One Step at a Time: Do threshold patterns matter in public good provision?

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8 December 2008

One Step at a Time: Do Threshold Patterns Matter In Public Good Provision?*

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December 5, 2008

Abstract

There is a substantial literature examining coordination in public goods games. We conducted an experiment to explore how varying patterns of thresholds affect the willingness of subjects to contribute to a public good. We had subjects play a multi-period game where each subject was allocated an initial point endowment, told a threshold for the group and had to choose how much to contribute to the common pot. Each period is identical, except for the possibility of having a different threshold, which is always stated before the players make their contributions. We found that while contributions are similar for the increasing and decreasing threshold group types when thresholds were low, a sizeable gap opens up around the average threshold size. We found that for nearly every threshold, it is more profitable to be in an increasing than in a decreasing threshold group type. Early cooperation seems to facilitate the achievement of harder-to-reach thresholds, which require considerable contributions from all members of the group. These findings are also very robust in the regression specifications. Our findings shed light on the role of past cooperative success and threshold patterns on subsequent willingness to cooperate.

JEL Classifications: C91; C92, H41, D81; G14
Keywords: Experimental economics; Public goods decision making

* We would like to thank Johannes Castner and Randall Lewis, for useful comments and suggestions. Financial support from the Massachusetts Institute of Technology Department of Economics is gratefully acknowledged.
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I. Introduction

Much research has been done on how to facilitate coordination in public goods games (Fedyard, 1995). In particular, sanctioning institutions and reputation mechanisms have both been found to assist in the facilitation of coordination by discouraging free-riding (Olson 1965; Ostrom et al., 1992; Fehr and Gächter, 2000; Masclet et al., 2003; Egas and Riedl, 2005; Gächter and Herrmann, 2006; Bochet et al., 2006; and Carpenter, 2006).

Building on this literature, we study how varying thresholds affect the willingness of subjects to contribute to a public good. Since many public goods are lumpy (parks, roads, bridges, etc), an "all or nothing" contributions process, such as a public good threshold mechanism (or provision point mechanism) is appropriate. In a threshold point public good mechanism, members of the group impacted by the project submit bids stating their dollar commitment to covering the project costs. If the sum of contributions do not cover the threshold (equivalent to a predetermined cost of the project), the project is not undertaken. If the sum of the contributions covers the pre-established threshold, then the project is provided. We play a standard public goods game with repeated interactions and varying group thresholds below which the players receive no return on their contributions. We introduce three treatment threshold group types, the first of which has an increasing, the second a decreasing and the last a constant threshold. This within-subjects design allows us to analyze the relation between patterns of variation of the required contributions (i.e. increasing, decreasing) and actual contributions, thereby shedding light on the role of past cooperative success and failure on subsequent willingness to cooperate.

Perhaps more than any other topic in experimental economics, public goods games directly relate to real world coordination scenarios. From taxes to charitable contributions, we are frequently asked to contribute to public goods. But coordination failures can prevent the provision of valuable goods, particularly when contribution is voluntary and there is a large incentive to free-ride. A better understanding of people's willingness to contribute to public goods can shed light on many economic problems, from tax evasion in public economics to village savings schemes in developing countries.

One example very close to our experimental design is Niagara Mohawk's Green Choice Program, a provision point public good mechanism to provide an environmentally friendly power station. Participants in the program commit to paying a fixed surcharge in addition to their electric. If enough participants participate, the power station will be built, otherwise all investments are lost and the station is not built.[4]

In the relatively short history of experimental economics, nearly 200 public goods experiments have been conducted thus far[5]. The main finding is that significant contributions are observed despite the individual incentives to free ride. Economists have designed experiments with a variety of treatments to better understand motives for contributing. Altruism provides one possible explanation, since contributions may be rational if enough utility is derived from helping others. Many studies have shown that an increase in the marginal per capita return raises contributions, but the interpretation of this result is complicated by the fact that the marginal per capita returns affects both one's private return (the "internal return") and the benefit to others (the "external return"). Goeree, Holt and Laury (2002) report that contributions are positively related to the external return, holding the internal return constant. Not surprisingly, contributions are also positively related to the internal return.

The addition of multiple rounds adds important dimensions to the public goods game. In a multiple round experiment some people might reciprocate by contributing more in response to cooperative actions of others. Such reciprocity also opens up the possibility for strategic behavior, where a person might contribute more in early rounds to encourage others to do the same. This explanation is consistent with the observation that contributions decline with repetition. Contributions are also somewhat lower for people who have participated in a public goods experiment on a previous date. Despite the negative effect of repetition and experience on contribution rates, some people contribute in all rounds. Thresholds add a further dimension by providing a minimum contribution level for receipt of the public good. These can serve as a reference point for contributions, but may also discourage contributions by providing for the possibility of a zero return on investment if other group members do not contribute sufficiently.

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[4] Schulze, William (1995). "GREEN PRICING: Solutions to the Potential Free-Rider Problem." Discussion Paper, Department of Economics, University of Colorado.

[5] Holt, Charles, The Y2K Bibliography of Experimental Economics and Social Science http://www.people.virginia.edu/~cah2k/y2k.htm

To date, there exist no empirical tests of how coordination varies with threshold levels in multiple-round experiments. We study this issue with a simple experiment where subjects play a multi-period public good contribution game. Subjects are randomly assigned to groups for a fixed number of periods. In every period, each player is allocated an initial point endowment and told a threshold for the group. They he chooses how much to contribute to the common pot. If group contributions sum to a number greater than the threshold for the period, then the total contribution is increased and distributed evenly among the group members. If the group fails to meet the threshold, then each player receives only the points that he did not contribute to the pot. Each period is identical, except for the possibility of having a different threshold, which is always stated before the players make their contributions.

We hypothesize that subjects contribute in a given period based not only on the threshold but also on their history of cooperation or cooperation failure with their assigned group. While standard game theory predicts that equilibrium should be zero contribution no matter the threshold patterns (Palfrey and Rosenthal, 1984; Bagnoli and Lipman, 1989), at least two possible countervailing behavioral patterns can arise from the presence of variable thresholds. In the first, difficulty of coordination is increasing in the size of the threshold. In other words, lower thresholds facilitate coordination, possibly through the knowledge that the threshold can be reached even in the presence of some free-riding. Alternately, difficulty of coordination could be decreasing in the size of the threshold. With low thresholds, it is possible for subjects to assume the fulfillment of the threshold even if they fail to contribute, exacerbating the free-rider problem.

We hypothesize that the former effect dominates. Under this hypothesis, lower thresholds will be achieved more frequently. More importantly, we posit that early coordination will lead to greater coordination even as the thresholds become large. Although it is impossible to know the exact motivation of such behavior, we suggest that the formation of trust and team spirit encourage greater willingness to contribute conditional on past success. This is really just a reformulation of conditional cooperation. Our experiment aims to demonstrate how changes in the pattern of thresholds can have significant effects on the variable upon which players are conditioning their cooperation, namely past cooperation, leading to significant differences in both contributions and outcomes.

Our results appear consistent with this hypothesis. We find that for nearly every threshold, it is more profitable to be in an increasing than in a decreasing threshold group type. Contributions are similar for the increasing and decreasing threshold group types when thresholds were low, a sizeable gap opens up around the average threshold size. We find that successful cooperation of the early stages in the increasing group produces higher contributions than the failed cooperation of the early stages of the decreasing threshold group type. From 50 to 70, the increasing threshold group types are much more likely to attain the public good than their decreasing threshold group type counterparts.

The rest of the paper is organized as follows: In Section 2, we detail the experimental design. In Section 3, we present the graphs, tables and regressions, as well as explanations of the major results. Section 4 closes with a summary of our main results and concludes. Appendix A provides a walk-through of the experiment as experienced by the subjects. Appendix B contains the survey used to gather personal data on the subjects.

II. Experimental design

Our experimental design is a variation on the standard multi-period public goods game. Subjects are randomly assigned to groups of 4 for each stage[6]. A stage consists of 10 periods. In a period, players are given 25 points and asked to make a contribution to their group's public good. Each group in each period has a threshold, which is the minimum total amount of contributions that the group must make in order to receive the public good. If contributions fall short of the threshold, each player exits the round with only the money that he/she did not contribute. If the threshold is reached, each player receives an additional 1.6 times the average contribution on top of the points that they did not contribute. All earnings are deposited in the individual's total profit account and cannot be used to make contributions in future periods; in other words, players can only make contributions from the 25 points that they are allocated for a given period.

[6] Croson and Marks (2000) show in a meta-analysis study of public goods games that the most frequently used group sizes are 5, 7 and 4 subjects per group. In their own studies, Croson and Marks (1998) and Croson and Marks (1999), groups consist of 4 players.

Subjects play three stages for a total of 30 periods. Although the order is different for different subjects, everyone plays one stage with increasing thresholds (from 10 to 100), one stage with decreasing thresholds (from 100 to 10) and one stage of constant thresholds (55 for every period).

At the end of the game, the total earnings of the subjects consist of the sum of two parts: the attendance pay of $5 and the reward from the game, which is the total number of points they accrue divided by the exchange rate. We set the exchange rate at 60 points/dollar, for expected earnings of approximately $20.

The information structure is such that a player always knows the rules of the game he is playing, but is not fully aware of how much money he is making. At the start of each stage, a player learns how the thresholds will be varying for those 10 periods. He is also reminded of these thresholds as they make their contribution at each period. At the end of each period, a player learns whether or not the group contributed enough to reach the threshold, but not the exact amount of points accumulated from that period. The reason for this was to reduce any possible salience of income effect, where player's total accumulations could affect his future play. At the end of each stage, each player is told how many points he has accumulated to date and that he is joining a new group[7].

At the end of the third stage, which marked the completion of the game, subjects were asked to complete a brief survey. The survey asked for information on age, gender, income, ethnicity, nationality and subject of study (if student), in addition to eliciting risk preferences over lotteries[8].

III. Results

In this section we present our findings in table, graphic and regression format. We analyze the effect that stages and thresholds have on the following three outcome variables: i) average contributions, ii) proportion of groups reaching the threshold, and iii) average profits.

[7] See Appendix A for the zTree screenshots
[8] See Appendix B for the complete surveys

The findings are clear: in general, the increasing threshold game produces more contributions and higher profits than the decreasing threshold game. This is particularly true when we look at two cases for which our hypothesis predicts the largest differences: in the middle range of thresholds (where cooperation has been established in the increasing group and disestablished in the decreasing group) and in the first stage (when subjects' behavior is not confounded by having played the other games).

Table 1: Summary Statistics of Subjects' Survey Information

Variable	Mean and standard deviation
Age	30.81 (9.91)
Male	0.58 (0.49)
Income	4.67 (2.87)
Risk Aversion Index	4.89 (1.73)
Ethnic Group:	
Caucasian	0.56 (0.50)
African American	0.17 (0.37)
Latino	0.00 (0.00)
Asian	0.28 (0.45)
Other Ethnicity	0.06 (0.23)
Country/Region:	
USA	0.58 (0.49)
Asia	0.25 (0.43)
Australia	0.03 (0.16)
Africa	0.11 (0.31)
UK	0.03 (0.16)
Concentration:	
Economics	0.14 (0.35)
Other Social Science	0.36 (0.48)
Business	0.11 (0.31)
Humanity	0.06 (0.23)
Science	0.06 (0.23)
Engineering	0.03 (0.16)
Medical/Health	0.03 (0.16)
Other Concentration	0.06 (0.23)
Observation	**36**

Note: Income is a scale variable from 1 to 10, with higher value indicating higher income (1: annual income<= $4999; 10: annual income>= $80000). Risk aversion index is a scale from 0 to 10, with higher value indicating higher risk aversion; this index is measured through our questionnaire about subjects' choice over two lotteries.

Table 1 contains basic summary characteristics of the subject pool, which appears very diverse. Subjects were divided almost evenly between American citizens and foreign nationals, as well as between men and women. The majority were Caucasian, with the remainder mostly either African-Americans or Asians.

Table 2: Summary Statistics of Performance in the Public Good Game

Panel A: Performances over Periods

Variable	All Subjects, All Periods	Subjects and Periods with Increasing Threshold	Subjects and Periods with Decreasing Threshold	Subjects and Periods with Constant Threshold
Contribution	10. 84	10. 28	10. 38	11. 86
	(9. 32)	(9. 26)	(10. 14)	(8. 40)
Sum	43. 36	41. 11	41. 51	47. 44
	(22. 87)	(24. 25)	(21. 00)	(22. 75)
Reached	0.50	0.50	0. 43	0. 57
	(0.50)	(0.50)	(0. 50)	(0. 50)
Profit	25.27	25. 49	22. 68	27. 65
	(11.68)	(11. 17)	(12. 73)	(10. 52)
Observation	1080	360	360	360

Panel B: Overall Performance

Variable	All Subjects
Total Profit	758.17
(Points)	(149.37)
Earning	17.64
(USD)	(2.49)
Observation	36

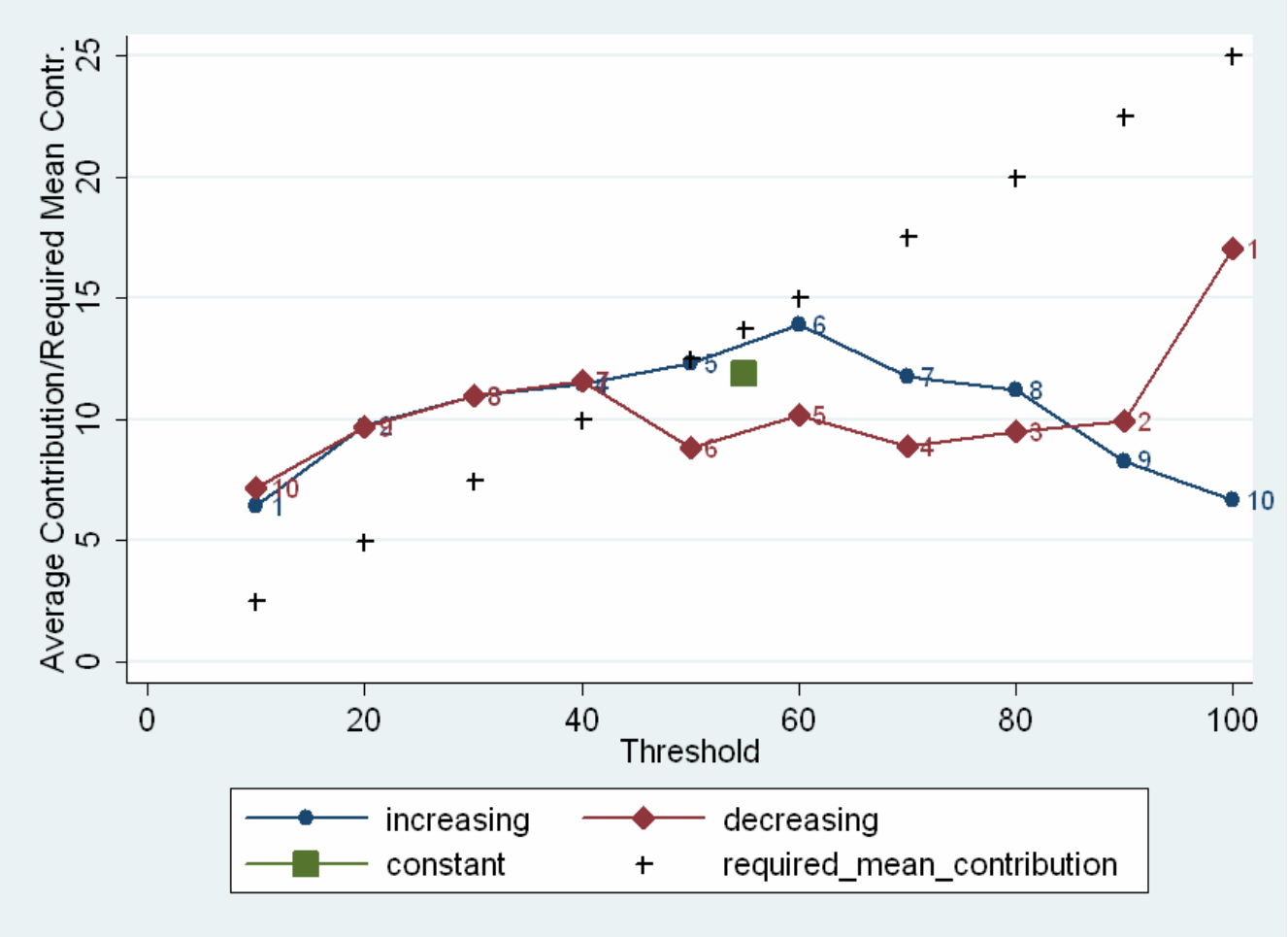
Note: The mean and standard deviation (in parentheses) are reported in the table. For variables in Panel A, there is one observation for each of the 36 subjects in each period over the total 30 periods of the game. For the variable in Panel B, i.e., total profit, there are only 36 observations, since it is only attained at the end of the game. Actual earning from the experiment is total profit points divided by 60, plus a show-up of 5.

Table 2 contains the summary statistics of the major outcome variables: contribution (individual contribution per period), sum (total group contribution per period), reached (whether the threshold is reached by the group per period) and profit (individual profit earned per period). The comparison to focus on is the one between increasing threshold and decreasing threshold. Although average contribution and average sum are very similar for the two treatments, subjects in the increasing threshold group type were 16% more likely to reach the threshold than those in the decreasing

threshold group type. Accordingly, profits were 12% higher in the increasing threshold group type. In the figures below, we break out these summary statistics into performance by period to gain a clearer understanding of the different effects of the increasing and decreasing threshold group types on behavior and outcomes.

A. Average Contribution

Figure 1: Average Individual Contribution by Threshold Type and Threshold



Note: the period corresponding to the threshold is given by the number to the right of the data point.

This figure summarizes our most basic result: While contributions are similar for the increasing and decreasing threshold group types when thresholds were low, a sizeable gap opens up around the average threshold. This is entirely consistent with our hypothesis: the successful cooperation of the early stages in the increasing group produces higher contributions than the failed cooperation of the early stages of the decreasing threshold group type. Notice that average contributions for the

increasing threshold group type were higher at thresholds of 50 and 60 than the average contribution in the constant 55 threshold group type, while contributions at 50 and 60 for the decreasing threshold group type were actually lower than in the constant threshold group type. The higher willingness to contribute in the increasing threshold group type persists through the threshold of 80, though the difference shrinks considerably.

The outlier at the top right-hand corner can be explained by a lack of learning: in the first period of the decreasing threshold group type, many players contribute too much on the hope that the others will as well. Once they observe that the threshold was not met, average contributions fall close to the level of contributions from the increasing threshold type for a threshold of 90, which is very low.

B. Proportion of Groups Reaching the Threshold

Figure 2: Proportions of Reaching Thresholds by Threshold Type and Threshold

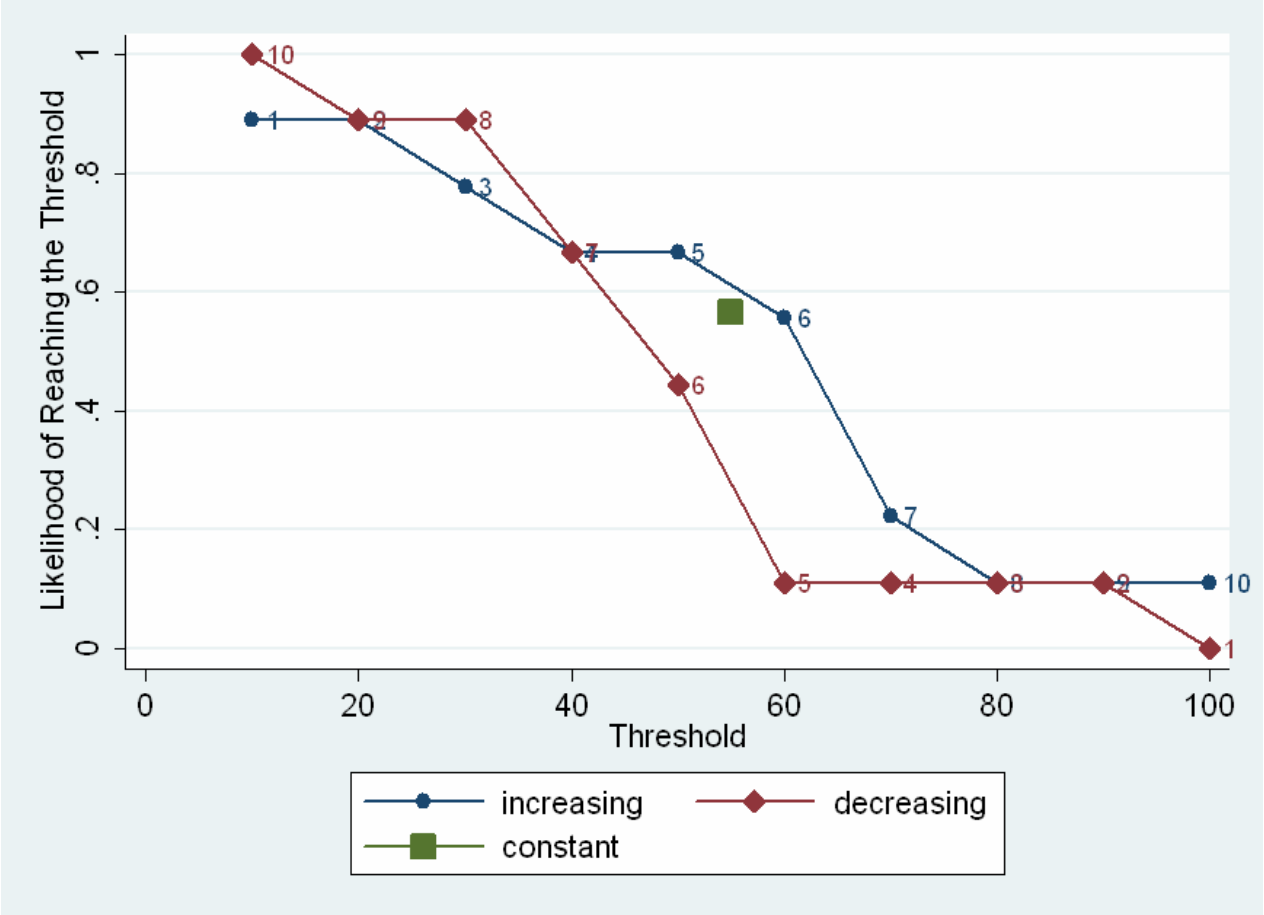


Figure 2 demonstrates a very similar pattern to the one in Figure 1, although with less noise. There is little difference in the probability of reaching the threshold for the increasing and decreasing threshold group types at the highest and lowest thresholds. However in the middle range, from 50 to 70, the increasing threshold group types are much more likely to attain the public good than their decreasing threshold group type counterparts. In fact, they are higher than the average of the groups with the constant threshold type of 55, despite the fact that the groups with the constant threshold have 10 periods to learn how to coordinate their behavior with a threshold of 55. This again supports our premise: early cooperation seems to facilitate the achievement of harder-to-reach thresholds, which require considerable contributions from all members of the group. The most striking difference is at 60: increasing threshold group types achieved the good nearly 60% of the time, while decreasing threshold group types managed to reach the threshold only 10% of the time.

C. Average Profit

Figure 3: Average Individual Profit by Threshold Type and Threshold

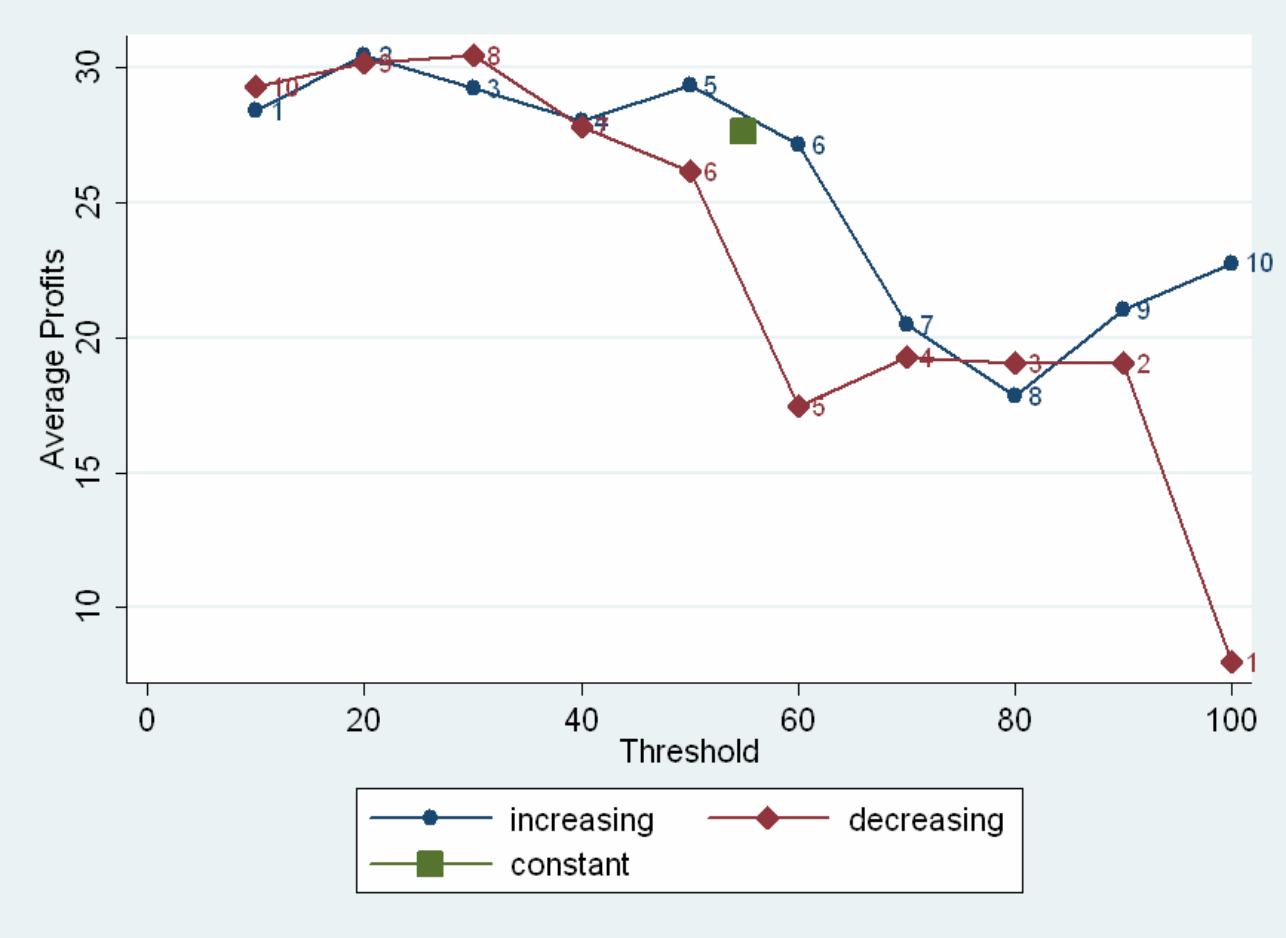


Figure 3 makes clear that the gap between increasing and decreasing threshold group types holds for profits in addition to contributions and reaching the threshold. Ignoring the difference when the threshold is 100 (which is due to increasing players not having learned that others will not contribute sufficiently), the difference is once again most noteworthy at thresholds of 50 and 60. Interestingly, average profits for the increasing group remain almost constant through period 6 at which they had a high likelihood of reaching the threshold, but after that players begin to throw away money. The increase in periods 9 and 10 for the increasing threshold group type are due to players' learning that the thresholds are unreachable, and thus conserving their points instead of contributing them.

Ultimately, this is the information of most importance. Figure 3 demonstrates that for nearly ever threshold, it is more profitable to be in an increasing than in a decreasing threshold group type.

Figure 4: Average Individual Profit by Threshold Type within Stage

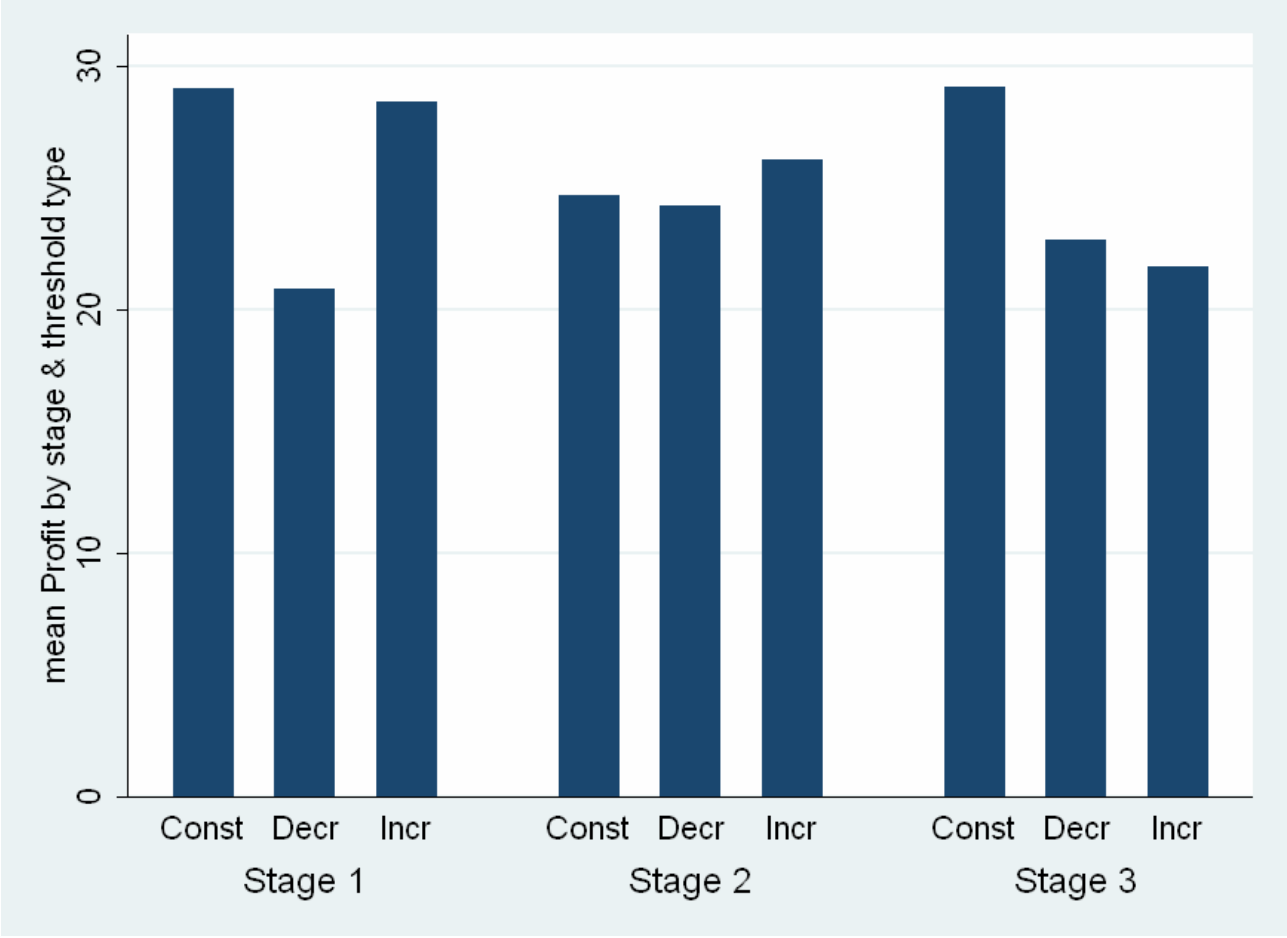
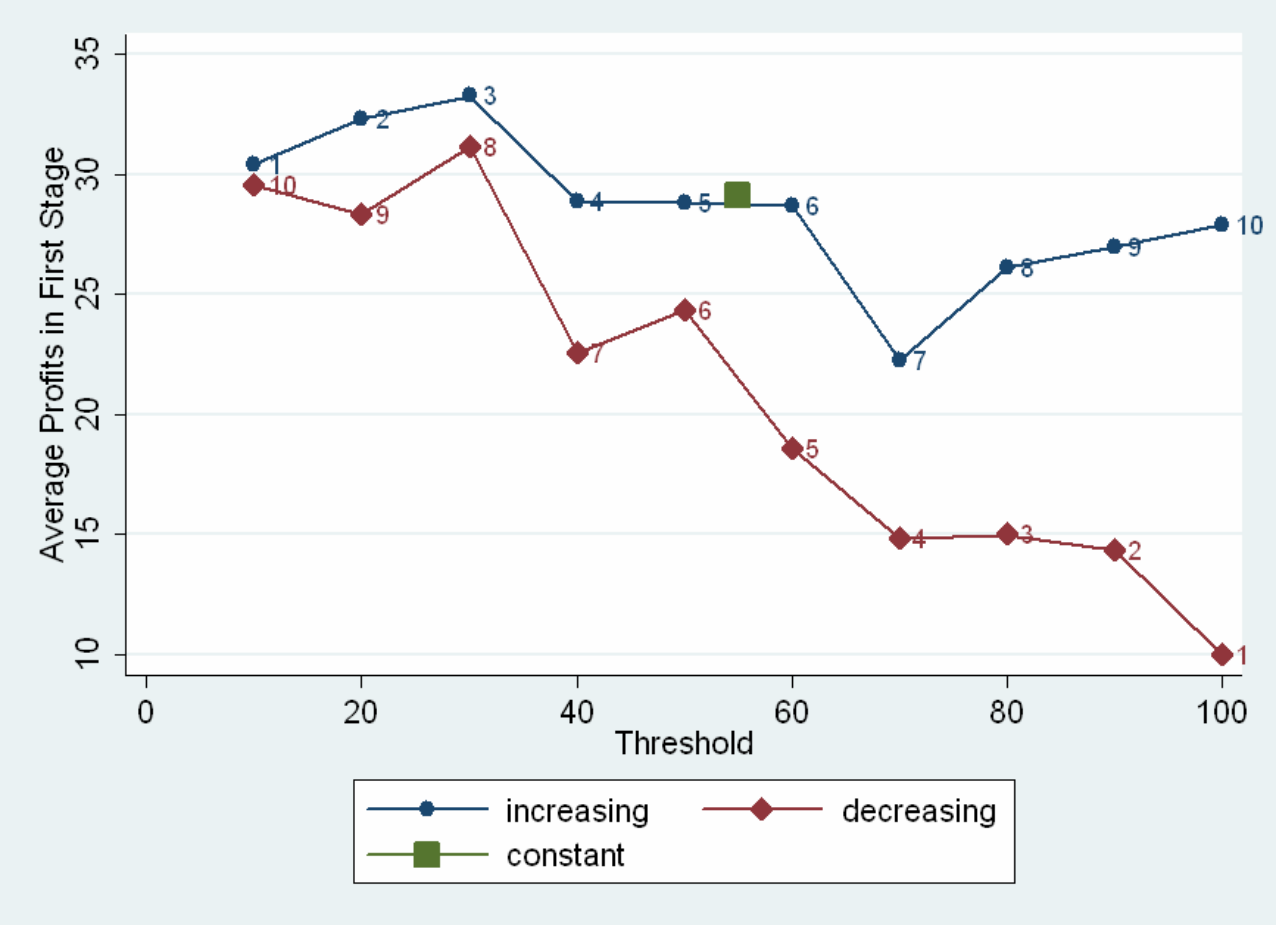


Figure 4 illustrates how average profits are affected by group, holding stage constant. As we can see, the difference in profitability of the increasing and decreasing threshold group types is constant and large in the first stage. This difference remains, though it becomes much smaller, in Stage 2, and in Stage 3 the difference is small and negative. This is probably due to the learning process: half of the subjects playing increasing in the second stage played decreasing previously. Likewise, half of those playing decreasing in the second stage played increasing in Stage 1. This shrinking gap is consistent with the idea that playing the decreasing threshold game type erodes trust, while playing increasing builds it. Most interesting here is that this effect on trust seems to occur not only within a stage (when the group is fixed) as we had predicted, but remains even after groups are reassigned. See Table 5 and the following discussion for more evidence on this inter-stage effect.

Figure 5: Average Profit in the First Stage by Threshold Type and Threshold



Because of the unexpected "inter-stage effect," Figure 5 displays the average profits from only the first period. In this period, players have not yet learned any behavior from their previous stages. The results are striking: for every threshold level, players earned more points in the increasing threshold group type than in the decreasing threshold group type, thus supporting our initial hypothesis. But this graph also reveals that most of the action seems to be in the decreasing threshold game. Profits in the increasing threshold group type game at thresholds of 50 and 60 are identical to the constant game, suggesting that at least by those periods, little trust has been gained or lost as compared to a constant game. However, the decreasing threshold groups game's profits are considerably lower at those levels, suggesting a greater coordination failure than in the other two games. These findings call for a more in-depth study to determine whether the dominance of increasing over decreasing thresholds holds up with a larger sample size.

Figure 6: Average Profit by Stage within Threshold Type

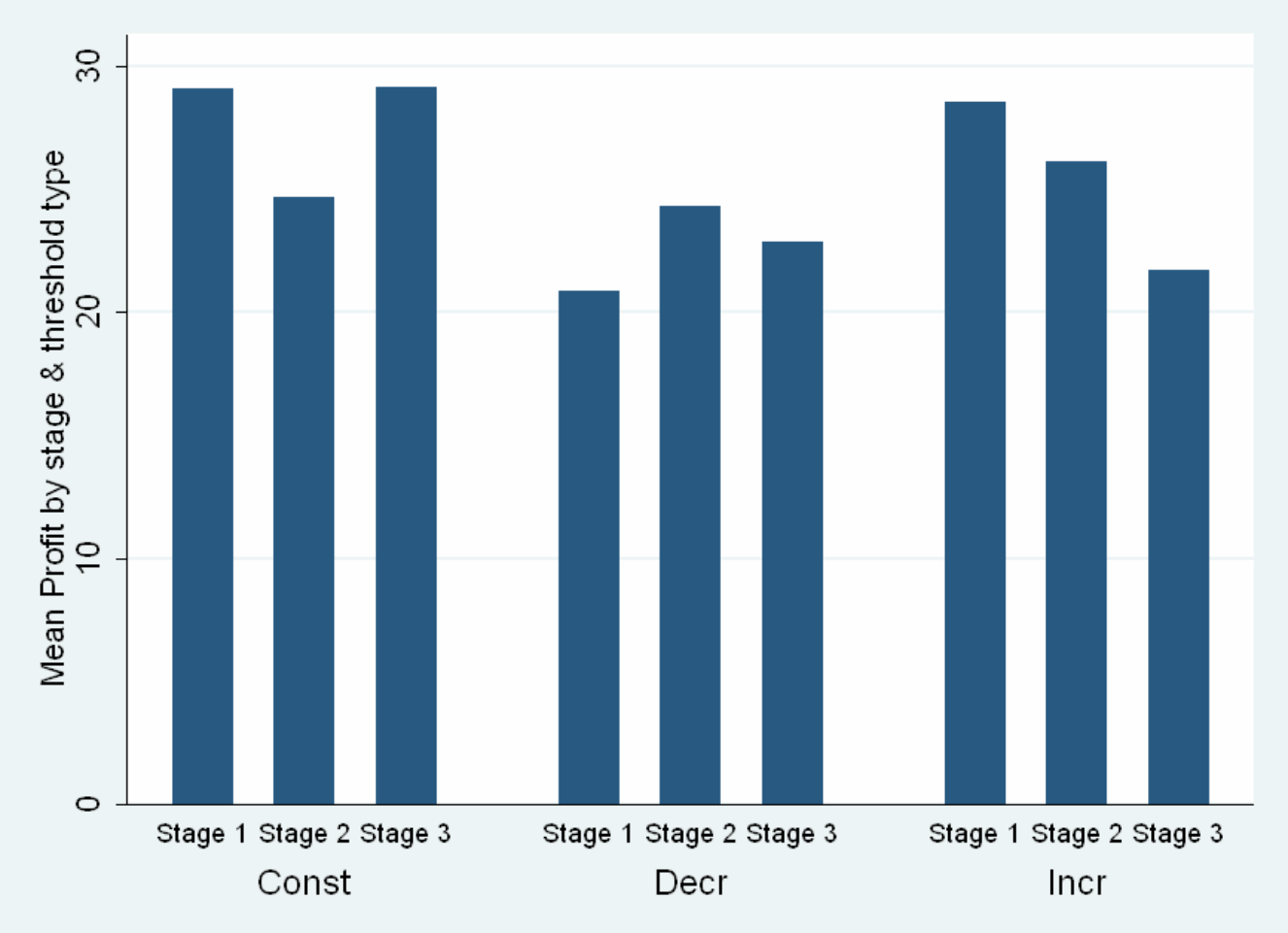


Figure 6 captures the same information as in Figure 4, but arranged to cluster type of game rather than stage. Here, we can observe a clear downward trend in the profitability of the increasing threshold group type over time. While it is possible to attribute this to the effect of time, we instead suggest that the subjects' experiences in previous games are affecting their willingness to contribute. This story fits the course of the experiment. If, as Figure 5 suggested, playing the decreasing threshold group type game erodes trust and willingness to contribute, then we would expect profits to go down in the increasing threshold group type game as more of its players had previously played decreasing. In the first stage, none of the increasing threshold group type players had played decreasing, in the second stage half of them had, and in the third all had previously played the decreasing threshold type. This is confounded somewhat by the experience in the constant threshold game, where profits fall and then rise, but we consider the constant threshold game to be distinct enough from the other two to not be particularly instructive.

D. Regression Results

In the next tables we present our regression results concerning the primary variables of interest: average contribution, likelihood of reaching the threshold, and profits earned (all per period). Before discussing these results, it is necessary to describe our empirical strategy. In all the tables, we restrict our sample to subjects playing with increasing or decreasing thresholds; in other words, we drop observations belonging to the constant threshold group type and compare only the two varying threshold group types. We run our baseline specification with all three stages. However, one concern is that when people play in the second and third stage, their behavior is affected by their experiment history as well as by their current assignment. Therefore, we choose to run further regressions only including observations from the first stage, based on the data summarized by Figure 5 above.

Table 3: Individual Contribution vs. Threshold Group Type

	Dependent Variable: Individual Contribution Level					
	[All Stages]				[Stage 1 Only]	
	[(1)	(2)	(3)	(4)]	[(5)	(6)]
Increasing	-.100	-.100	-.778	-.778	3.369	1.417
	(0.663)	(1.415)	(2.246)	(1.531)	(2.408)	(1.842)
Increasing*Thresh 20			0.861	0.861		2.083
			(3.176)	(1.834)		(4.382)
Increasing*Thresh 30			0.778	0.778		2.083
			(3.176)	(1.655)		(3.316)
Increasing*Thresh 40			0.667	0.667		2.000
			(3.176)	(1.867)		(4.627)
Increasing*Thresh 50			4.250	4.250*		6.250
			(3.176)	(2.292)		(4.949)
Increasing*Thresh 60			4.500	4.500*		7.250*
			(3.176)	(2.563)		(4.366)
Increasing*Thresh 70			3.667	3.667		1.583
			(3.176)	(2.858)		(6.301)
Increasing*Thresh 80			2.500	2.500		-.417
			(3.176)	(3.197)		(7.690)
Increasing*Thresh 90			-.861	-.861		-1.000
			(3.176)	(3.501)		(8.072)
Increasing*Thresh 100			-9.583***	-9.583***		-6.000
			(3.176)	(3.364)		(8.716)
Threshold Controls	YES	YES	YES	YES	YES	YES
Survey Controls	YES	YES	YES	YES	YES	YES
Standard Errors	HSK Robust	Clustered	HSK Robust	Clustered	Clustered	Clustered
(#clusters)		(27)		(27)	(27)	(27)
Obs.	720	720	720	720	240	240
R^2	0.186	0.186	0.062	0.062	0.212	0.065

Table 3 presents our main results concerning the amount that people choose to contribute to the common pool. Our baseline specification (Column 1) includes survey controls and threshold level controls[9]. We find an effect indistinguishable from zero of the threshold group type on contribution, consistent with the results presented in Table 2. Note that this takes into account controlling for specific threshold effects. Results are very similar in Column 2 where we cluster standard errors at group level. Columns 3 and 4 add interactions between threshold group type and threshold level dummies. We find that the increasing threshold group type dummy has a large positive coefficient for medium thresholds. Note again that these are indeed the mid-level thresholds where we expect previous history to make a difference in the choice of how much to contribute. However, the results are

[9] We choose not to report the results for the baseline survey variables coefficients in the current version (demographics, risk aversion). However, we plan to analyze them in future versions of the paper.

generally insignificant, with the exception of threshold at 60 in column 4 (significant at 10%). In column 5 and 6 we restrict our attention to stage one observations only, so to isolate the effect of the threshold group type from a potentially confounding effect of previous stage outcomes and learning. While keeping in mind that we are now working with a smaller sample (240 people) we now find that the effect of playing in a group with increasing threshold is positive overall. Moreover, when we include interactions with threshold levels we find that the effect is positive for every level below eighty and significant at 60[10]. However, the results are indeed robust when we use normal linear model and we find the coefficient in column 5 become significant (results not reported). The standout coefficient is Increasing*Threshold 100, which is large and negative. As in the discussion following Figure 1, we attribute this to the pre-learning play of the subjects in the decreasing group, who have not yet learned that large contributions for a large threshold are a bad investment because there is usually someone in the group who is free-riding at such a high threshold. This explains the weakly negative coefficients for Thresholds 80 and 90 in Table 3. Another possible explanation is conditional cooperation: the first period is very important to one's strategy.

Table 4 (next page) presents our results about the likelihood of reaching the required threshold. Since this is a group-level variable, we collapse our dataset to group means. As the dependent variable is a binary indicator, we choose to use a linear probability model. All the results reported below are robust when we use a nonlinear probit model. Throughout the specifications presented in column 1-4 we find that the effect of being in the increasing threshold group type is always positive (except at threshold 30 where the effect is negative but very small and insignificant). When we restrict our analysis to samples of stage one, we find an overall significant effect: subjects in the increasing threshold group type are .26 percentage points more likely to reach the threshold, which is an increase of more than 50% in the probability relative to the decreasing average presented in table 2. Finally, we note that the probability of reaching the threshold when playing in the increasing threshold group type is higher even for high thresholds. This is consistent with our explanation that subjects in the decreasing threshold group type are wasting their money: they face high thresholds in initial period, make somewhat higher contributions but still do not reach the required level. In other words, players in the increasing group are playing "smarter".

[10] Notice that, by introducing clustering, we are using asymptotic properties of the OLS model even if we have relatively few observations.

Table 4: Probability of Reaching Threshold vs. Group Type

	Dependent Variable: Probability of Reaching the threshold (group-level)			
	[All Stages]		[Stage 1 Only]	
	[(1)	(2)	(3)	(4)]
Increasing	0.067	-.111	0.26**	-4.23e-16
	(0.057)	(0.111)	(0.111)	(4.30e-09)
Increasing*Thresh 20		0.111		0.333
		(0.192)		(0.333)
Increasing*Thresh 30		3.88e-15		5.95e-16
		(0.215)		(7.45e-09)
Increasing*Thresh 40		0.111		0.333
		(0.261)		(0.471)
Increasing*Thresh 50		0.333		0.333
		(0.266)		(0.471)
Increasing*Thresh 60		0.556**		0.667**
		(0.236)		(0.333)
Increasing*Thresh 70		0.222		0.333
		(0.215)		(0.333)
Increasing*Thresh 80		0.111		0.333
		(0.192)		(0.333)
Increasing*Thresh 90		0.111		0.333
		(0.192)		(0.333)
Increasing*Thresh 100		0.222		0.333
		(0.157)		(0.333)
Threshold Controls	YES	YES	YES	YES
Standard Errors	HSK Robust	HSK Robust	HSK Robust	HSK Robust
Obs.	180	180	60	60
R^2	0.454	0.479	0.692	0.555

Table 5 (next page) shows our results concerning profits. As we could expect from our previous analysis, players in the increasing group make higher profit. The effect presented in column one is substantial. An increase of 2.8 profit points per period is more than 10% relative to the average. However, this result is no longer significant when we cluster standard errors at group level. In columns 3-4 we introduce threshold-group type interactions and we find that the effects are strongly significant at level 60 and 100. Based on previous discussions, these two cases seem to show somewhat different stories. At 100, players in the decreasing group, on average, are contributing more money (some people may contribute 0, other may contribute a total 25, but the average is higher) but not enough to reach the threshold. At 60, players in the decreasing threshold group type are playing more conservatively (i.e. lower contribution) and are less likely to make the threshold. On the contrary, players in the increasing threshold group type benefit from previous cooperation success history, are

willing to contribute more, and reach the target. When looking only at stage one (column 5-6), our results are even stronger. The average positive effect is three times as big as the one reported in column one and is highly significant even after clustering. Finally, column 6 shows strong positive effects for almost each threshold level though most coefficient are not significant, also due to smaller sample size.

Table 5: Profit vs. Group Type

	Dependent Variable: Profit					
	[All Stages]				[Stage 1 Only]	
	[(1)	(2)	(3)	(4)]	[(5)	(6)]
Increasing	2.807***	2.807	-.867	-.867	7.457***	0.85
	(0.78)	(1.785)	(2.506)	(1.113)	(2.883)	(1.105)
Increasing*Thresh 20			1.139	1.139		3.117
			(3.544)	(1.711)		(4.044)
Increasing*Thresh 30			-.333	-.333		1.250
			(3.544)	(2.471)		(1.990)
Increasing*Thresh 40			1.067	1.067		5.467
			(3.544)	(3.806)		(8.056)
Increasing*Thresh 50			4.061	4.061		3.617
			(3.544)	(3.547)		(8.593)
Increasing*Thresh 60			10.567***	10.567**		9.283
			(3.544)	(4.270)		(7.386)
Increasing*Thresh 70			2.067	2.067		6.550
			(3.544)	(4.460)		(8.251)
Increasing*Thresh 80			-.367	-.367		10.283
			(3.544)	(4.099)		(7.475)
Increasing*Thresh 90			2.861	2.861		11.800
			(3.544)	(4.071)		(7.560)
Increasing*Thresh 100			15.672***	15.672***		17.067**
			(3.544)	(3.099)		(7.014)
Threshold Controls	YES	YES	YES	YES	YES	YES
Survey Controls	YES	YES	YES	YES	YES	YES
Standard Errors	HSK Robust	Clustered	HSK Robust	Clustered	Clustered	Clustered
(#clusters)		(27)		(27)	(27)	(27)
Obs.	720	720	720	720	240	240
R^2	0.269	0.269	0.243	0.243	0.367	0.287

In Table 6 we present an interesting and unexpected finding. Based on our observations from Figures 4 and 6, we noticed that previous assignment to threshold group type seemed to have an effect on subsequent behavior in the game. In order to test this hypothesis, we restricted our sample to subjects playing the constant threshold group type game in stage 2. Based on our experimental design, half of these players had faced decreasing thresholds in stage 1, while the other half had faced increasing thresholds in stage 1. This provided us with a randomly assigned treatment from stage 1

whose effect we could test on stage 2 behavior and outcomes; in other words, our stage 1 group assignment can be thought of as an instrument for successful cooperation history (given what we know of stage 1 outcomes based on our previous analysis). The table below shows that in fact subjects contribute significantly more when their previous assignment had been to an increasing threshold group type. It is important to keep in mind that the stage 2 group assignment is a new randomization, and players know that they are playing in a new group. Thus, this finding is indicative of a new effect, namely an inter-stage effect of having played increasing thresholds, rather than an intra-stage effect that lasts only as long as the group remains constant. We ran this regression using data from both the first three periods and from all ten periods, as shown below. We find that the effect of having played increasing thresholds is large and significant for the first three periods (representing a roughly 50% increase over the mean contribution in the constant threshold stage). However, this effect gradually disappears over the course of the ten periods, suggesting a learning process where the behavior of the two types converges as they observe the play of their fellow group members. The story is slightly different for profits. At first, the higher contributions of the "lagged increasing" types, combined with a low probability of reaching the threshold, produces profit levels far lower than the "lagged decreasing" types. This effect decreases as well over the ten periods, but remains large and significant.

It is possible that the fact that "lagged increasing" types contribute significantly more is the result of a wealth effect coming from their higher average profits from the preceding stage. Under the assumption of decreasing absolute risk aversion, this greater wealth could produce a greater willingness to contribute. While possible, we do believe that any income effect would be small, certainly not enough to generate the observed discrepancy. On the contrary, we consider these findings to be strongly suggestive evidence that threshold type can induce long-run cooperative behavior, most likely through a history of successful cooperation and an increased level of trust.

Table 6: Contribution and Profit vs. Lagged Group Type

	Normal Linear Model			
	[First 3 Periods[		[Whole Stage]	
	Contribution	Profit	Contribution	Profit
Increasing in previous stage	5.838***	-12.152*	1.172	-9.249***
	(1.815)	(6.386)	(1.815)	(2.499)
Obs.	36	36	120	120
R^2	0.856	0.538	0.64	0.623

IV. Conclusion

The findings in this paper are important because they tell us that thresholds can serve as powerful reference points for contributions. In general, the increasing threshold game produced more contributions and higher profits than the decreasing threshold game. The largest differences occurred in the middle range of thresholds and in the first stage. Despite the fact that contributions were similar for the increasing and decreasing threshold group types when thresholds were low, a sizeable gap opened up around the average threshold size. This finding is entirely consistent with our initial hypothesis: the successful cooperation of the early stages in the increasing group produces higher contributions than the failed cooperation of the early stages of the decreasing threshold group type. In the middle range of thresholds, from 50 to 70, the increasing threshold group types are much more likely to attain the public good than their decreasing threshold group type counterparts. The gap between increasing and decreasing threshold group types also held for profits. All of these findings demonstrate that for nearly ever threshold, it was more profitable to be in an increasing than in a decreasing threshold group type.

Profits in the increasing game at thresholds of 50 and 60 are identical to the constant game, suggesting that at least by those periods, little trust has been gained or lost as compared to a constant game. However, the decreasing threshold groups game's profits are considerably lower at those levels, suggesting a greater coordination failure than in the other two games. These findings call for a more in-depth study to determine whether the dominance of increasing over decreasing thresholds holds up with a larger sample size.

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Appendix A: Experimental Instructions

Figure A1: Introduction Screen

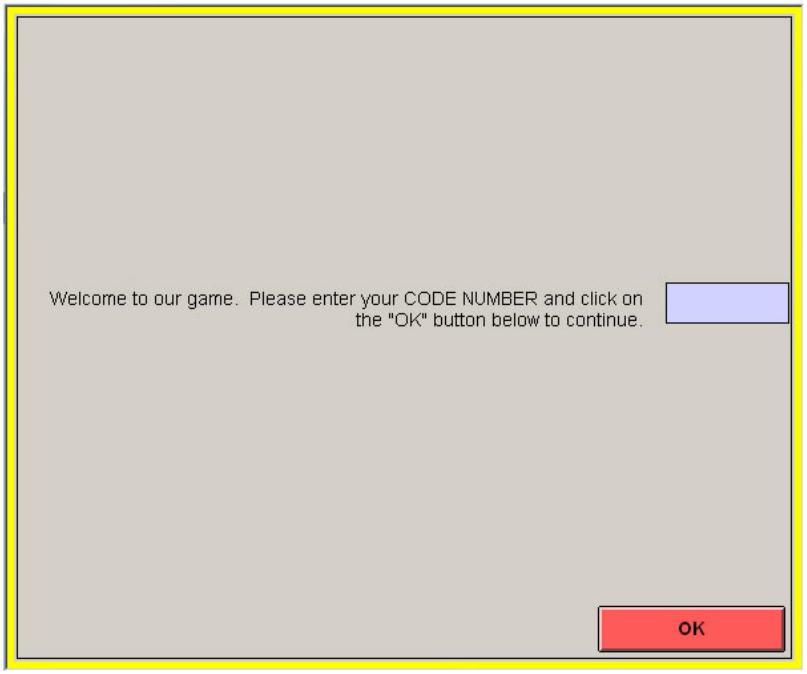
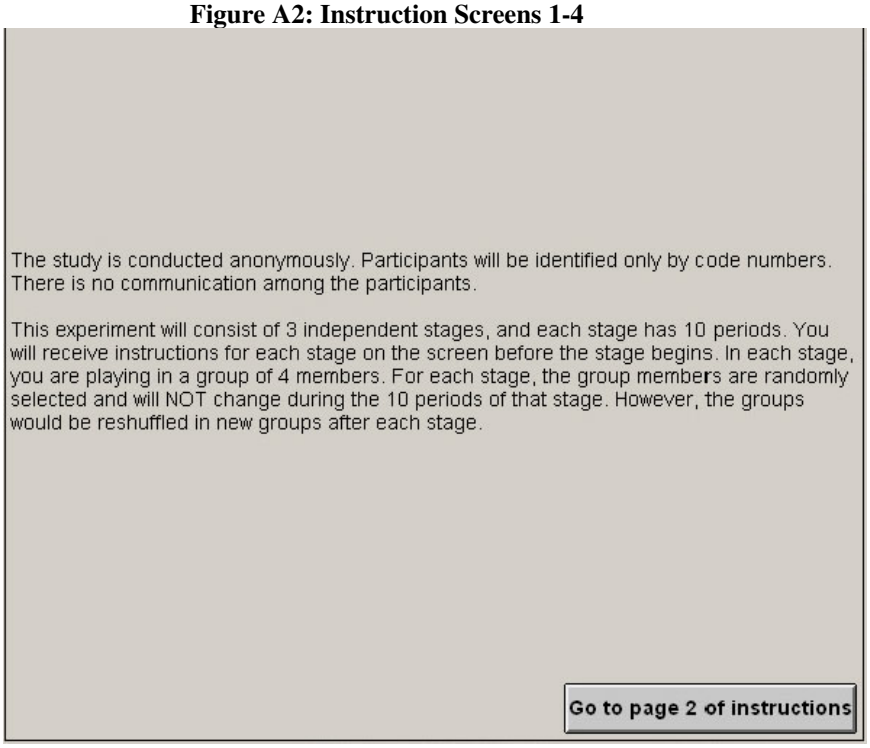
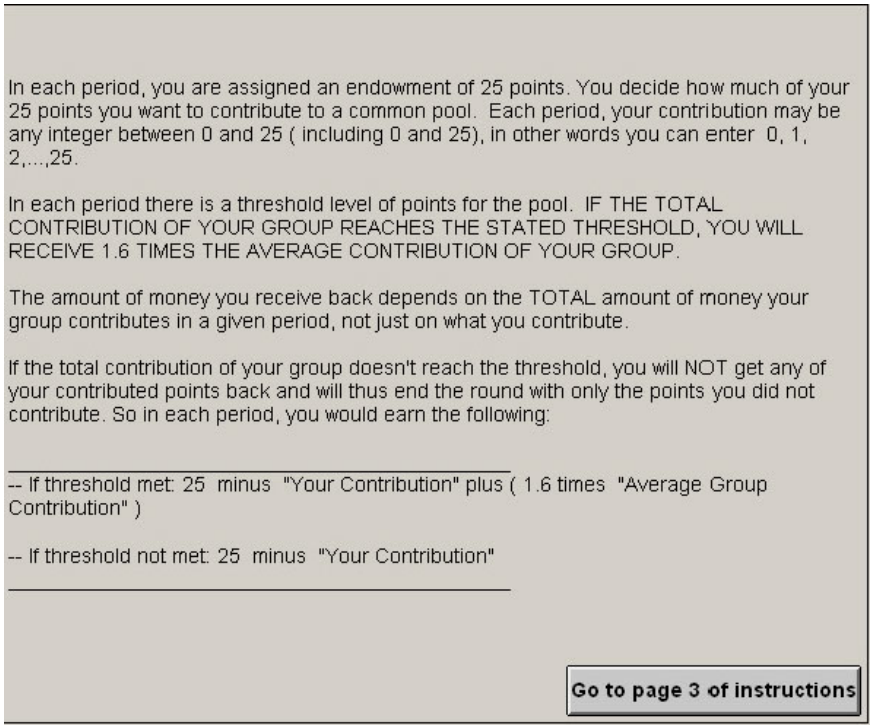


Figure A2: Instruction Screens 1-4





EXAMPLE 1: Threshold is 40, you contribute 20, two other group members contribute 15 each, and the last group member contributes 10. The total amount the group contributes is 60, which exceeds the threshold, so you get the multiplier. The average contribution is 15; therefore, in this period you earn 25 (endowment) - 20 (your contribution) + 1.6 (multiplier) * 15 (average contribution)= 29.

EXAMPLE 2: Threshold is 40, you contribute 10, two other group members contribute with 5 each, and the last group member contributes 0. The total amount the group contributes is 20 and the average contribution is 5. The total contribution of 20 fails to reach the threshold, therefore you earn only what you did not contribute. In this period you earn 25 (endowment) - 10 (your contribution) = 15.

Go to page 4 of instructions

The threshold may change across periods. The amount you earn in each period will be added to your total point tally. Regardless of your performance in the previous period, you begin each period with 25 points. At the end of each period, you will be told whether your group reached the threshold or not, but you will not be informed of your total points or your earnings in that round.

At the end of the game, you will be reminded of your individual code number. You can collect your earnings by presenting your code number to the supervisor at the end of the study. Your earnings will be in an envelope marked with your code number.

Your final payment for this experiment is the sum of two parts. The first is a show-up fee of $5. The second is a performance payment, i.e., the sum of your earnings from all 3 stages, with the conversion rate of 60 points = $1.00. If you quit before the end of the game, you will NOT receive any performance payment. All payments will be in cash.

If anything is unclear to you, please ask the supervisor NOW as questions will not be allowed while the game is in progress.

I understand and I am ready to start the game

Figure A3: Stage Introduction Screen: Here the players learn how the thresholds will be varying over the course of the following 10 periods.

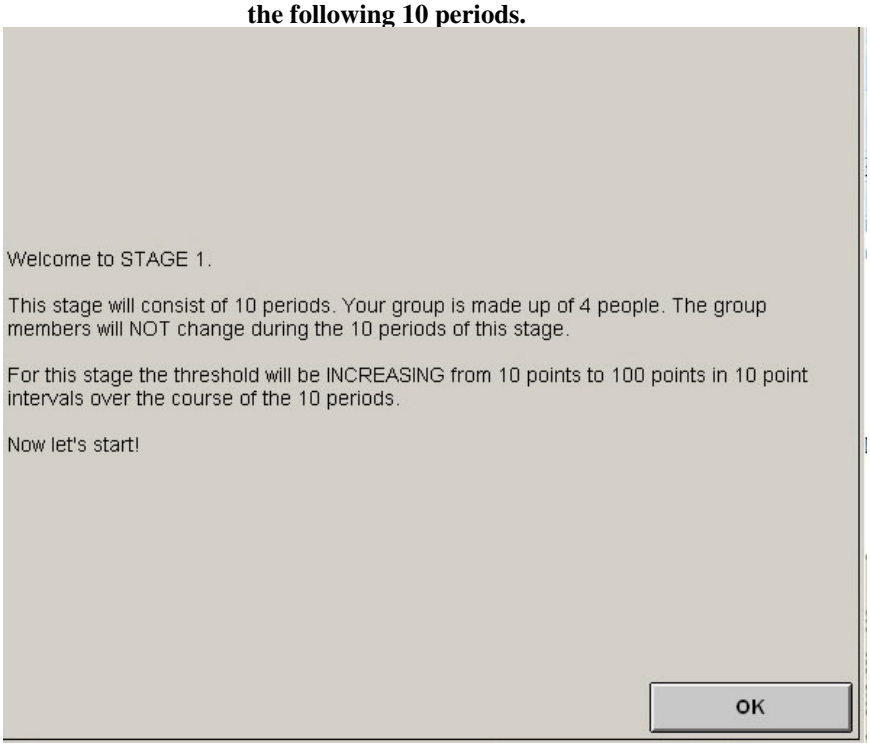


Figure A4: Contribution Screen: Here the players decide how much of their 25 points they contribute to the common pot.

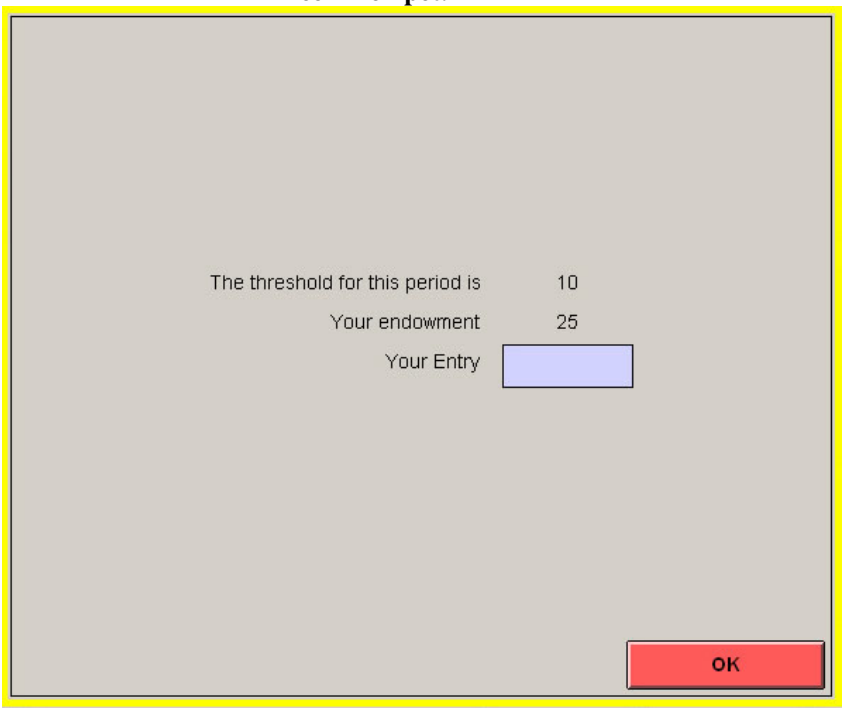


Figure A5: Period Outcome Screen: Here the players learn whether or not the threshold was reached for this period. Note that in order to avoid salience of income effects, the players do not learn exactly how much money they made from that stage.

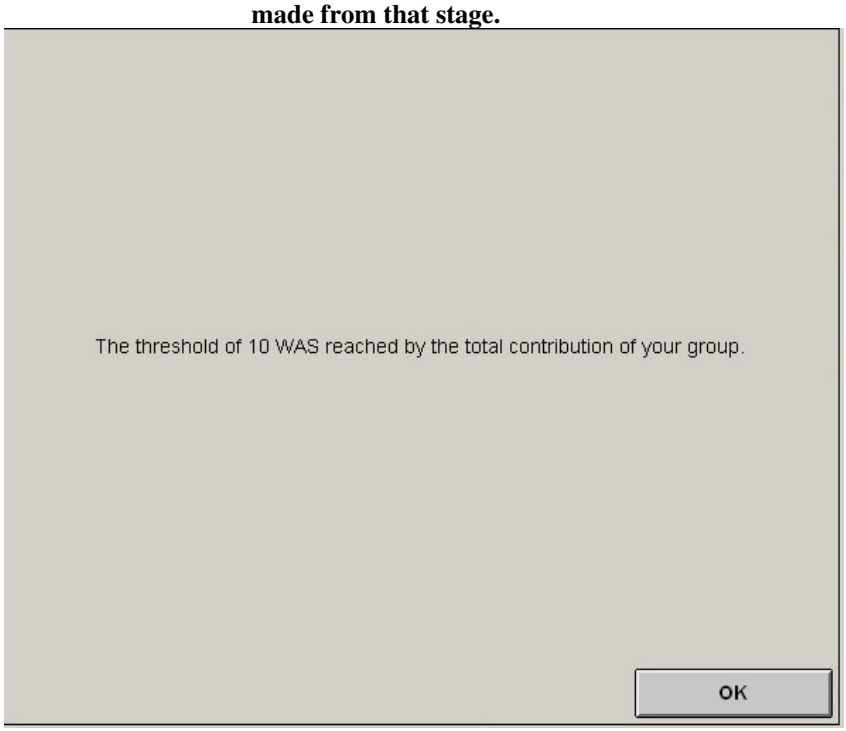
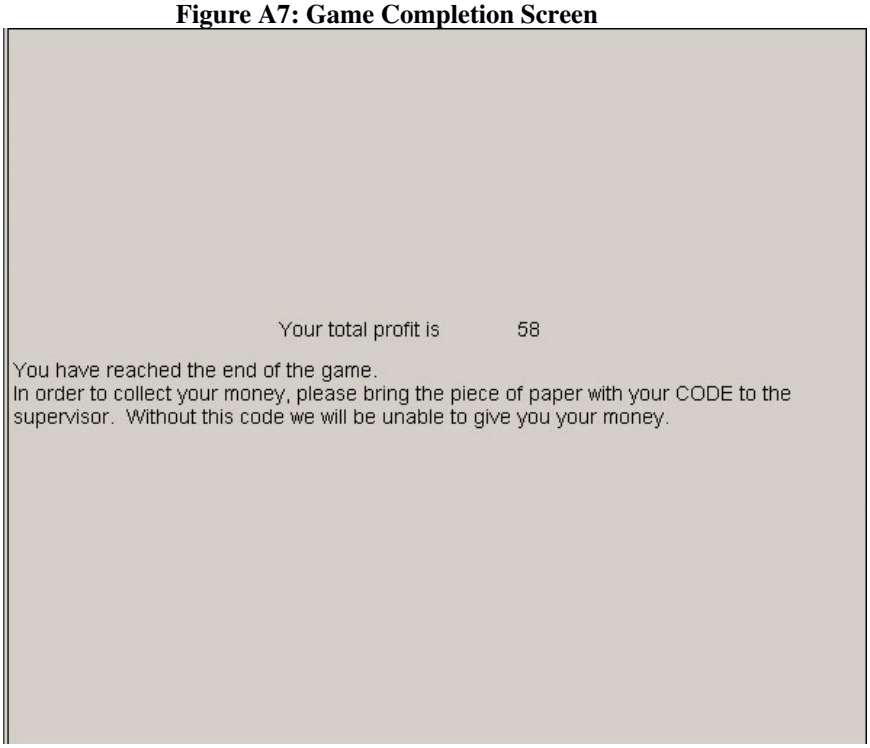


Figure A6: Stage Completion Screen: Players are told that the stage is finished, and how much money they have made in total.

Figure A7: Game Completion Screen



Appendix B: Voluntary Surveys

Figure B1: Risk Aversion Question

Your code___ _____

In the table below, you are presented with a choice between two lotteries, A or B, along with the payoff matrix for each lottery.

For example, the first row shows that lottery A offers a 10% chance of receiving $2 and a 90% chance of receiving $1.60. Similarly, lottery B offers a 10% chance of receiving $3.85 and a 90% chance of $0.10.

In the third table column, simply indicate given the two lotteries in each row, which one would you prefer if you are given the choice? A or B for each row?

Loterry A				**Loterry B**				**Your lottery choice**
prob($2)		prob($1.6)		prob($3.85)		prob($0.10)		
0.1	$2.00	0.9	$1.60	0.1	$3.85	0.9	$0.10	
0.2	$2.00	0.8	$1.60	0.2	$3.85	0.8	$0.10	
0.3	$2.00	0.7	$1.60	0.3	$3.85	0.7	$0.10	
0.4	$2.00	0.6	$1.60	0.4	$3.85	0.6	$0.10	
0.5	$2.00	0.5	$1.60	0.5	$3.85	0.5	$0.10	
0.6	$2.00	0.4	$1.60	0.6	$3.85	0.4	$0.10	
0.7	$2.00	0.3	$1.60	0.7	$3.85	0.3	$0.10	
0.8	$2.00	0.2	$1.60	0.8	$3.85	0.2	$0.10	
0.9	$2.00	0.1	$1.60	0.9	$3.85	0.1	$0.10	
1	$2.00	0	$1.60	1	$3.85	0	$0.10	

Figure B2: Socioeconomic Survey

Congratulations! Now the experiment has ended! You can present your CODE NUMBER to collect you earnings! Before that, we would appreciate if you can fill out a simple VOLUNTARY survey. The survey would NOT affect your payment, and your information would be kept CONFIDENTIAL.

1. What is you age? _____ years old

2. Are you male or female? (Check one)
_____ Male
_____ Female

3. How would you range your expected net-of-tax income for year 2008 (Check one; if your tuition, health fee and health insurance paid by others like your school, please include them to your income)?
_____ <= $4999
_____ $5000 – $9999
_____ $10000 – $19999
_____ $20000 – $29999
_____ $30000 – $39999
_____ $40000 – $49999
_____ $50000 – $59999
_____ $60000 – $69999
_____ $70000 – $79999
_____ >= $80000

4. What is your concentration? (Check the most relevant one)
_____ Economics
_____ Psychology
_____ Law
_____ Other Social Sciences
_____ Business
_____ Humanities
_____ Science
_____ Engineering
_____ Medical/Health
_____ Other

5. How would you classify your ethnic group?
_____ Caucasian
_____ African-American
_____ Latino
_____ Asian
_____ Other