

cooperative gaming framework.

CONCLUSION

In the real economic and business activities, cooperative behavior has some important aspect. Public Goods concept gives us a new attention for gaming simulation. This concept, of course, is not enough to cover all cooperative situations in business gaming. But the cooperative game we proposed can apply concrete situation. For example, a situation in which firms should consider collaboration to develop new product and each firm should provides funds and management resources. In this situation, if firms cooperate enough to provide appropriate cooperative investments, collaboration will be successful and related firms will gain higher profits. The situation is similar to public goods case.

The public goods concept is a useful framework to learn cooperative problem. This paper picked up one of the cooperative problems as framing effect for designing game. As a result, our game induces framing effect and each student may learn this effect. Cooperative problem will be more important in business management, and cooperative business gaming simulation will be more required in such a situation.

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REFERENCE

Andreoni, J. (1988). Why free ride? strategic and learning in public goods experiments. Journal of public economics,37, 291-304.

Andreoni, J. (1995). Warm-glow versus cold-prickle: The effects of positive and negative framing on cooperation in experiments, Quarterly journal of economics, 110 (1), 1-21.

Brekke, K. A., S. Kverndokk, and K. Nyborg (2003). An economic model of moral motivation.Journal of public economics 87, 1967-1983.

Cox, J. C., D. Friedman, and V. Sadiraj (2008). Revealed altruism. Econometrica 76 (1), 31-69.

Davis, D. D. and C. A. Holt (1992). Experimental economics. Princeton university press.

Engelmann, D. and M. Strobel (2004). Inequality aversion, efficiency, and maximin preference sin simple distribution experiments. American economic review 94 (4), 857-869.

Hichri, W. (2004). Interior collective optimum in a voluntary contribution to a public goods game. Applied economics letters 11, 135-140.

Kahneman, D., Tversky, A. (1979). Prospect theory: An analysis of decision under risk. Econometrica, 47,263-291.

Kotani, K., Managi, S., Tanaka, K. (2008) Further investigations of framing effects on cooperative choices in a provision point mechanism. Economic Britain, vol.3, No51, 1-9.

Markulis, M, Peter. Strang, R, Daniel. (1997) Cooperative learning: What are we learning? Development in Business Simulation and Experiential Learning, Vol24, 98-103.

Liebrand, W. B. G. (1984). The effect of social motives, communications and group sizes on behavior in an n-person multi-stage mixed motive game, European journal of social psychology 14, 239-264.

Offerman, T., Sonnemans, J., Schram, A. (1996). Value orientations, expectations and voluntary contributions in public goods. Economic Journal,817-845

Park, E. (2000). Warm-glow versus cold-prickle: A further experimental study of framing effects on free-riding. Journal of economic behavior and organization 43, 405-421.

Rondeau, D., G. L. Poe, and W. D. Schulze (2005). VCM or PPM ? : A comparison of the efficiency properties of two voluntary public goods mechanisms. Journal of public economics 89,1581-1592.

Sauaia, A., Kallas, D. (2003), Cooperation for profits or compete for Market? Study of oligopolistic pricing with a business. Development in Business Simulation and Experiential Learning, Vol30, 232-242.

Sonnemans, J., A. Schram, and T. Offerman (1998). Public good provision and public bad prevention: The effect of framing. Journal of economic behavior and organization 34,143-161.

Tanabu, M. (2008). Facilitating business gaming simulation modeling. Development in Business Simulation and Experiential Learning, Vol35, 360-367.

Figure1: Percentage of cooperative choices by period for goods and bads

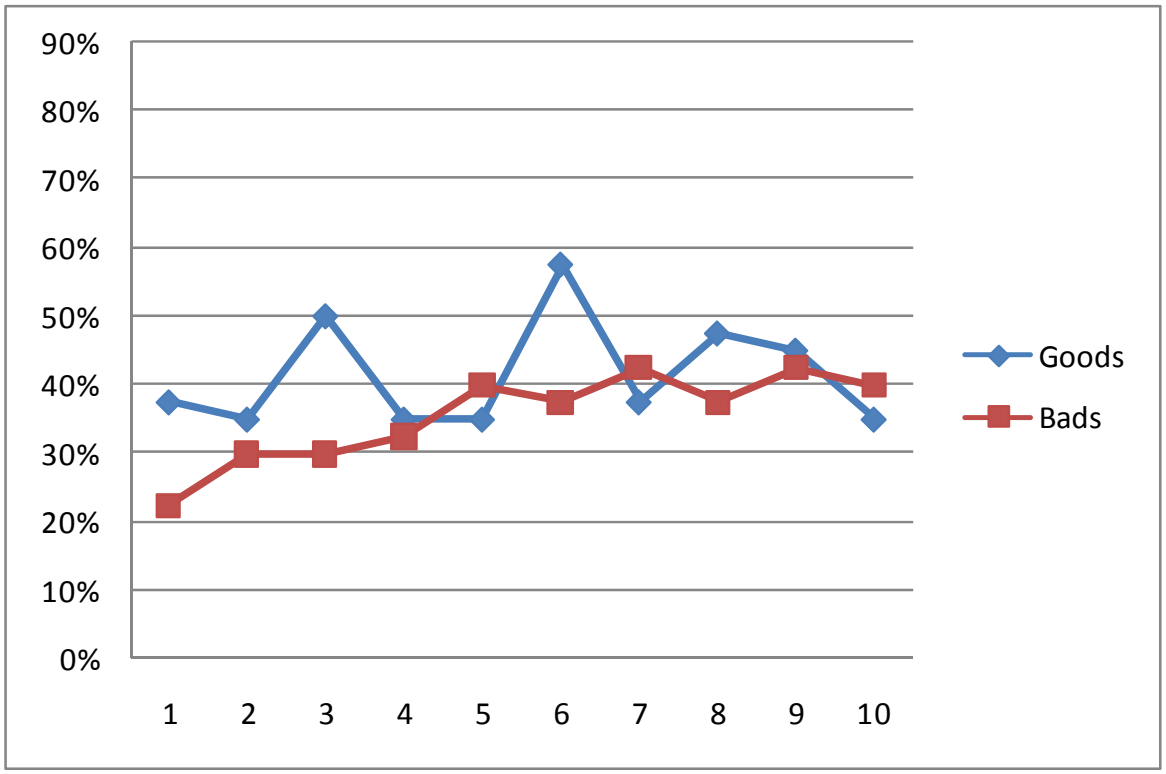

Figure2: Percentage of cooperative choices per orientation in public goods

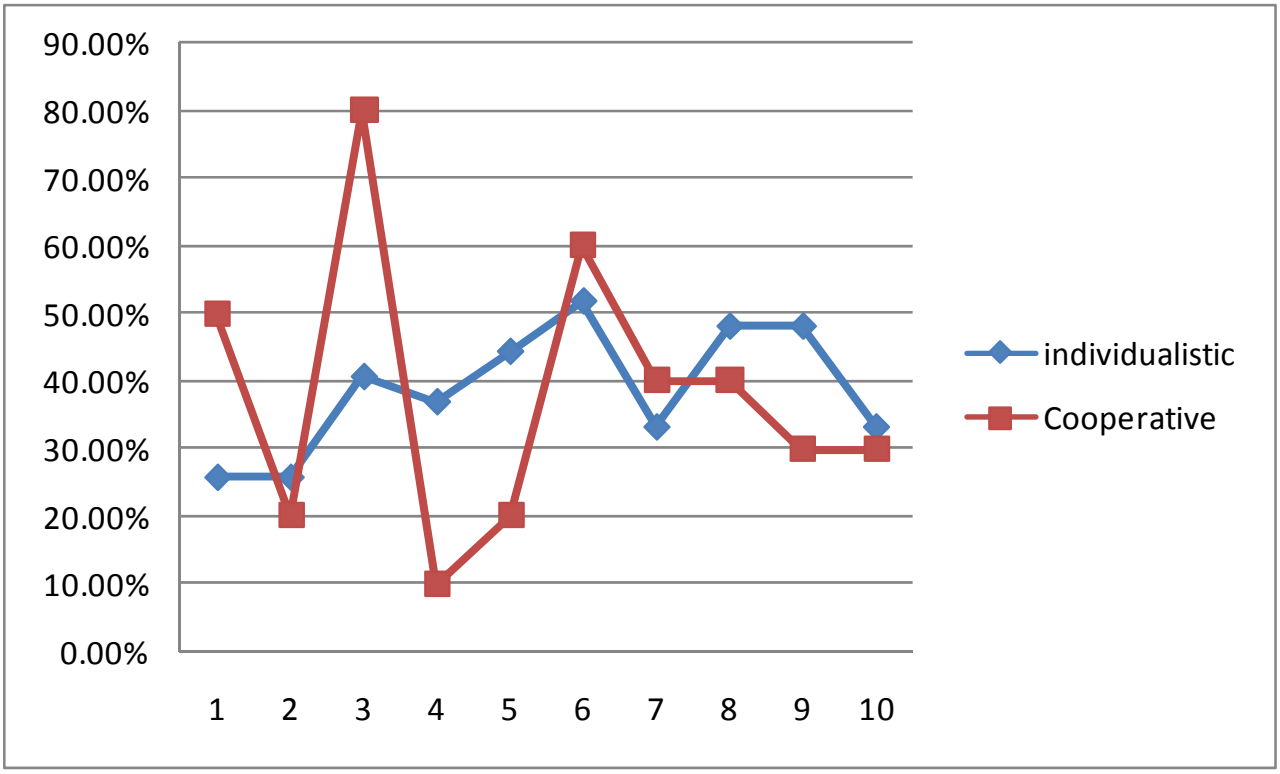

Figure3: Percentage of cooperative choices per orientation in public bads

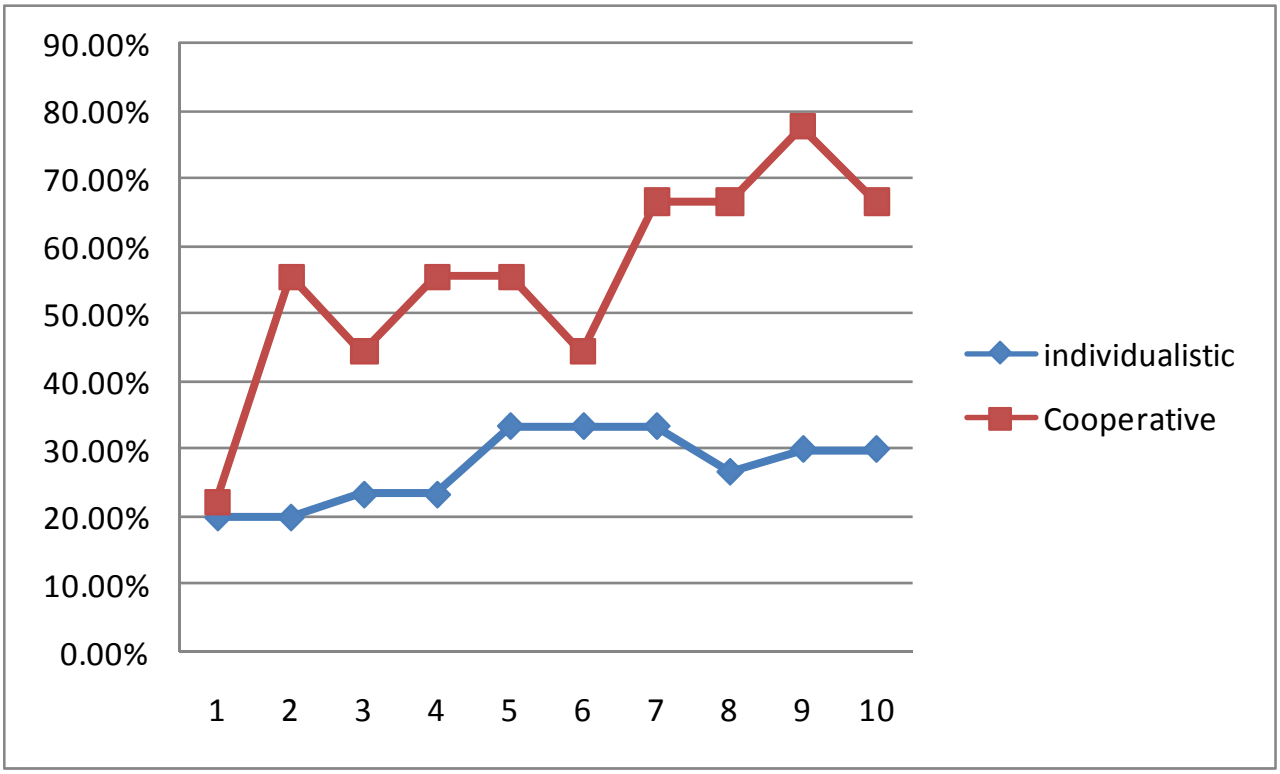

Figure4: percentage of cooperative choices per treatment for individualistic

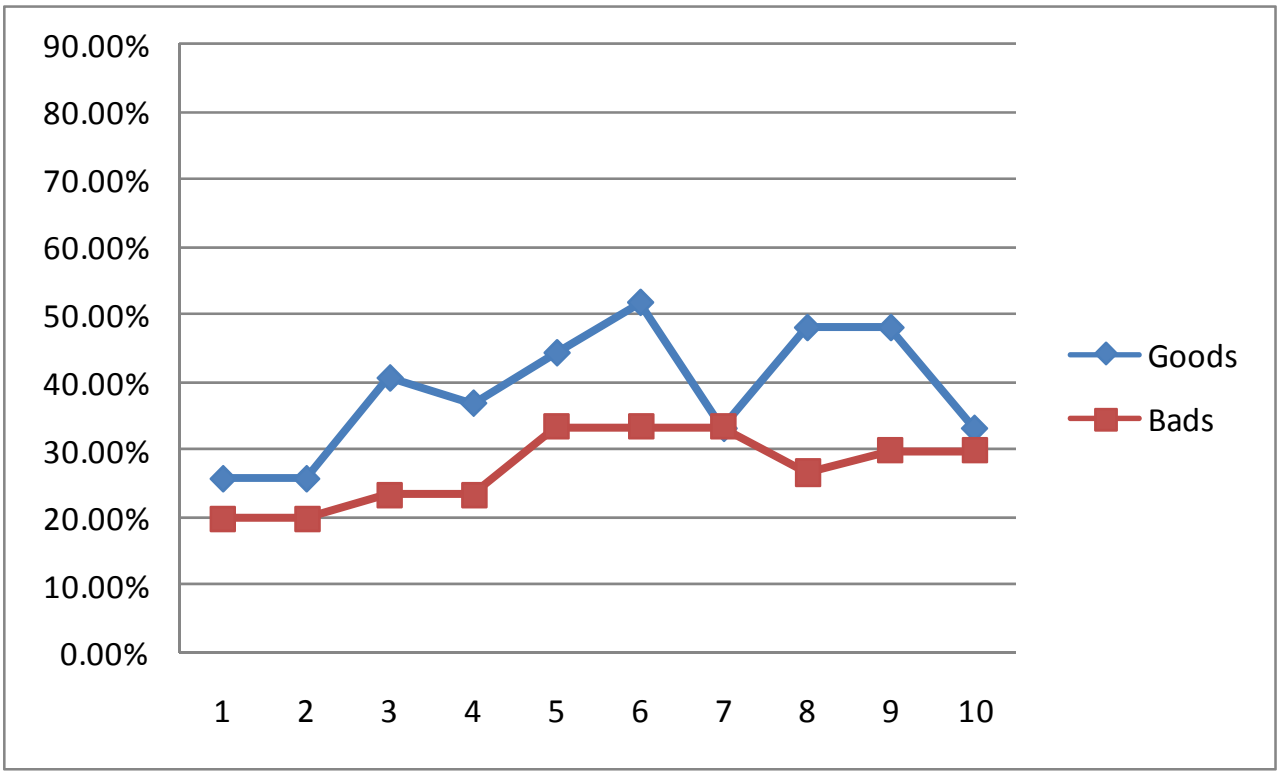

Figure5: percentage of cooperative choices per treatment for cooperative