2001

Feedback in Voluntary Contribution Mechanisms: An Experiment in Team Production

Rachel Croson
University of Pennsylvania

Feedback in Voluntary Contribution Mechanisms: An Experiment in Team Production

Abstract
Alchian and Demsetz's (1972) classic paper models team production as a public good. They claim detection of individual effort levels, rather than aggregate effort levels, reduces shirking (free riding). This paper experimentally tests this claim. Participants are informed either about the individual contributions of others on their team or only about their team's total contribution. Average contributions in the two treatments are the same. However, contributions under individual feedback have a significantly higher variance than those under total feedback. Implications of these results for team production are discussed.

Disciplines
Economics | Social Work

"Feedback in Voluntary Contribution Mechanisms: An Experiment in Team Production"

95-05-02

Rachel Croson

FEEDBACK IN VOLUNTARY CONTRIBUTION MECHANISMS: AN EXPERIMENT IN TEAM PRODUCTION

Rachel T. A. Croson

95-05-02

Department of Operations and Information Management
The Wharton School
University of Pennsylvania
Philadelphia, PA 19104-6366

Also available as a working paper of the Risk Management and Decision Processes Center

Feedback in Voluntary Contribution Mechanisms: An Experiment in Team Production

Rachel T.A. Croson
1318 Steinberg Hall-Dietrich Hall
Department of Operations and Information Management
Wharton School of Business
Philadelphia, PA 19104-6366

(215) 898-3025
CrosonR@grace.wharton.upenn.edu

Feedback in Voluntary Contribution Mechanisms: An Experiment in Team Production*

Abstract

Alchian and Demsetz's (1972) classic paper models team production as a public good. They claim detection of individual effort levels, rather than aggregate effort levels, reduces shirking (free riding). This paper experimentally tests this claim. Participants are informed either about the individual contributions of others on their team or only about their team's total contribution. Average contributions in the two treatments are the same. However, contributions under individual feedback have a significantly higher variance than those under total feedback. Implications of these results for team production are discussed.

Feedback in Voluntary Contribution Mechanisms:
An Experiment in Team Production

1. Introduction

Alchian and Demsetz (1972) classic paper suggests modeling team production as a public goods problem. Each team member's effort has a positive externality on the other team members. They claim that any costs of monitoring the effort expanded by an individual on a team will lead to shirking (free riding).

> If a worker's "relaxation cannot be detected perfectly at zero cost, part of its effects will be borne by others in the team, thus making *his* realized cost of relaxation less than the true total cost to the team. The difficulty of detecting such actions permits the private costs of his actions to be less than their full costs. . . [which] implies a lower rate of productive effort and more shirking than in a costless monitoring, or measuring, world." (p. 780)

This vision of team production has been extensively developed and explored in the theoretical literature (Marshak and Radner (1972), Holmstrom (1982), Holmstrom and Tirole (1989)).

This paper provides an experimental test of Alchian and Demsetz's original claims. A public goods problem is induced in the laboratory and the extent of shirking (free riding) is measured in both of two treatments. In the first, *total-feedback* treatment, participants have information only on the total amount contributed to the public good by the other members of their group. This is analogous to knowing the output or total effort of one's team (and one's own effort level) but not knowing how much effort each of the other players have contributed. Shirking thus cannot be detected, much less perfectly and at zero cost. In the second, *individual-feedback* treatment, participants are told at the end of each round how much each individual in their group contributed. This is analogous to knowing exactly how much effort each individual has contributed to the group product. Thus shirking can be detected perfectly and at zero cost.[1]

The use of the voluntary contribution mechanism to elicit contributions to the public goods directly mirrors the voluntary nature of expended effort in an employment situation. Alchian and Demsetz write that "[The firm]. . . has no power of fiat, no authority, no disciplinary action any different in the slightest degree from ordinary market contracting between any two people." (p. 777) Workers voluntary choose the level of effort to expend, as in this mechanism participants voluntarily choose the level of contributions to make to the group account.

The experiment further captures the team production analogy in that the game is repeated, but only finitely many times. Like an employment situation, individuals interact repeatedly and also like an employment situation, the game comes to an end eventually.

The main result from this study is not consistent with Alchian and Demsetz's claim. Average contributions are not statistically different between the two feedback treatments. The variance of contributions in the individual-feedback treatment, however, is significantly higher than that in the total-feedback treatment. Implications of this result for team production are discussed in Section 5.[2]

This research is of some methodological interest as well. Experimental economists have studied the public goods problem and the voluntary provision of public goods extensively (for excellent summaries see Davis and Holt (1993), ch. 6 and Ledyard (1995)). Although most previous public goods experiments have been run under the total-feedback condition, some (e.g., Chan, Godby, Mestelman and Muller (1993)) have been run under individual feedback. Understanding the difference between these two treatments can help us predict outcomes in these experiments and in their real-life counterparts more accurately.

2. Previous Research

Two previous papers have examined the impact of distributional information on contributions in public goods games. Sell and Wilson (1991) compared three experimental conditions: *individual information, aggregate information* and *no information*. In the *no information* condition, participants were told nothing about the previous round's results until the entire (ten-round) game had ended. In the *aggregate information* treatment, participants were told the total group's investment at the end of each period. This corresponds to the total-feedback treatment in this study. In the *individual information* condition, participants were told the total number of tokens each individual member had contributed to the public good. This treatment is similar to the individual-feedback treatment in this study, with one exception. In Sell and Wilson, members of a participant's group were identified and their contributions recorded over time. Each participant could thus "trace" each other participant's contributions from period to period. In this study, the contributions were not associated with any particular contributor. A participant could thus not directly observe another participant's lowering or raising his contribution.[3]

Sell and Wilson find no statistical difference between contributions in the *individual information* and *aggregate information* conditions over all ten periods. These results are consistent with those presented here. In particular, average contributions between the individual- and total-feedback treatments do not differ significantly over the course of the game.[4]

The *variance* of contributions observed in this study, however, does differ between the two treatments. Measures of the spread of individual contributions are not reported in Sell and Wilson. Here, contributions in the individual-feedback condition have a significantly higher variance than those in the total-feedback condition.

Weimann (1994) also provides participants with information about individual contributions (as well as about individual earnings) and compares their decisions with

those of participants provided with information only about total contributions. He also concludes that average contributions do not change with the additional information. No information about the spread of individual contributions is reported.

3. Experimental Procedure and Design

This study used a voluntary contribution mechanism to elicit public goods provision. For each treatment, 24 participants (in two groups of 12) were recruited from economics classes in the University of Arizona summer session. Participants were randomly assigned to groups of four, remaining in the same group for the entire experiment. In each round they were endowed with 25 tokens, which could be placed either into a private account or into a group account but could not be saved for use in future rounds. Tokens are thus analogous to time which can be spent on leisure or on expanding effort. In a similar way hours cannot be saved for use the next day. Subjects were compensated in dollars for tokens (time) spent in a private account (on leisure) and in a public account (on effort). The experiments lasted a finite number of rounds.

The conditions under which this procedure will induce a public goods problem are simple to illustrate. Assume each player *i* in a group of N identical players has some endowment E_i which can either be contributed to a group account and used to produce units of a public good (analogous to expending effort) or can be privately consumed and converted to cash (analogous to shirking or consuming leisure). Call the amount contributed to the group account by *i*, x_i. The individual's earnings from private consumption (leisure) is simply the amount consumed $(E_i - x_i)$. The individual's earnings from contributions to the group account is a function of the sum of contributions by all participants $P(\Sigma_i x_i)$. The group's earnings is the sum of the individual earnings and the payouts from the group account $\Sigma_i(E_i - x_i) + NP(\Sigma_i x_i)$. Each individual chooses x_i to

maximize his earnings $((E_i - x_i) + P(\Sigma_i x_i))$. We say there is a (pure) public goods problem when two conditions are satisfied.

Condition 1: Contributions to the private account are individually optimal.

$$1 > P'(\Sigma_i x_i))^5 \quad \forall x_i, \forall x_{-i} \qquad (1)$$

Thus regardless of the contributions of the other players, player *i* never wants to contribute to the group account. This is analogous to assuming that an individual prefers to shirk than to work in the absence of any punishment. Were this not the case there would be no need for any sort of monitoring—all individuals would work because they preferred to do so.

Condition 2: Contributions to the private account are not optimal for the group.

$$NP'(\Sigma_i x_i) > 1 \quad \forall x_i, \forall x_{-i}$$

$$P'(\Sigma_i x_i) > \frac{1}{N} \quad \forall x_i, \forall x_{-i} \qquad (2)$$

Regardless of the contributions of the other players the group as a whole earns more when player *i* contributes to the group account than when he contributes to the private account. This is analogous to assuming that the team as a whole produces more than an individual's value of leisure when an individual expands effort. Were this not the case it would be socially optimal for all workers to engage in leisure rather than in expanding effort.

The payoff per token for the private account in this study was 2¢ to the private and for the group account was 1¢ to each member of the group. With a group size of 4 we can confirm that both conditions (1) and (2) above are satisfied. Condition (1) suggests that each individual prefers to contribute each marginal token to the private account (earning 2¢) than to the group account (earning 1¢). Condition (2) suggests that the group as a whole is better off when each individual contributes his marginal token to the group account (which earns 4¢ for the group—1¢ for each of four members) than when he contributes his marginal token to the private account (which earns 2¢ only for him).

There were two games lasting ten rounds each. Participants were initially told they would play a game of ten rounds. At the end of the ten rounds, they were told (unexpectedly) that there was just enough time to restart the game and to play another ten rounds. This technique has been used previously to simulate a "new game" (Andreoni (1988)) or in this setting, a new task with the same team members. The first ten rounds (the first game) and the second ten rounds (the restart game) are reported separately.

This study was completely computerized. Participants signed in, collected their show-up fee and sat at a computer terminal. The instructions were given via the computer screen and participants typed their contribution decisions on the keyboard. Participants played three practice rounds (for which they earned no money) to familiarize themselves with the setup of the computer.[6] Participants were paid a five dollar show-up fee plus their earnings in the experiment. Each session lasted around an hour and participants earned on average $13.97 along with the show-up fee.

At the end of each round in the total-feedback treatment, participants saw their own earnings, the total number of tokens the other three members of their group had contributed to the public good and the group's total contribution. In the individual-feedback treatment, participants saw the individual contributions of the other three members of their group in increasing order of contribution, as well as their own earnings and the total contributed. In contrast to Sell and Wilson, here individual contributions were not identified with their contributor. Weimann does not describe the level of identification available in his setting.[7]

When a game such as this one, which includes a pure public goods problem, is played once there is a unique dominant strategy equilibrium in which all players fully free ride (fully shirk). When the game is repeated finitely many times (with endowments expiring at the end of each period), contributing zero in all periods is the unique subgame perfect equilibrium. These strong equilibrium predictions are, however, not typically observed.

4. Experimental Results

A. Feedback Treatment

Of primary interest is the difference in contributions between the two feedback (monitoring) conditions. Overall, average contributions in the two treatments were statistically indistinguishable.[8] Over all periods in the first game there are no significant differences between treatments in average contributions. Over all periods in the restart game, contributions are significantly different between treatments at the 5% level. If we pool average contribution levels over both games, there is no statistical difference in contributing behavior between the two treatments. These results are described in Table 1 below.[9]

Insert Table 1 here

Figure 1 shows the average participant contribution in each treatment over ten first rounds and ten restart rounds. The average contributions in each treatment are very close, except at the end of the second ten rounds where they diverge.

Insert Figure 1 here

Although there is no statistical difference in average contributions between the two treatments overall, the variances of these contributions differ greatly. There is significantly more variation in group contributions under the individual-feedback condition.[10] That the variances of contributions differ between treatments can be tested with an F-test. Table 2 reports variances of average group contributions in each period.

Insert Table 2 here

An F-test on contributions between treatments within each game and over both games combined, reports significantly more variation under individual feedback than under total feedback. The results of these F-tests are depicted in Table 3.[11]

Insert Table 3 here

These high variances under the individual-feedback condition seem to come from each group developing its own norm of contribution (or effort) level. Implications of a group effort-norm on team production will be discussed in section 5.

The variance of contributions *within* each group is not significantly greater under individual feedback than under total feedback. The variance of contributions *between* groups, however, is significantly greater under individual feedback than under total. A comparison in Figures 2 and 3 of the spread of average group contributions shows this variance.

Insert Figures 2 and 3 here

Finally, we can look at the proportion of free riders (participants contributing zero tokens or shirking) and of full contributors (participants contributing all 25 tokens) in each treatment. Table 4 compares the incidence of free riding in the two treatments and Table 5 examines the incidence of full contribution. If the proportions of players free

riding and fully contributing are pooled over *both* games, these proportions are significantly different at the 1% level between treatments (t=11.27 for free riders, t=-5.05 for full contributors).[12]

Insert Tables 4 and 5 here

There is always at least as much free riding and full contributing in the individual-feedback treatment as in the total-feedback treatment. This result is consistent with the higher variance of contributions in the individual-feedback condition seen in Table 3.

B. Learning

Of secondary interest is the amount of learning exhibited by participants in this experiment between the first and the restart games. If learning were found it may suggest that workers learn to shirk less (or more) as they engage in more team production. However, behavior in the restart game was similar to that of the first under both conditions. In fact, the distribution of contributions in a given round was indistinguishable from the distribution of contributions in that same-numbered restarted round, with one exception.[13]

A more powerful statistical test uses a blocking technique to distinguish between contributions in the first game (the first 10 rounds) and contributions in the restart game (the second 10 rounds). Here, the total-feedback treatment shows some evidence of decreasing contribution levels over the two games (more shirking), but there is no such evidence for the individual-feedback treatment.[14]

5. Conclusion

This study experimentally tests and rejects Alchian and Demsetz's original hypothesis that if individual contributions to team production were known, shirking

would decrease. Individual contributions to a public good in the lab are the same under both feedback conditions; total feedback about the group's aggregate effort levels and individual feedback detailing how much each member of the group contributed. This result replicates those found under similar informational conditions reported in Sell and Wilson and in Weimann.

However, the variance of the contributions between the two treatments differs significantly. A much higher proportion of participants fully shirk (free ride) under individual feedback than under total feedback. More participants fully contribute under the individual-feedback condition as well. The higher variance in contributions is driven not by more variance *within* each group, but by more variance *between* groups. The average group contributions under individual feedback are more varied than they are under total feedback.

This difference in variance has some important implications for incentive and compensation schemes in team production. More available and detailed information on who is contributing what to the output of the team will not necessarily raise the average contribution or effort expanded. It will, however, raise the variance of output between teams. In a production process where one team's outputs are other team's inputs this increased variance could be extremely costly. In processes where teams operate relatively independently, the increased variance may be irrelevant.

This high variance suggests there may be some (hidden) characteristics of teams which lead them either to shirking or cooperating. Without knowing in advance which team has which characteristics, a planner cannot know how an individual team will react to the additional information. More research is clearly needed to understand the development of these group norms which will enable us to estimate a team's reaction to a change in information.

These results have implications for experimental methodology as well. Researchers often compare outcomes between experiments to draw general conclusions.

This study suggests that results from public goods experiments run under different feedback conditions might look the same in terms of average contributions. Despite this observational equivalence, the distributions generating those averages may be significantly different. Statistical tests comparing contributions between experiments should be carefully selected to be consistent with this difference.[15]

References

Andreoni, James. "Why Free Ride?: Strategies and Learning in Public Goods Experiments." *Journal of Public Economics*, Vol 37, 1988, pp. 291-304.

Alchian, Armen and Harold Demsetz. "Production, Information Costs, and Economic Organization." *American Economic Review,* Vol 62, 1972, pp. 777-795.

Chan, Kenneth, Rob Godby, Stuart Mestelman and Andy Muller. "Boundary Effects on Voluntary Contributions." McMaster University working paper presented at ESA meetings, October, 1993.

Davis, Douglas and Charles Holt. *Experimental Economics.* Princeton, NJ.: Princeton University Press, 1993.

Holmstrom, Bengt. "Moral Hazard in Teams." *Bell Journal of Economics,* Vol 13, 1982, pp. 324-340.

Holmstrom, Bengt and Jean Tirole. "The Theory of the Firm." in *Handbook of Industrial Organization,* R. Schmalensee and R.D. Willig eds. New York: North Holland, 1989, pp. 61-133.

Ledyard, John. "Public Goods: A Survey of Experimental Research." 1995 forthcoming in *The Handbook of Experimental Economics*. Roth and Kagel, eds.

Marshak, Thomas and Roy Radner. *The Economic Theory of Teams.* New Haven: Yale University Press, 1972.

Nalbantian, Haig and Andrew Schotter. "Productivity under Group Incentives: An Experimental Study." C.V. Starr Center for Applied Economics, New York University working paper RR#94-04, February, 1994.

Sell, Jane and Rick Wilson. "Levels of Information and Contributions to Public Goods." *Social Forces,* Vol 70, no. 1, September 1991, pp. 107-124.

Siegel, Sidney. *Nonparametric Statistics for the Behavioral Sciences.* New York City, NY: McGraw-Hill, 1956

Weimann, Joachim. "Individual Behaviour in a Free Riding Experiment" *Journal of Public Economics,* Vol 54, no. 2, June 1994, pp. 185-200.

Endnotes

*The author thanks Jon Baron, David Croson, Jerry Green, Mark Isaac, Eric Maskin, Jeff Prisbrey, Jane Sell and George Wu for helpful comments. All omissions or mistakes are the responsibility of the author. Funding of experiments from Economic Science Lab at the University of Arizona is gratefully acknowledged

[1]These two types of feedback mechanisms are used in fundraising efforts as well. A counterpart to the total-feedback treatment is the giant thermometer often seen in fundraising drives. The readings at the thermometer's top indicate the drive's fundraising goal and thermometer is filled to the level of money already raised. This provides information about the *total* others have contributed to the effort, but no information about the size and distribution of individual contributions. A counterpart to the individual-feedback treatment can be seen on the backs of theater playbooks. Contributions are typically divided into categories by amount (Patron, Friend, Benefactor, etc.). A potential contributor can see how many others have contributed (approximately) how much to the effort.

[2]The experiment reported in this paper uses a fixed compensation scheme and changes the level of information available to the participants. For an excellent evaluation of various incentive and compensation schemes with the same levels of information see Nalbantian and Schotter (1994).

[3]In Sell and Wilson's design, two factors were confounded in the comparison between individual and aggregate information; (1) knowing individual feedback versus total feedback and (2) knowing how an individual's contribution changed over time (by tracing his contributions period-to-period) versus knowing only how the total group contribution (minus your own) changed over time. Under this paper's procedure, participants cannot trace an individual's contribution over time in either of the conditions, making the comparison between treatments a measure of only the feedback and not of the additional information. The similarity of the results between the two studies suggests that this particular distinction was irrelevant.

[4]By aggregating the contributions only over the last five periods of the game (a somewhat arbitrary choice), Sell and Wilson demonstrate that participants in the *individual information* condition contribute more than participants in the *aggregate information* condition.

[5]$P'(S_j x_i))$ is often called the marginal per capita return (MPCR) and is the marginal return on contributions to the group account.

[6]Data from practice rounds and copies of instructions are available from the author.

[7]Since the individual contributions were displayed in increasing order rather than in the order of participant number, participants could not identify how much (or whether) a group member's contribution had changed in consecutive rounds.

[8]In only one of the twenty periods of the game (period nine of the restart game), average contributions differ. Contributions in the other periods are not significantly different.

[9]The Wilcoxon statistic tests the hypothesis that two sets of data were generated from the same underlying distribution. For each period, independent observations (average group contributions n=6 m=6) were compared. For each game, average group contributions for all ten periods were tested using the large sample approximation version of the test (n=60 m=60). Over both games together (n=120 m=120) the Wilcoxon test with large sample approximation could not reject the hypothesis that the data were generated from the same underlying distribution at the 5% level (z=1.57 p=.1157).

[10]Group contributions in each round are independent observations as members of one group never interacted with members of another. Some groups achieved the pareto optimal solution of full contribution in the individual-feedback condition in all but the last few rounds of each game.

[11]The F-test results reported here pooled the average group contributions for each period over each game and over both games. In each game n=60 m=60 (6 groups for 10 periods). In both games n=120 m=120.

[12]The t-test used here tests the similarity of two proportions. If p_i is the proportion of free riders (alternately, full contributors) in treatment i and n_i is the number of observations in the treatment then

$$t = \frac{p_1 - p_2}{\sqrt{p_1(1-p_1)/n_1 + p_2(1-p_2)/n_2}}$$

Here, n_i for each individual period is 24 individual contributions. Over each game, 240 observations were used (24 contributions in each of 10 periods). Over both games, 480 observations were used.

[13]Using a 2-sided Wilcoxon test on individual contributions, we cannot reject at 5% level the hypothesis that contributions in round i of the first game are the same as contributions in round i of the restart game with one exception: total feedback first round 7 and restart round 7 are different at the 5% level.

[14]The blocking technique looks at the differences between each participant's contribution in period i of the first game and period i of the restart game for i=1, 2, ...10. Then it tests whether the distribution of these differences is significantly different from zero. In the total-feedback treatment, the distribution of these differences was significantly positive (z=5.11, p<.01), suggesting that participants contributed less in the restart game than they had in the first game. In the individual-feedback treatment, however, this distribution is not distinguishable from zero at any level of significance (z=.30, p>.2).

[15]Weimann (1994) is an excellent case-in-point. The author compares two experimental treatments with differing feedback on the basis of their means, concludes that there is no statistical difference between the treatments and proceeds to pool the data without examining the variances of the observations.

Table 1

Average Investment in Public Good per Subject

	Round											Both	
	1	2	3	4	5	6	7	8	9	10	All	Games	
Total	13.96	12.83	11.42	12.33	12.33	11.88	9.92	7.79	9.04	4.54	10.60		
Individual	16.50	13.71	12.67	12.33	11.63	11.67	8.38	8.38	8.42	6.42	11.01		
Difference	-2.54	-0.88	-1.25	0.00	0.71	0.21	1.54	-0.58	0.63	-1.88	-0.40	8.95	Total
												10.88	Individual
Restart Total	11.54	11.33	10.29	7.88	7.33	6.88	4.21	6.50	4.25	2.67	7.29	-1.94	Difference
Restart Individual	13.13	11.71	10.58	9.88	9.42	12.00	11.33	9.54	12.13	7.83	10.75		
Difference	-1.58	-0.38	-0.29	-2.00	-2.08	-5.13	-7.13	-3.04	-7.88 *	-5.17	-3.47 *		

*different at the 5% level (two-sided Wilcoxon test)

Table 2

Variance of Average Group Contributions

	Round									
	1	2	3	4	5	6	7	8	9	10
Total	51.06	66.47	35.57	13.54	16.62	43.79	14.14	44.09	32.34	13.36
Individual	28.25	38.94	73.04	58.59	74.39	62.44	74.72	78.87	33.69	26.17
Difference	22.81	27.53	-37.48	-45.05	-57.78	-18.65	-60.58	-34.78	-1.36	-12.81
Restart Total	32.34	13.36	38.24	37.82	43.94	43.14	21.42	25.77	10.64	13.33
Restart Individual	26.17	65.32	80.36	66.39	67.99	63.22	76.03	73.14	94.64	43.59
Difference	6.17	-51.96	-42.13	-28.58	-24.06	-20.07	-54.61	-47.37	-84.00	-30.27

Table 3

F-Test Results on Average Group Contributions
Total versus Individual Feedback

Original Game	Restart Game	Both Games
$F(59,59) = 1.56$	$F(59,59) = 1.97$	$F(119,119) = 1.61$
$p = 0.046$	$p = 0.005$	$p = 0.005$

Table 4

Proportion of Free Riders

	Round										
	1	2	3	4	5	6	7	8	9	10	All
Total	0.08	0.08	0.04	0.04	0.08	0.04	0.00	0.04	0.04	0.13	0.06
Individual	0.08	0.21	0.25	0.21	0.21	0.38	0.46	0.29	0.42	0.63	0.31
Difference	0.00	-0.13	-0.21 *	-0.17	-0.13	-0.33 **	-0.46 **	-0.25 *	-0.38 **	-0.50 **	-0.25 **
Restart Total	0.04	0.04	0.04	0.13	0.04	0.04	0.04	0.17	0.13	0.13	0.08
Restart Individual	0.29	0.33	0.42	0.38	0.42	0.33	0.33	0.46	0.33	0.50	0.38
Difference	-0.25 *	-0.29 **	-0.38 **	-0.25 *	-0.38 **	-0.29 **	-0.29 **	-0.29 *	-0.21	-0.38 **	-0.30 **

*different at the 5% level (two-sided t-test)

**different at the 1% level (two-sided t-test)

Table 5

Proportion of Full Contributors

	Round										
	1	2	3	4	5	6	7	8	9	10	All
Total	0.33	0.29	0.25	0.29	0.25	0.21	0.08	0.17	0.21	0.04	0.21
Individual	0.46	0.29	0.38	0.29	0.29	0.33	0.21	0.17	0.21	0.13	0.28
Difference	-0.13	0.00	-0.13	0.00	-0.04	-0.13	-0.13	0.00	0.00	-0.08	-0.06
Restart Total	0.21	0.21	0.13	0.08	0.08	0.04	0.04	0.08	0.04	0.04	0.10
Restart Individual	0.38	0.29	0.25	0.29	0.25	0.33	0.29	0.29	0.38	0.25	0.30
Difference	-0.17	-0.08	-0.13	-0.21	-0.17	-0.29 **	-0.25 *	-0.21	-0.33 **	-0.21 *	-0.20 **

*different at the 5% level (two-sided t-test)

**different at the 1% level (two-sided t-test)

Figure 1

Average Contributions under Varying Feedback Conditions

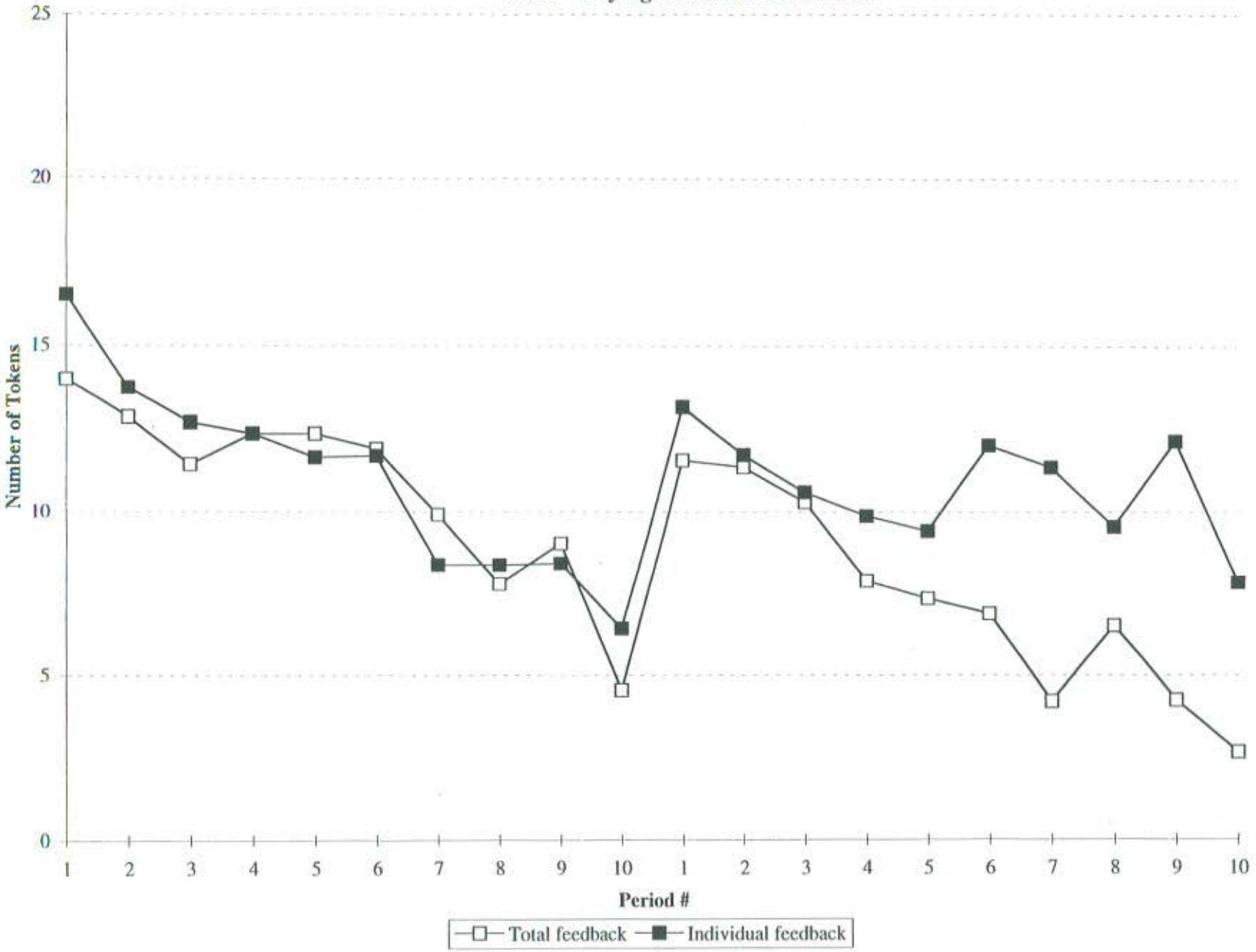


Figure 2

Maximum, Minimum and Average Group Contributions under Total Feedback

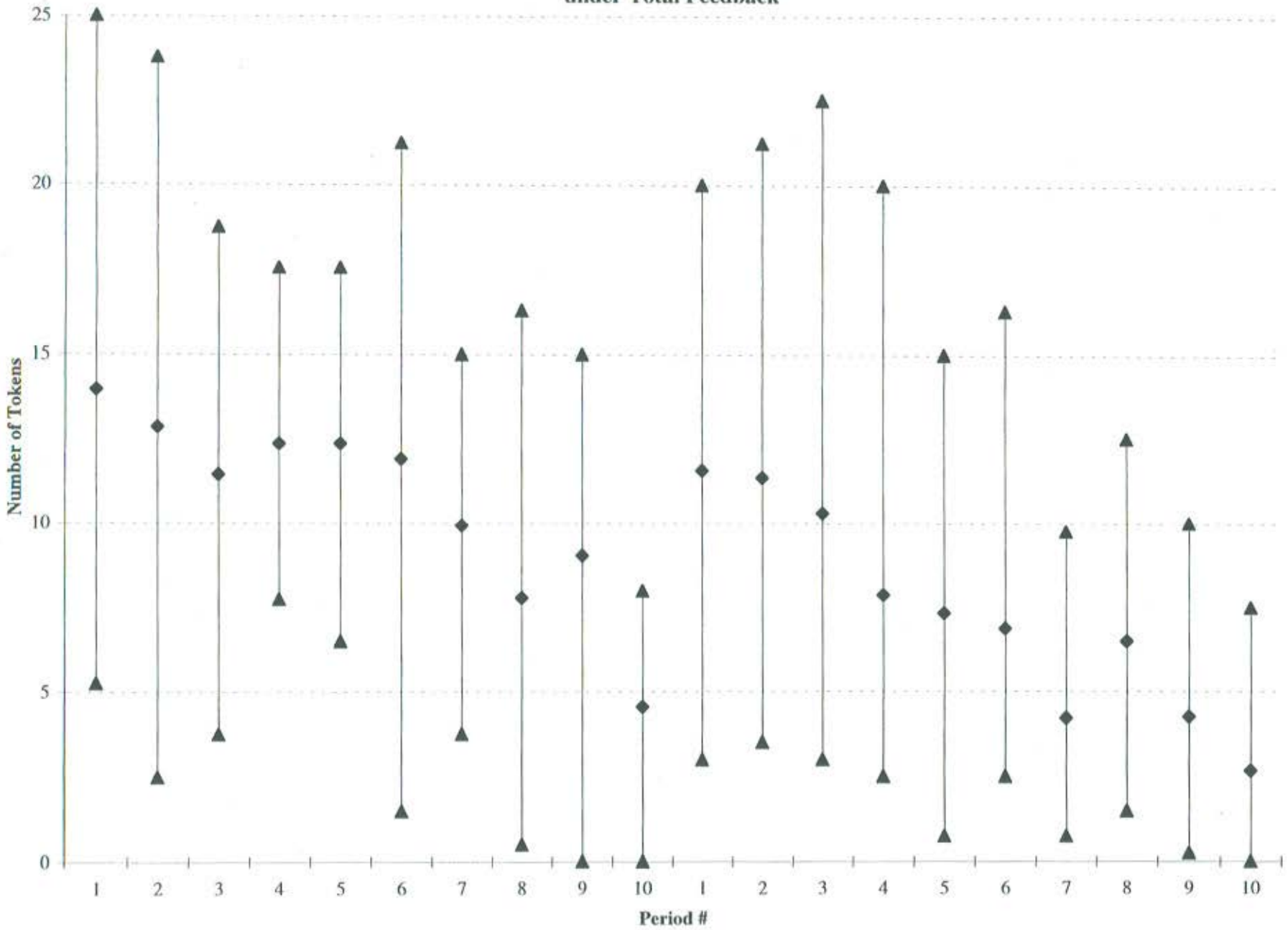
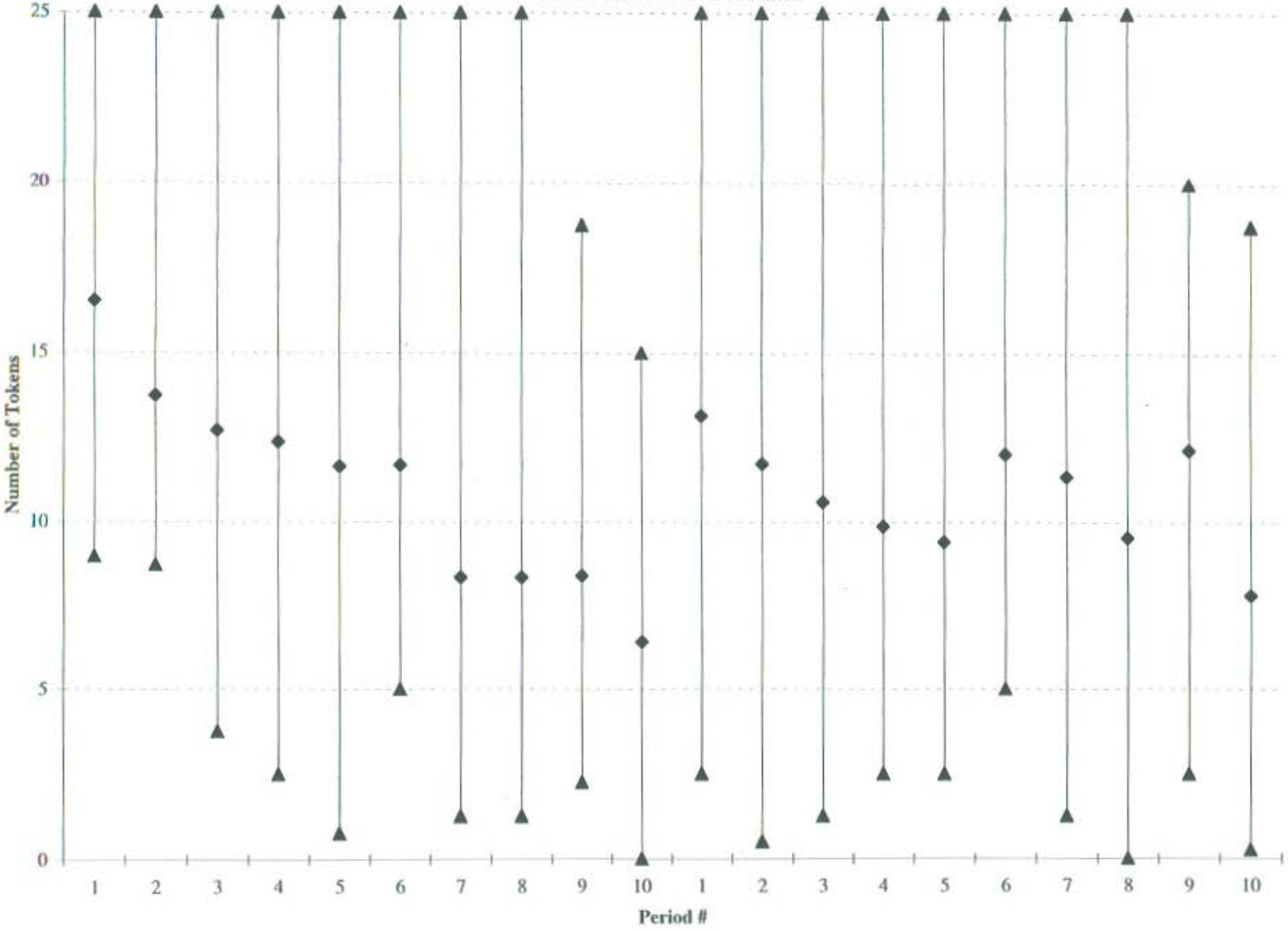


Figure 3

Maximum, Minimum and Average Group Contributions under Individual Feedback



Attached please find a set of screen print-outs which illustrate the instructions presented to the subjects for each of the treatments of this experiment. These instructions are to be used to aid in the reviewing process and are not intended for publication.

This is station # 1

Welcome to an
Economic Experiment

This is an experiment in the economics of group decision making. Various research agencies have provided the funds for conducting this research. If you follow the instructions and make good decisions you may earn a considerable amount of money which will be paid to you in cash at the end of the experiment. Feel free to make as much money as you can.

We will require some personal data for record keeping. All information is kept confidential.

Press PgDn to continue

Design : Arlington Williams, Antoni Bosch, Isabel Sánchez
Programming : Shawn LaMaster, Jordi Mas, Zaca Sánchez
Universitat Pompeu Fabra, Barcelona & Universidad Carlos III, Madrid

Copyright(C) 1991 Computer Research & Consulting Tucson, Arizona

Please enter the following information.

Your Name : croson

Your Social Security Number : 111-11-1111

Your Telephone Number : 999-9999

Press PgDn to continue

Design : Arlington Williams, Antoni Bosch, Isabel Sánchez
Programming : Shawn LaMaster, Jordi Mas, Zaca Sánchez
Universitat Pompeu Fabra, Barcelona & Universidad Carlos III, Madrid

Copyright(C) 1991 Computer Research & Consulting Tucson, Arizona

Period: 2 Decision Stage (Practice Period)

You have 25 tokens to divide between the PRIVATE and GROUP ACCOUNTS

Page 1

This is an experiment in the economics of group decision making. The experiment will last 2 periods. You have been randomly assigned to a particular group of 1 people (0 other people plus yourself). The members of your group will not change throughout the experiment.

In the beginning of each period you and every other member of the group will be endowed with 25 "tokens". In each period you must decide how to divide your tokens between a PRIVATE ACCOUNT and a GROUP ACCOUNT. Each person in the group has a PRIVATE ACCOUNT and is making a similar decision. However, there is only one GROUP ACCOUNT for the entire group.

In each period you will earn 2 cents for each token placed in your PRIVATE ACCOUNT. Thus, if you choose to place all of your tokens in your PRIVATE ACCOUNT you would earn (25 x 2) = 50 cents in that period.

In each period you and every other member of the group will earn 1 cent for each token placed in the GROUP ACCOUNT. All members of the group can place tokens in the GROUP ACCOUNT.

Before making your decision you will have an opportunity to review the past decisions of your group by pressing F5.

Your cash earnings for the experiment will be the sum of your profits from the GROUP ACCOUNT and from your PRIVATE ACCOUNT. There will be 2 practice periods before you begin the actual experiment. The practice periods will familiarize you with the computer program. You will not be paid for the practice periods.

Press PgDn to continue

All

Press the R key to see the instructions again.
Press the Q key to summon an assistant if you have questions. Otherwise, please be patient until the other players are ready.

Waiting for others to finish...

Round 1

Everyone is now ready to begin. Before starting the experiment there will be 2 practice periods. The practice periods will help you become familiar with the computer program. You will not be paid for the practice periods. After the practice periods, the actual experiment will begin and will last 2 periods. The money earned during the actual experiment will be yours to keep.

Good luck.

Press PgDn to continue

Period: 1 Decision Stage (Practice Period)

You have 25 tokens to divide between the PRIVATE and GROUP ACCOUNTS.

For each token that you place in the PRIVATE ACCOUNT you will receive 2 cents.

For each token that each member of the group (including yourself) places in the GROUP ACCOUNT you and every other member of the group will receive 1 cent.

How many tokens do you want to place in the GROUP ACCOUNT? ->2

You have decided to place 2 tokens in the GROUP ACCOUNT this period.
You will place the remaining 23 tokens in your PRIVATE ACCOUNT this period.

Press F10 to confirm, or press any other key to change your decision

cel

Results of Period: 1 (Practice Period)

Total number of tokens in the GROUP ACCOUNT	: 3 tokens
Number of tokens others placed in the GROUP ACCOUNT	: 0 tokens
Your earnings from the PRIVATE ACCOUNT	: 44.0 cents
Your earnings from the GROUP ACCOUNT	: 3.0 cents

Press any key to continue

20 M/
Practice

The practice periods have ended. Press F5 to review the history of the practice periods. Press any other key to continue to the actual experiment.

Press F5 to review the history Press any other key to continue

Period: 2 Decision Stage (Practice Period)

You have 25 tokens to divide between the PRIVATE and GROUP ACCOUNTS.

For each token that you place in the PRIVATE ACCOUNT you will receive 2 cents.

For each token that each member of the group (including yourself) places in the GROUP ACCOUNT you and every other member of the group will receive 1 cent.

To help with your decision, you may want to look at the history of past decisions of this group. To see the history of past decisions press F5.

How many tokens do you want to place in the GROUP ACCOUNT? ->5

You have decided to place 5 tokens in the GROUP ACCOUNT this period.
You will place the remaining 20 tokens in your PRIVATE ACCOUNT this period.

Press F10 to confirm, or press any other key to change your decision

all

all w/ practice

Now we will begin the actual experiment. The experiment will last 2 periods. The money you earn from now on will be yours to keep, so make your decisions carefully.

Press any key to continue

Period: 1 Decision Stage

You have 25 tokens to divide between the PRIVATE and GROUP ACCOUNTS.

For each token that you place in the PRIVATE ACCOUNT you will receive 2 cents.

For each token that each member of the group (including yourself) places in the GROUP ACCOUNT you and every other member of the group will receive 1 cent.

How many tokens do you want to place in the GROUP ACCOUNT? ->3

You have decided to place 3 tokens in the GROUP ACCOUNT this period.
You will place the remaining 22 tokens in your PRIVATE ACCOUNT this period.

Press F10 to confirm, or press any other key to change your decision

History of results

Period	Your tokens: GROUP ACCNT	Your tokens: PRIVATE ACCNT	Others tokens: GROUP ACCNT	Total: GROUP ACCNT	Earnings from: GROUP ACCNT	Earnings from: PRIVATE ACCNT	TOTAL EARNINGS
1	3	22	0	3	$ 0.03	$ 0.44	$ 0.47
2	8	17	0	8	$ 0.08	$ 0.34	$ 0.42

Press any key to return to the experiment

The experiment has ended. Press F5 to review the history of the experiment. Press any other key to end the program and to collect your money.

Press F5 to review the history Press any other key to end

Congratulations! You have reached the end of the exercise.

You have earned 0.84 dollars.

Please remain in your seat quietly until your name is called.

Thank you for your participation.

Params3

History of results

Period	Your tokens: GROUP ACCNT	Your tokens: PRIVATE ACCNT	Others tokens	Total: GROUP ACCNT	Earnings from: GROUP ACCNT	Earnings from: PRIVATE ACCNT	TOTAL EARNINGS
1	1	24	995, 681, -5882	1	$ 0.01	$ 0.48	$ 0.49
2	1	24	-30,7986, -203	1	$ 0.01	$ 0.48	$ 0.49

Press any key to return to the experiment

Runs 3

This is an experiment in the economics of group decision making. The experiment will last 2 periods. You have been randomly assigned to a particular group of 1 people (0 other people plus yourself). The members of your group will not change throughout the experiment.

In the beginning of each period you and every other member of the group will be endowed with 25 "tokens". In each period you must decide how to divide your tokens between a PRIVATE ACCOUNT and a GROUP ACCOUNT. Each person in the group has a PRIVATE ACCOUNT and is making a similar decision. However, there is only one GROUP ACCOUNT for the entire group.

In each period you will earn 2 cents for each token placed in your PRIVATE ACCOUNT. Thus, if you choose to place all of your tokens in your PRIVATE ACCOUNT you would earn (25 x 2) = 50 cents in that period.

In each period you and every other member of the group will earn 1 cent for each token placed in the GROUP ACCOUNT. All members of the group can place tokens in the GROUP ACCOUNT.

Before making your decision you will have an opportunity to review the past decisions of your group by pressing F5.

Your cash earnings for the experiment will be the sum of your profits from the GROUP ACCOUNT and from your PRIVATE ACCOUNT. There will be 2 practice periods before you begin the actual experiment. The practice periods will familiarize you with the computer program. You will not be paid for the practice periods.

Press PgDn to continue

Pairs 3

Results of Period: 1 (Practice Period)

Total number of tokens in the GROUP ACCOUNT : 1 token
Number of tokens placed in the GROUP ACCOUNT by the other 0 members of the group (increasing order)
: 24203, -7215, 9732
Your earnings from the PRIVATE ACCOUNT : 48.0 cents
Your earnings from the GROUP ACCOUNT : 1.0 cents

Press any key to continue

History of results (Practice Session)

Period	Your tokens: GROUP ACCNT	Your tokens: PRIVATE ACCNT	Others tokens: GROUP ACCNT	Total: GROUP ACCNT	Earnings from: GROUP ACCNT	Earnings from: PRIVATE ACCNT	TOTAL EARNINGS
1	1	24	242,3-72,59732	1	$ 0.01	$ 0.48	$ 0.49
2	1	24	-11,8-15,220617	1	$ 0.01	$ 0.48	$ 0.49

Press any key to return to the experiment