THE EFFECTS OF GROUP INTERACTION
IN A PUBLIC GOODS EXPERIMENT
WITH TWO EXCHANGES

by

Yoav Wachsman

Working Paper No. 02-5
January 2002

The Effects of Group Interaction in a Public Goods Experiment with Two Exchanges

Yoav Wachsman

Department of Economics,
University of Hawaii at Manoa
2424 Maile Way, Room 542
Honolulu, HI 96822
808-956-2325 (phone)
808-956-4347 (fax)
E-mail: yoavwachsman@aol.com

January 17, 2002

Abstract

Consumers can often allocate resources to the provision of local public goods and to the provision of global public goods. This paper reports a public goods experiment in which participants allocated tokens to a local exchange with a relatively high marginal payoff and a global exchange with a lower marginal payoff but a higher potential payoff. The experiment consisted of three treatments with varying degree of interaction amongst the members of the local groups. When participants were not allowed to interact they allocated more tokens to the global exchange. This result suggests that individuals care about the potential payoff of the group exchange more than about the marginal payoff of the exchange. When we allowed members of each local group to communicate, they kept almost no tokens for themselves and attempted to coordinate their contributions to the global exchange with members of the other local group.

1. Introduction and Hypotheses

Various researchers, starting with Marwell and Ames (1979, 1980, 1981) and Schneider and Pommerehne (1981), studied participants' allocation decisions under voluntary contributions mechanism in a controlled environment. Previous authors focused their investigation on participants' allocation decisions when they had to divide their resources between their private exchange and a single group exchange. However, consumers can usually allocate resources to the provision of local public goods, which only benefit their local group, and to the provision of global public goods, which benefit their local group as well as other local groups. For example, participants can contribute resources to the provision of local parks, which only benefits members of their locality, and to the provision of national parks, which benefits members of their locality and members of other localities.

We use a controlled experiment to investigate whether participants contribute more to a local exchange with a relatively high marginal payoff or a global exchange with a lower marginal payoff but higher potential payoff.[1] One expects a contribution that is made to the provision of a global public good to have a lower marginal payoff than a contribution that is made to the provision of a local public good because the benefits of the contribution are distributed over more consumers. However, since more individuals can contribute to the provision of global goods, participants often receive a higher payoff if they all contribute their resources to the provision of a global good than if they all contribute their resources to the provision of a local public good.[2]

The design of our experiment is similar in some respects to previous public goods experiments with a single group exchange. Participants in these experiments are typically endowed with tokens that they must divide between their private exchange and a group exchange. Each token contributed to the group exchange increases the payoffs of the other group members but has a marginal payoff that is smaller than one. The participants' dominant strategy is to allocate all their tokens to the private exchange. However, if participants allocate a sufficient number of tokens to the group exchange they receive a higher payoff than if they invest all their tokens in the private exchange.

Marwell and Ames (1981) find that individual contribute roughly half of their tokens to the group exchange under a variety of environmental conditions in a one shot public goods experiment. Isaac, Walker and Thomas (1984), Kim and Walker (1984) and Isaac, McCue and Plott (1985) find that average contribution tends to deteriorate in repeated public goods experiments, but remains above the Nash equilibrium prediction.

Our experiment differs from previous public goods experiments because it has two group exchanges – a local exchange and a global exchange. Participants in our experiment were randomly divided into two 4-person groups that we term local groups. During each decision period participants were asked to divide 25 tokens between their private exchange, their local exchange and the global exchange. Contributions made to the private exchange only benefited the contributor and had a marginal payoff of 1 (by definition). Contributions made by a participant to the local exchange only benefited members of the participant's local group and had a marginal payoff of .6. Contributions made to the global exchange benefited all the participants in the experiment and had a marginal payoff of .4. The experiment consisted of 10 decision periods.

One of our objectives is to investigate whether participants contribute more tokens to the local exchange or the global exchange. On one hand, we have reasons to believe that participants would contribute more tokens to the local exchange because it has a higher marginal payoff. Marwell and Ames (1979), Isaac, Walker and Thomas (1984) and Isaac McCue and Plott (1985) all report that participants in sessions with high marginal payoff contribute more that participants in sessions with low marginal payoff Kim and Walker (1984) and Brown-Kruse and Hummels (1993) find that participants significantly increase (decrease) their contributions when the marginal payoff is increased (decreased) during the experiment. The higher the marginal payoff the less risky it is for participants to contribute to the group exchange.

On the other hand, getting other participants to reciprocate by contributing to the global exchange can lead to higher total payoffs than getting them to contribute to the local exchange. Isaac and Walker (1988a) show that increasing the group size from 4 to 10 participants (while keeping the marginal payoff fixed) slightly increases the average contributions of the participants. Isaac, Walker and Williams (1991) find that a group of 40 participants contribute a larger portion of their tokens then groups of 4 or 10

participants with the same marginal payoff. They argue that participants' willingness to contribute is inversely related to the proportion of the group necessary to form a minimal profitable coalition, defined as the smallest collection of participants for whom the return from contributing to the group exchange exceeds the return from investing in the private exchange. In out experiment, the minimal profitable coalition in the global exchange (3 participants) represents a smaller portion of the global group (33.3%) than the minimal profitable coalition in the local exchange (2 participants or 50% of the local group).[3] Therefore, participants may choose to allocate more tokens to the global exchange.

The experiment further examines how increasing the degree of interaction amongst members of the local groups (without allowing any interaction between the local groups) affects the participants' allocation decisions.[4] Participants were assigned to one of three treatments: No Interaction (NI), Group Identity (GI) and Continuous Communication (CC). We attempt to develop group identity in the GI and CC treatments by introducing participants in those treatments to other members of their local group and giving each local group a name.

We have reasons to believe that group introduction would lead participants to contribute more to the local exchange. Campbell (1958) argues that grouping individuals into a reference group enhances cooperation amongst members of the group. Kramer and Brewer (1984) and Brewer and Kramer (1986) find that individual show more restraint in the consumption of a common good when they are identified as a part of a group. Schram and Sonnemans (1996) also find that group identity increases voting participation in a controlled environment. A strong group identity tends to suppress selfish ambitions and lead individuals to seek common goals.

It is also possible that a group introduction, such as the one used in this experiment, will have no effect on participants' allocation decisions. Eckel and Grossman (forthcoming) find that merely introducing members of the group to one another in a public goods experiment does not significantly increase their contributions to the group exchange. However, since members of each local group have to coordinate their contributions with members of another local group, introducing members of each local group to one another may lead them to trust members of their own local group more than members of the other local group.

Therefore, group introduction may be sufficient to cause participants to contribute more to the local exchange even though it had little effect in other public goods experiments.

The experiment also investigates the effect of unstructured, non-binding communication amongst members of each local group on participants' allocation decisions. Participants in the CC treatment were allowed three minutes of unstructured, non-binding communication at the beginning of each decision period. Isaac, McCue and Plott (1985) and Isaac and Walker (1988b) show that allowing participants to communicate increases their contributions. Cason and Khan (1999) show that communication increases average contribution even with limited monitoring.[5] Other authors showed that communication has varying degree of effectiveness under different environmental designs.[6]

Allowing members of the local group to communicate can have several possible effects. Communication can promote trust and facilitate coordination amongst members of the local groups and thus lead them to contribute more tokens to the local exchange. Alternatively, participants in the CC treatment may attempt to coordinate contributions to the global exchange, which has higher potential payoff. Bornstein, Winter and Goren (1996), for instance, observe a great deal of inter-group cooperation during the early stages of an Inter-group Prisoner's Dilemma Game.

2. Experimental Design and Procedures

The participants in the experiment were undergraduate students from the University of Hawaii at Manoa. They were solicited from economics classes and via electronic mail from various e-mail lists. All the students who signed up for the experiment and arrived on time were paid a $5 show up fee. The first eight students to arrive at the laboratory were given a number from 1 to 8 and then were randomly assigned to one of two local groups. Depending on which session the participants were assigned to they participated in one of three treatments: No Interaction (NI), Group Identity (GI) or Continuous Communication (CC).

Participants in the NI treatment were not allowed to communicate with one another and did not know who the other members of their local group were. Participants in the GI treatment were introduced to other members of their local group but were not allowed to communicate with one another. Participants in the CC treatment were introduced to other members of their local group and were permitted to communicate with one another at the beginning of each decision period. We repeated each treatment four times in separate sessions. Each student was only allowed to participate in one session of one treatment.

Once the participants arrived at the laboratory they were seated facing away from each other. We instructed the participants not to communicate with one another either verbally or non-verbally (except during the communication sessions in the CC treatment) and threaten to reduce their payoff if they communicated. We gave each participant a copy of the instructions for the experiment (shown in Appendix B) and read the instructions out loud before starting the experiment. By reading the instructions out loud we assured that the rules of the experiment were common knowledge to all the participants. After the instructions were read the participants were asked to complete two exercises in order to make certain that they knew how to calculate their payoff from each exchange. We gave participants payoff tables that were designed to help them calculate their payoff from each exchange (also shown in Appendix B).

The experiment began after all the participants completed the exercises. We first ran one trial period that did not count towards the participants' earning. Each session consisted of one trial period and 10 decision periods. Before the beginning of the first

decision period participants in the GI and CC treatments were introduced to other members of their local group. The local groups were seated in two separate rooms throughout the introduction. Each participant was asked to state his name, his favorite food and one of his hobbies. Other members of the local group were asked to repeat what the participant said. We then gave each local group a name, either Red or Blue.

Following the introduction participants in the GI treatment returned to their seat after which the first decision period began. Participants in the CC treatment were allowed to communicate with one another for three minutes following the introduction. Participants were told that they could talk about anything they want as long as they did not threaten one another or offer one another awards that did not result from their decisions in the experiment. Participants were also prohibited from asking other participants about their allocations in previous periods or from volunteering such information about themselves.

The communication rules were designed to assure that the participants in the CC treatment had the same payoff structure and information as the participants in the GI and NI treatments. An assistant remained with each group to assure that the communication rules were followed. Participants in the CC treatment were allowed to communicate for 3 minutes at the beginning of every decision period. After each communication session we secretly recorded on a form we term a communication log whether the group reached an agreement. If the group reached in agreement we tried to record how many tokens they decided to allocate to each exchange.[7] Following each communication session participants in the CC treatment returned to their seat where they made their allocation decisions in private.

During each period participants were asked to divide 25 tokens between a private exchange, a local exchange and a global exchange. Each token contributed to the private exchange yielded one experimental Peso to the participant. Each token contributed to the local exchange yielded .6 experimental Pesos to the participant and to the other members of his local group. Each token contributed to the global exchange yielded .4 experimental Pesos to the participant and to other members of the global group, which included all the participants in the session. At the end of the experiment participants received 4 cent for every experimental Peso that they earned during the experiment.

If the participants contributed all the tokens to the private exchange, the local exchange or the global exchange they would each earn 25 experimental Pesos ($1), 60 experimental Pesos ($2.40) or 80 experimental Pesos ($3.20) per period respectively. The socially optimal solution, which yielded the highest combined payoff to all the participants, was for the participants to contribute all their tokens to the global exchange. However, the dominant strategy for each participant was to allocate all his tokens to the private exchange.

Participants were given two minutes each period to decide on their allocation. They wrote their decisions on a slip of paper titled allocation slip. All the allocations slips were collected and given to an assistant who inputted the data into an Excel spreadsheet. Excel automatically calculated the payoff of each participant from each of the three exchanges. The assistant wrote the earning from each exchange, the total earning for the period and the cumulative earning up to that period on slips of paper titled earning slips. We then folded the earning slips to assure that the participants' earning remain private and handed the slips to the participants. Earnings were provided in experimental Pesos, but the participants were informed how to convert experimental Pesos into dollars.

Participants were required to record their earnings on a spreadsheet titled record sheet (provided in Appendix B). After all the participants recorded their earnings a new decision period would begin. At the end of the session we paid the participants their cumulative earning in cash. To assure that the participants were paid in private we moved all the participants to a separate room and then brought them back in one by one. We instructed participants not to discuss their earnings or the experiment's design with anybody else.

3. Analyses and Interpretation

For each of the sessions we calculated the total contribution (summed across all 10 periods) to each exchange as a percent of all the tokens. For convenience we define selfishness as the inclination allocate tokens to the private exchange, localism as the inclination to allocate tokens to the local exchange and globalism as the inclination to allocate tokens to the global exchange. We measure selfishness, localism and globalism as the portion of the tokens allocated to the private exchange, local exchange and global exchange respectively. Additionally we divide the data into two intervals: Time 1 – periods 1 through 5, and Time 2 − periods 6 through 10, in order to investigate what effects, if any, experience has on participants' allocation decisions. Results 1 through 3 compare participants' allocation decisions across the three treatments. Result 4 states that participants allocate more tokens to the global exchange than the local exchange when they are not allowed to interact. Result 5 discusses how communication amongst members of each local group effects participants' allocation decisions. The data is presented in Appendix A. We make the following conclusions.

Result 1: *Participants in the GI treatment exhibited more selfishness than participants in the NI and CC treatments. Participants in the CC treatment exhibited less selfishness than participants in the GI and NI treatments. Furthermore, participants in the CC treatment exhibited almost no selfishness at Time 2.*

Figure 1 – Total Allocation to the Private Exchange by Session[8]
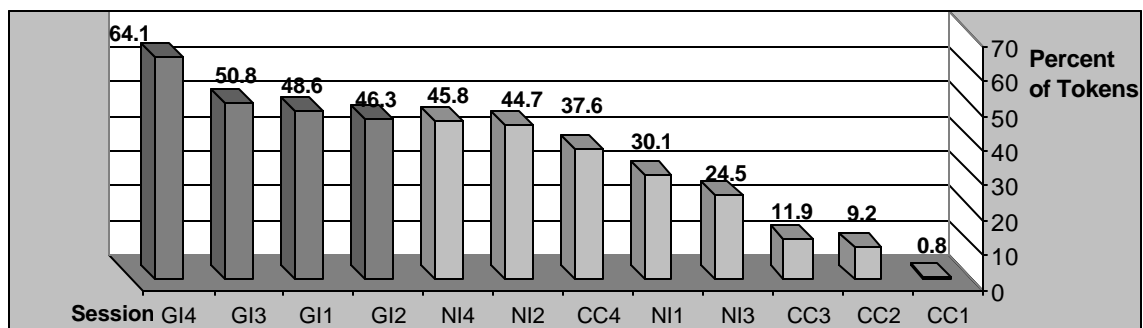
Support: When the sessions were ordered from the session with highest to the session with the lowest level of selfishness the four sessions with the highest level of selfishness were all GI sessions (refer to Figure 1). A Wilcoxon-Mann-Whitney Test (hereinafter Wilcoxon Test) rejects the hypotheses that participants in the GI treatment exhibited the same level of selfishness as participants in the NI treatment (p = .0143) or the CC treatment (p = .0143). We conclude that participants in the GI treatments exhibited a higher level of selfishness than participants in other treatments with a .05 significance level. On average, participants allocated 52.41% of their tokens to the private exchange in the GI treatment compared to 36.25% in the NI treatment and 14.88% in the CC treatment.

The three sessions with the lowest degree of selfishness were CC sessions (refer to Figure 1). A Wilcoxon Test rejects the hypotheses that participants in the CC treatment exhibited the same level of selfishness as participants in the GI treatment (p = .0143) or NI treatment (p = .0286). We conclude that participants in the CC treatment exhibited less selfishness than participants in other treatments with a .05 significance level.

Participants in the CC treatment exhibited little selfishness at Time 2. On average, participants in the CC treatment allocated 17.18% of their tokens to the private exchange in Time 1 and 12% in Time 2.

Discussion: We strongly believe from observing the communication sessions that the fourth CC session, CC4, is not comparable with the other three sessions. Participants in sessions CC1, CC2 and CC3 used the communication sessions to discuss their allocation decisions. On the other hand, participants in session CC4 used the communication sessions to discuss personal matters that did not pertain to the experiment. Not counting session CC4, participants in the CC treatment allocated 11.13% of their tokens to the private exchange in Time 1 and only 3.47% of their tokens in Time 2. Furthermore, only 5 out of 24 participants in sessions CC1, CC2 and CC3 allocated any tokens to the private exchange during any of the periods in Time 2.

Communication in the CC treatment may have helped participants coordinate their allocation decisions. Communication may have also increased trust and strengthened group identity amongst members of the local group. However, in other public goods experiments with communication selfishness remained significant even after several

periods of communication (see Isaac, McCue and Plott 1985 for an example). In this experiment the majority of the participants in the CC treatment did not allocate any tokens to the private exchange in Time 2.

One likely explanation for the low levels of selfishness in the CC treatment is that presence of two group exchanges led participants to focus on which group exchange they should contribute to instead of how many tokens they should keep for themselves. It is also likely that the existence of another local group helped raise trust and group identity amongst members of each local group. During the communication sessions several participants verbalized the idea that group members must stay unified in order not to be outplayed by the other local group.

Participants in the GI treatment probably exhibited more selfishness than participants in the CC treatment because communication helped participants in the CC treatment reduce selfishness. However, it is not readily apparent why participants in the GI treatment exhibited more selfishness than participants in the NI treatment. One possibility is that the group introduction may have signaled participants to allocate tokens to the local exchange when their predisposition was to allocate more tokens to the global exchange. Participants in the GI treatment may have chosen to allocate more tokens to private exchange because they were not sure which group exchange to contribute to.

On average participants in the NI treatment contributed 40.74% to the global exchange and 31.25% to the local exchange in the first decision period. On the other hand, participants in the GI treatment allocated 27.75% of their tokens to the global exchange and 27.13% to the local exchange in the first decision period. We thus suspect that indecisiveness about which group exchange to contribute to may have lead participants in the GI treatment to keep more tokens for themselves in the first period. Selfishness in the first decision period was 24.21% higher in the GI treatment than in the NI treatment. The high level of selfishness in the first period may have made participants in the GI treatment more reluctant than participants in the NI treatment to contribute to either group exchange in later periods.

Result 2: *Participants in the CC treatment exhibited more localism than participants in the NI or the GI treatments. There is no statistically significant difference between the level of localism in the GI treatment and the NI treatment.*

Figure 2 – Total Allocation to the Local Exchange by Session[9]
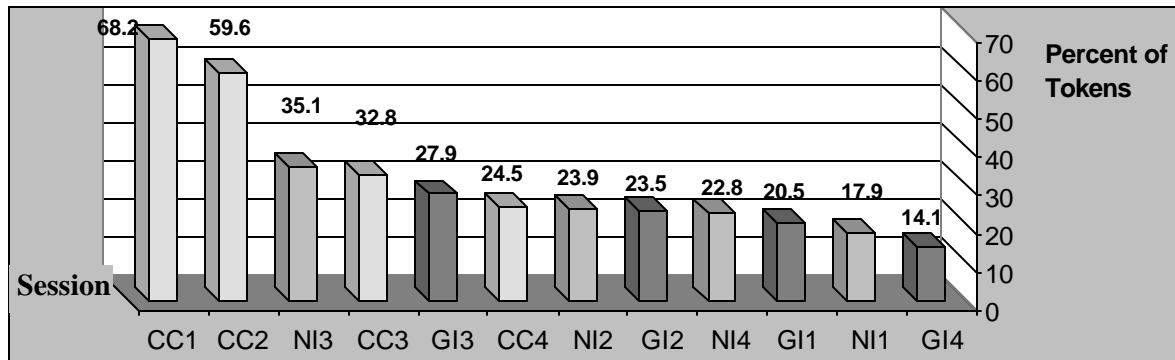
Support: When the sessions were ordered from the session with the highest to the session with the lowest level of localism, the two sessions with the highest level of localism were CC sessions (refer to Figure 2). On average, the level of localism was 46.24% in the CC treatment, 24.89% in the NI treatment and 21.46% in the GI treatment. A Wilcoxon Test rejects the hypotheses that participants in the CC treatment exhibited the same level of localism as participants in the NI treatment ($p = .0286$) or the GI treatment ($p = .0286$). We conclude that participants in the CC treatment exhibited more localism than participants in the other treatments with a .05 significance level.

The order of the GI and NI session appears completely random (refer to Figure 2). A Wilcoxon Test cannot reject the hypothesis that participants in the GI treatment exhibit the same degree of localism as participants in the NI treatment ($p = .7571$).[10] We also cannot reject the hypothesis that participants in the GI treatment contribute the same share of their public contribution (their total contribution to the two group exchanges) to the local exchange than participants in the NI treatment. Participants in the GI treatment allocated 44.78% of their public contribution to the local exchange, whereas participants in the NI treatment allocated 39.25% of their public contribution to the local exchange. A Wilcoxon Test shows that there is a .4429 probability that participants in the GI treatment allocated the same portion of their public contribution to the local exchange as
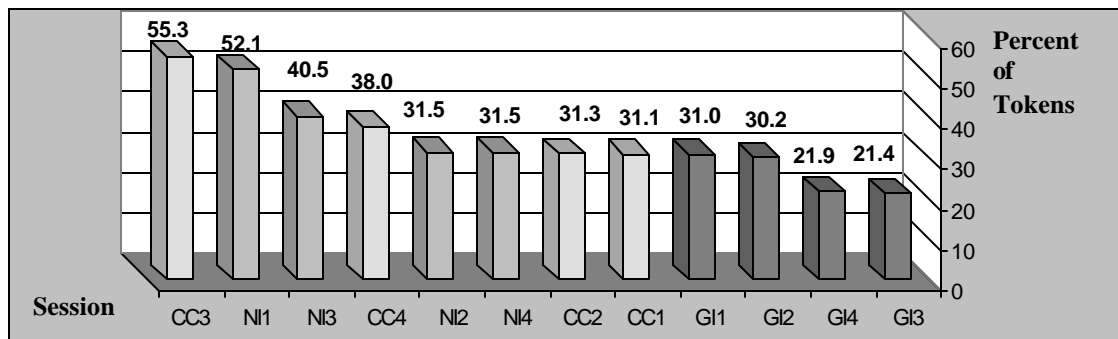
participants in the NI treatment. We therefore conclude that participants in the GI treatment exhibited the same level of localism as participants in the NI treatment.

Discussion: We believe that participants in the CC treatment exhibited a high level of localism because communication helped promote group identity and trust amongst members of each local group. Participants in the CC treatment allocated 52.67% of their public contribution to the local exchange. Nonetheless, participants in the CC treatment still exhibited a good deal of globalism. In fact, in two of the sessions (CC3 and CC4) participants allocated a larger portion of their public contribution to the global exchange.

Our conclusion that participants in the GI treatment did not exhibit more localism than participants in the NI treatment need not lead us to conclude that group identity does not increase localism. It is possible that the introduction used in the experiment failed to establish any group identity. [11] It is also possible that the introduction developed some group identity amongst members of the local group but did not leave them with a clear signal of how they should allocate their tokens as discussed in Result 1.

Result 3: *Participants in the GI treatment exhibited less globalism than participants in the CC treatment or the NI treatment. There is no statistical difference in the level of globalism between the CC treatment and the NI treatment.*

Figure 3 – Total Allocation to the Global Exchange by Session[12]

13

Support: The four sessions with the lowest level of globalism are GI sessions. A Wilcoxon Test rejects the hypothesis that participants in the GI treatment exhibited the same level of globalism as participants in the NI treatment (p = .0143) or participants in the CC treatment (p = .0143). Participants in the NI only allocated 26.13% of their tokens to the global exchange. We conclude that participants in the GI treatment exhibited a lower level of globalism that participants in the NI or the CC treatments. A Wilcoxon Test can not reject the hypothesis that participants in the CC treatment and participants in the NI treatment exhibited the same level of globalism. Participants in the CC treatment allocated 38.89% of their tokens to the global exchange compared to participants in the NI treatment who allocated 38.86% of their tokens to the global exchange.

Discussion: Results 1 through 3 reveal the key differences in participants' allocation decisions across the different treatments. Participants in the GI exhibited more selfishness that participants in the other two treatments. Because they allocated most of their tokens to they private exchange they ended up exhibiting less globalism than participants in the NI and CC treatment. Participants in the GI treatment exhibited less localism than participants in the CC treatment. They exhibited roughly the same level of localism as participants in the NI treatment because participants in the NI treatment allocate a smaller portion of their public to the local exchange than participants in the GI treatment.

Participants in the NI treatment exhibited less selfishness than participants in the GI and more selfishness than participants in the CC treatment. However, because participants in the NI treatment allocated a larger portion of their public contribution to the global exchange than participants in the CC treatment they ended up exhibiting the same level of globalism as participants in the CC treatment.

Participants in the CC treatment exhibited less selfishness and more localism than participants in the NI treatment or the GI treatment. However, there were significant behavioral differences between participants in different sessions of the CC treatment. In two of the CC sessions participants allocated a larger portion of their public contribution to the local exchange and in two of the sessions participants contribute a larger portion of their public contribution to the global exchange.

One of the main objectives of the experiment was to investigate whether participants allocate more tokens to the local exchange or the global exchange. To answer this question we focus our attention the NI treatment because it is more readily comparable than the other treatments to other public goods experiments.

Result 4: *Participants in the NI treatment allocated more tokens to the global exchange than to the local exchange. Localism in the NI treatment decreased over time but still remained significant.*

Figure 4 - Allocation to the Local and Global Exchanges in the NI Treatment[13]
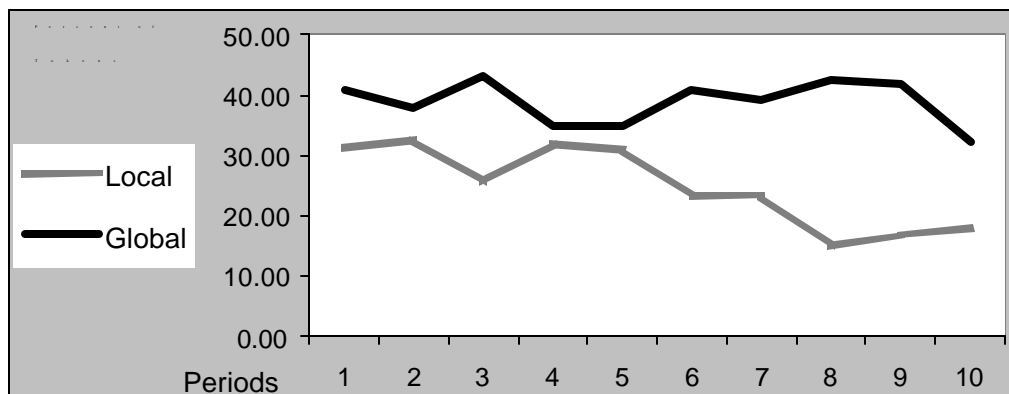
Support: In all four NI sessions globalism exceeded localism. Globalism averaged across the NI sessions was 38.86% and localism averaged across the NI sessions was 24.89%. Localism fell from 30.43% in Time 1 to 19.35% in Time 2. On the other hand, globalism increased from 38.35% in Time 1 to 39.05% in Time 2 despite of an increase in selfishness (refer to Figure 4).

Nonetheless, contributions to the local exchange remained positive and significant in all the NI sessions. Localism was lowest in session NI1 where it was still significant (17.85%). Localism did not drop below 5.5% in any period of any NI session. We conclude that although participants in the NI treatment allocated more tokens to the global exchange they still allocated a significant portion of their tokens to the local exchange.

Discussion: There is strong evidence that the participants in the NI treatment preferred contributing to the global exchange even though the global exchange has a lower marginal payoff than the local exchange. Participants may have decided to allocate more tokens to the global exchange because it has a higher potential payoff. Participants may have also thought that there is a higher chance of finding other participants who are willing to reciprocate in the global group because the global group has more members than the local group.

The drop in localism between Time 1 and Time 2 compared to the slight increase in globalism suggests that participants in the NI treatment attempted to coordinate their contributions to the global exchange. Participants in the NI treatment were relatively successful in coordinating their contributions to the global exchange. In session NI1, for instance, globalism peaked at 63% in period 7.

Result 5: *Participants in the CC treatment exhibited a high level of globalism when they discussed their allocation decisions. However, at the last period globalism in the CC treatment dropped and localism substantially increased*

Figure 5 - Allocation to each Exchange in CC Treatment[14]
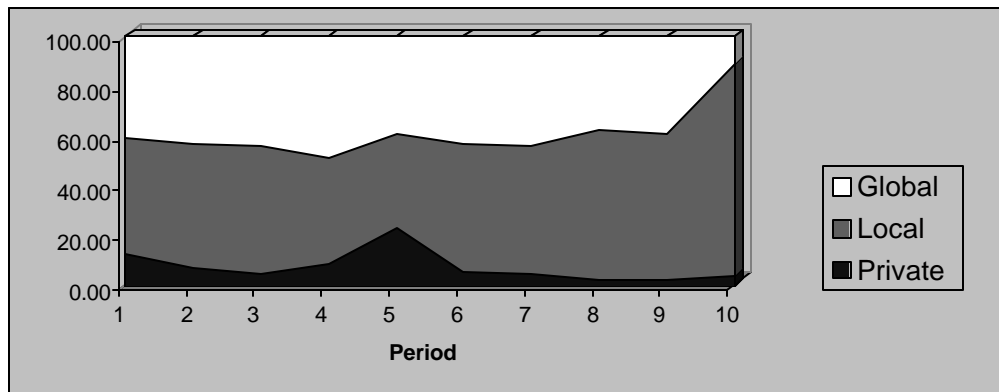
Support: Excluding session CC4, in which participants did not discuss their allocation decisions, participants in the CC treatment allocated 39.2% of their tokens to the global exchange. On average, participants in the CC treatment (excluding CC4) allocated

47.17% of their tokens to the global exchange in the first period. Globalism remained steady between 49.33% and 37.5% in periods 2 through 9 but then dropped to 11% in the last period (refer to Figure 5).

The drop in globalism was mainly due to an increase in localism. In all the CC sessions except CC4 localism increased in the last period. On average localism is sessions CC1, CC2 and CC3 increased by 26.5% (from 58.5% to 85.0%) between period 9 and period 10 (refer to Figure 5).

Discussion: From observing the communication sessions in sessions CC1, CC2 and CC3 we learned that participants in these sessions generally tried to reach an agreement about their allocations. Analysis of individual allocations reveals that in 50.0% of all cases at least three members of the local group made the exact same allocation decision and in many of the other cases the deviations between the amounts allocated to each exchange were relatively small.[15] This finding suggests that member of each local group usually reached an agreement on how to allocate their tokens and that participants tended to follow these agreements.[16]

We also observed that at least one participant in each local group in sessions CC1, CC2 and CC3 attempted to convince other members of the group to allocate more tokens to the global exchange in order to get participants in the other local group to increase their contributions to the global exchange. We believe that generally members of each local group attempted to coordinate their contributions to the global exchange with members of the other local group. Coordinating contributions to the global exchange was difficult but not impossible. For example, in session CC3 globalism reached 80.5% in period 4 but then substantially dropped in the following period

Some participants in the CC treatment expressed their reluctance to contribute tokens to the global exchange for various reasons. We recorded the following reasons in the communication logs. (1) Participants did not think that members of the other local group were willing to cooperate. (2) Participants did not think that the members of the other group understood the experiment. (3) Participants did not think that members of the other group would contribute enough tokens to the global exchange to make it profitable for them to contribute tokens to the global exchange.

We also observe an interesting end-game effect in all the CC sessions except CC4 in which participants substantially increase their contributions to the local exchange at the final decision period. In two cases members of the same local group allocated all their tokens to the local exchange in the final period. End game effects are commonly observed in public goods experiments with one public exchange. Participants typically increase their allocation to the private exchange at the last period of the experiment when other participants can no longer retaliate in respond to their selfishness.

The local groups in the CC treatment acted in a similar way to individual participants in public goods experiments with one exchange by choosing the dominant strategy for the local group in the last period. Allocating all the tokens to the local exchange is the dominant strategy for the local group since it yields the highest combined payoff possible to members of the local group no matter what members of the other local group do.

Participants in the CC treatment may have reduced their allocation to global exchange in the last period because the other local group could not retaliate in response to the reduction. It is also possible that participants expected members of the other group to decrease their contributions to the global exchange in the last period. Therefore, they shifted resources from the global exchange to the local exchange in order to avoid a reduction in their payoff.

The results of the experiment suggest that participants in the CC treatment tended to trust members of their local group (they abided by the agreements that they made with them). However, participants did not tend to trust members of the other local group with whom they could not communicate. As a result, participants in the CC treatment were able to accomplish intra-group coordination (coordination amongst members of each local group) but found it difficult to achieve inter-group coordination (coordination between the two local groups).

4. Conclusion and Possible Extensions

Consumers sometimes can allocate resources to the provision of local public goods and to the provision of global public goods. This paper reports a public goods experiment in which participants could allocate tokens to a local exchange with a relatively high marginal payoff and a global exchange with a lower marginal payoff but a higher potential payoff. The experiment consisted of three treatments with varying degree of interaction amongst the members of the local groups.

We find that when participants were not allowed to interact they allocated more tokens to the global exchange even though it had a lower marginal payoff than the local exchange. This result suggests that individuals care about the potential payoff of the group exchange more than about the marginal payoff of the exchange. It is also possible that participants allocated more tokens to the global exchange because their contributions to the global exchange positively affected more individuals that their contributions to the local exchange. Finally, participants may have considered it easier to find other participants who were willing to reciprocate in global group, which was larger than their local group. More research should be conducted to investigate the relative importance of these considerations.

We find that increasing group interaction amongst members of each local group significantly affects participants' allocation decisions. Surprisingly, merely introducing members of each local group to one another increased the selfishness that they exhibited. We suspect that the group introduction acted as signal for participants to increase their contributions to the local exchange, which confused participants whose predispositions was to contribute more tokens to the global exchange. We conjecture that since participants in the GI treatment were not sure which group exchange to allocate their tokens to, they decided to allocate more tokens to the private exchange.

We also find that when participants were allowed to communicate with members of their local group they exhibited very little selfishness. The existence of two exchange may have decreased participants' selfishness by increasing group identity amongst members of each local group and by shifting the participants' focus from intra-group coordination to inter-group coordination.

We observe that members of each local group tend to make their decisions collectively when they discuss their allocation decisions. Participants in the CC treatment generally attempted to increase their contributions to the global exchange in order to get members of the other local group to reciprocate. Communication amongst members of the local group reduces participants' selfishness but also increase localism especially at the final decision period.

Future research can investigate how changes in the marginal returns to the global exchange and the local exchange affect participants' allocations decisions. It is also instructive to investigate if participants' behavior changes when the size of the local group changes or when the global group consists of more local groups. [17]

The research discussed here can also be extended by looking at a forth treatment in which all the participants in the global group are allowed to communicate. We suspect that participants in such a treatment will exhibit more globalism than the CC treatment discussed here. However, it is also possible that participants in such a treatment will exhibit more selfishness because coordination may be more difficult to achieve in larger groups.

Appendix A: Summary of Statistics

Treatment/ Session	Selfishness			Localism			Globalism		
	All	Time 1	Time 2	All	Time 1	Time 2	All	Time 1	Time 2
NI Average	*36.25*	*31.23*	*41.28*	*24.89*	*30.43*	*19.35*	*38.86*	*38.35*	*39.38*
Std. Dev	*10.62*	*9.13*	*12.56*	*7.27*	*7.16*	*7.88*	*9.79*	*7.6*	*12.01*
NI1	30.05	26.8	33.3	17.85	24.3	11.4	52.1	48.9	55.3
NI2	44.65	35.50	53.8	23.9	31.5	16.3	31.45	33.0	29.9
NI3	24.5	21.0	28.0	35.05	40.1	30.0	40.45	38.45	42.0
NI4	45.8	41.6	50.0	22.75	25.8	19.7	31.45	32.6	30.3
GI Average	*52.41*	*46.58*	*58.25*	*21.46*	*23.0*	*19.93*	*26.13*	*30.43*	*21.83*
Std. Dev	*7.97*	*9.6*	*6.43*	*5.8*	*7.91*	*3.69*	*5.18*	*6.93*	*3.91*
GI1	48.55	41.4	55.7	20.45	21.6	19.3	31	37.0	25.0
GI2	46.3	38.8	53.8	23.5	25.8	21.2	30.2	35.4	25.0
GI3	50.75	45.8	55.7	27.85	31.7	24.0	21.4	22.5	20.3
GI4	64.05	60.3	67.8	14.05	12.9	15.2	21.9	26.8	17.0
CC Average	*14.88*	*18.33*	*11.43*	*46.24*	*40.45*	*52.03*	*38.89*	*41.23*	*36.55*
Std. Dev	*15.87*	*16.29*	*16.16*	*20.92*	*25.74*	*20.06*	*11.4*	*17.4*	*6.62*
CC1	.8	1.6	0	68.15	66.6	69.7	31.05	31.8	30.3
CC2	9.2	11.5	6.9	59.55	57.5	61.6	31.25	31.0	31.5
CC3	11.9	20.3	3.5	32.8	12.5	53.1	55.3	67.2	43.4
CC4	37.6	39.9	35.3	24.45	25.2	23.7	37.95	34.9	41.0

NI Average, GI Average and CC Average are the averages across all the sessions in the NI treatment, GI treatment and CC treatment respectively.

Std. Dev: shows the standard deviation in contributions across sessions in a given treatment

All: shows allocation throughout the session (summed from period 1 to 10)

Time 1: shows allocation at Time 1 (summed from periods 1 to 5)

Time 2: shows allocation at Time 2 (summed from periods 6 to 10)

Appendix B: Instructions and Payoff Tables

The parts of the instructions that are italicized only appeared in the instructions for the GI and the CC treatments. The parts of the instructions that are bolded only appeared in the instructions for the CC treatment.

Instructions

Please listen to the following instructions carefully. From this point onwards you are NOT allowed to communicate with any other participant. If you have any clarifying questions raise your hand and I will answer your questions in private.

This is an experiment in decisions making. Depending on the decisions that you and other participants in the experiment make you can earn a considerable amount of money that will be paid to you IN CASH at the end of the experiment. During the experiment all units of account will be in experimental Pesos. At the end of the experiment you will receive 4 cents for every Peso that you earn during the experiment ($1 for every 25 Pesos). Your Cumulative Earning plus a lump sum amount of $5 for showing up on time will be paid to you IN PRIVATE.

There are a total of eight participants in this experiment. At the beginning of the experiment the participants will be divided into two groups of 4 participants. You and three other participants will be assigned to one group and the four remaining participants will be assigned to another group. *You will then be escorted to a table where you will meet the other participants in your group. Each participant will introduce herself or himself to the rest of the group and will be asked to provide some basic information about themselves to others in the group. The two groups in the experiment will meet in two separate rooms.* The experiment will last 10 periods and the composition of both groups will remain the same throughout the experiment. There will also be one practice period at the beginning of the experiment that will not count towards your earnings.

A*fter the introduction you will be asked to return to your seat and the experiment will begin.* At the beginning of each period you will receive 25 tokens that you must allocate between three exchanges. You will then write on a slip of paper titled Allocation Slip (that will be provided to you) how many tokens you wish to allocate to Exchange A, how many tokens you wish to allocate to the Exchange B, and how many tokens you wish to allocate to Exchange C. Make sure that the total amount of tokens you allocate to the three exchanges equals 25 each period.

You, and only you, will receive one Peso for every token you allocate to Exchange A. Each token allocated to Exchange B will yield .6 Pesos to you and to the other participants in your group. The Total Allocation to Exchange B equals your allocation to Exchange B plus the allocation of the other participants in your group to Exchange B. If a participant allocates a token to Exchange B it yields no Pesos to participants who are not in her or his group.

Each token allocated to Exchange C will yield .4 Pesos to you and to all the other participants in the experiment. The Total Allocation to Exchanges C equals your allocation to Exchange C plus the allocation of the other participants in experiment to Exchange C. All eight participants in the experiment will be given 25 tokens each period (just like you) and are given the exact same set of instructions as you.

You can calculate your Total Earnings in a given period either by using the tables in the back of the instructions or by using Equation 1 (below). To use the tables obtain your Earnings from Exchange B from Table 1 and obtain your Earnings from Exchange C from Table 2 (both tables are provided in the back). Next, add your Earnings from Exchange A (which equal your allocation to Exchange A), your Earnings from Exchange B, and your Earnings from Exchange C together to get your Total Earnings for the period. To use Equation 1 calculate the Total Allocation to Exchange B and the Total Allocation to Exchange C by adding your allocation to the allocation of other participants in each Exchange then plug the numbers into the equation. Both methods will give you the same number for Total Earnings. You will receive a calculator to help you calculate your earnings. Example 1 shows how to use both methods.

Equation 1

Total Earnings = (Allocation to Exchange A) + .6×(Total Allocation to Exchange B) + .4×(Total Allocation to Exchange C)

Example 1: Suppose you allocate 10 tokens to Exchange A, 10 tokens to Exchange B and 5 tokens to Exchange C. Other participants allocate 40 tokens to Exchange B and 80 tokens to exchange C. Using the tables you can find out that you will receive 10 Pesos from Exchange A, 30 Pesos from Exchange B (see Table 1) and 34 Pesos from Exchange C (see Table 2) making your Total Earning for that period 74 Pesos.

You can also calculate your Total Earnings using Equation 1 (provided above). First note that the Total Allocation to Exchange B is 50 (the 10 tokens that you allocated plus the 40 tokens that others allocated) and that the Total Allocation to Exchange C is 85 (5 + 80). Plugging the numbers into the equation we get that Total Earnings equals10 (from Exchange A) + .6×50(from Exchange B) + .4×85 (from Exchange C) or 74 Pesos.

You will have two minutes to make your allocation decision at the beginning of each period. Once you wrote your decision on the Allocation Slip fold your allocation slip and raise your hand. An assistant will collect it from you. When all the Allocation Slips are collected the assistant will calculate your Total Earnings for the period, your Earnings from each of the exchanges and your Cumulative Earnings up to that period and will write them down on a slip titled Earnings Slip. Then the assistant will return the Earnings Slip to you and will give you a new Allocation Slip. You are REQUIRED to record all the information on the Earnings Slip unto the Record Sheet (attached to the instructions). No other participant will see how many tokens you allocated to each exchange nor will you learn the allocation decisions of any other participant.

After all the participants receive their Earnings Slips back you and other participants in your group will meet and will be allowed to talk about anything for three minutes. You will meet your group for communication sessions at the end of every period. Following each communication session you will return to your sit and a new period will begin. Again, you will be given 25 tokens and will have 2 minutes to decide on how to allocate them between Exchange A, Exchange B and Exchange C.

To assure that you know how to calculate your Total Earnings please complete the following two exercises. Once you complete both exercises raise your hand and an assistant will come by to check if you did them correctly. You can use the calculator provided and the tables in the back to help you solve these exercises.

DO NOT communicate with other participants in any verbal or non-verbal way while working on these exercises and throughout the experiment **other than during the communication sessions.** If you have a question raise your hand and I will answer your question in private.

Exercise 1: Suppose you allocate 20 tokens to Exchange A, 5 tokens to the Exchange B and no tokens to Exchange C. If other participants allocate 55 tokens to Exchange B and 60 Tokens to Exchange C. What will be your Total Earnings? You may use your calculator and the tables, provided in the back, to help you answer this question.

Exercise 2: Suppose you allocate 5 tokens to Exchange A, 5 tokens to Exchange B and 15 tokens to Exchange C. If other participants allocate 40 tokens to Exchange B and 125 tokens to exchange C what will be your Earnings from each exchange and your Total
Earning for the period?

Complete instructions including payoff table and record sheet can be obtained from my web site at www2.hawaii.edu/~yoav/papers.html

Record Sheet

Use this Record Sheet to record your Earnings from Exchange A, Earnings from Exchange B, Earnings from Exchange C, your Total Earnings and Cumulative Earnings. All Earnings are given to you on the Earnings Slip in experimental Pesos.

Period	Earning from Exchange A	Earnings from Exchange B	Earnings from Exchange C	Total Earnings	Cumulative Earnings
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

To get your Payoff from the experiment IN DOLLARS divided your Cumulative Earnings from period 10 by 25 and add $5 for showing up on time.

Tables

Total Earnings = Allocation to Exchange A + Earnings from Exchange B (Table 1) + Earning from Exchange C (Table 2)

Earnings from Exchange B (Table 1)

Use your allocation and other allocations (in your group) to find your Earnings from Exchange B IN PESOS (the white area)

Others' Allocation (in your group)	Your Allocation					
	0 Token	5 Tokens	10 Tokens	15 Tokens	20 Tokens	25 Tokens
0 token	0	3	6	9	12	15
5 Tokens	3	6	9	12	15	18
10 Tokens	6	9	12	15	18	21
15 Tokens	9	12	15	18	21	24
20 Tokens	12	15	18	21	24	27
25 Tokens	15	18	21	24	27	30
30 Tokens	18	21	24	27	30	33
35 Tokens	21	24	27	30	33	36
40 Tokens	24	27	30	33	36	39
45 Tokens	27	30	33	36	39	42
50 Tokens	30	33	36	39	42	45
55 Tokens	33	36	39	42	45	48
60 Tokens	36	39	42	45	48	51
65 Tokens	39	42	45	48	51	54
70 Tokens	42	45	48	51	54	57
75 Tokens	45	48	51	54	57	60

Earnings from Exchange C (Table 2)
Use your allocation and other allocations (in both groups) to find your Earnings from Exchange C IN PESOS (the white area)

Others' Allocation (in both groups)	Your Allocation					
	0 Tokens	5 Tokens	10 Tokens	15 Tokens	20 Tokens	25 Tokens
0 Tokens	0	2	4	6	8	10
10 Tokens	4	6	8	10	12	14
20 Tokens	8	10	12	14	16	18
30 Tokens	12	14	16	18	20	22
40 Tokens	16	18	20	22	24	26
50 Tokens	20	22	24	26	28	30
60 Tokens	24	26	28	30	32	34
70 Tokens	28	30	32	34	36	38
80 Tokens	32	34	36	38	40	42
90 Tokens	36	38	40	42	44	46
100 Tokens	40	42	44	46	48	50
110 Tokens	44	46	48	50	52	54
120 Tokens	48	50	52	54	56	58
130 Tokens	52	54	56	58	60	62
140 Tokens	56	58	60	62	64	66
150 Tokens	60	62	64	66	68	70
160 Tokens	64	66	68	70	72	74
170 Tokens	68	70	72	74	76	78
175 Tokens	70	72	74	76	78	80

References

Bornstein, Gary, Winter, Eyal and Hare Goren (1996). "Experimental Study of Repeated Team-Games." *European Journal of Political Economy*, 12(4), 629-639

Brewer, Marilynn B. and Roderick M. Kramer (1986)."Choice Behavior in Social Dilemmas: Effects of Social Identity, Group Size, and Decision Framing." *Journal of Personality and Social Psychology*, 50, 543-549

Brown-Kruse, Jamie and David Hummels (1993) "*Gender Effects in Laboratory Public Goods Contribution: Do Individuals Put Their Money Where Their Mouth Is?*" Journal of Economic Behavior and Organization, 22(3), 255-267

Campbell, D. T. (1958). "Common Fate, Similarity, and Other Indices of the Status of Aggregates of Persons as Social Entities." *Behavioral Science*, 3, 14-25. 1958.

Cason, Timothy N., Feisal U. Khan (1999). "A Laboratory Study of Voluntary Public Goods Provision with Imperfect Monitoring and Communication." *Journal of Development Economics*, 58, 533-52

Eckel, Catherine C. and Philip J. Grossman (forthcoming) "Managing Diversity by Creating Team Identity."

Isaac, Mark R., McCue, Kenneth F. and Charles R. Plott (1985) Public Goods Provision in an Experimental Environment." *Journal of Public Economics*, 26, 51-74

Isaac, Mark R. and James M. Walker (1988a) "Group Size Effects in Public Goods Provision: The Voluntary Contributions Mechanism." *Quarterly Journal of Economics*, 103, 179-200

Isaac, Mark R. and James M. Walker (1988b) "Communication and Free-Riding Behavior: The Voluntary Contributions Mechanism." *Economic Inquiry*, 26, 585-608

Isaac, Mark R., Walker, James M. and Susan H. Thomas (1984) "Divergent Evidence on Free Riding: An Experimental Examination of Possible Explanations." *Public Choice*, 43, 113-149

Isaac, Mark R., Walker James M. and Arlington Williams (1991) "Group Size and the Voluntary Provision of Public Goods: Experimental Evidence Utilizing Large Groups." *Journal of Public Economics*, 54, 1-24

Kim, Oliver and Mark Walker (1984) "The Free Rider Problem: Experimental Evidence." *Public Choice*, 43, 3-24

Kramer, Roderick M. and Marilynn B. Brewer (1984). "Effects of Group Identity on Resource Use in a Simulated Commons Dilemma." *Journal of Personality and Social Psychology*, 46, 1044-1057

Ledyard, John (1995) "Public Goods: A Survey of Experimental Research." At the Handbook of Experimental Economics, 111-194, Princeton University Press, Princeton, NJ (Editors: Kagel, John H. and Roth, Alvin E.)

Marwell, Gerald and Ruth Ames (1979) "Experiments on the Provision of Public Goods I: Resources, Interest, Group Size and the Free Rider Problem." *American Journal of Sociology*, 84, 1335-1360

Marwell, Gerald and Ruth Ames (1980) "Experiments on the Provision of Public Goods II: Provision Points, Stakes, Experience and the Free Rider Problem." *American Journal of Sociology*, 85, 926-937

Marwell, Gerald and Ruth Ames (1981) "Economists Free Ride, Does Anyone Else?" *Journal of Public Economics*, 15, 295-310

Schneider, Friedrich and Werner W. Pommerhene (1981). "Free Riding and Collective Action: An Experiment in Public Microeconomics." *Quarterly Journal of Economics*, 96, 689-704

Schram, Arthur and Joep Sonnemans (1996). "Why People Vote: Experimental Evidence." *Journal of Economic Psychology*, 17(4), 417-42

[1] Marginal payoff is defined as the return to the participant from the group exchange over the return to the participant from the private exchange. Potential payoff is defined as the highest payoff that participants can receive from the group exchange.

[2] Given the payoff structure of the experiment, the global exchange will have a higher potential payoff than the local exchange if and only if increasing the size of the group by some factor n will change the marginal payoff from the group exchange by some factor larger than $1/n$.

[3] If 2 out of 4 participants in a local group contribute all their tokens to the local exchange the payoff from the local exchange would be 30 experimental Pesos (discussed in Section 2), which is higher than what participants would make if they kept all the tokens for themselves (25 experimental Pesos). If 3 out of 8 participants contribute to the global exchange the payoff from the global exchange would also be 30 experimental Pesos, which is higher that what they would receive if they kept all the tokens for themselves.

[4] Due to the high transaction cost of interacting with a large group, consumers often only interact with members of their local group.

[5] Cason and Khan (1999) designed an experiment in which participants engage in face-to-face communication but the contribution levels are only revealed once every six periods

[6] See Ledyard (1995, pp.156- 158) for a summary of other public good experiments with communication.

[7] In many cases it was not clear what the group decision was. Sometimes the group decided to allocate "a lot" of their tokens to a certain exchange but did not specify how many. Other times the group could not decide between the different allocations schemes that its members proposed.

[8] NI1 through NI4 refer to session 1 through session 4 of the NI treatment. GI1 through GI4 refer to session 1 through 4 of the GI treatment. CC1 through CC4 refer to sessions 1 through 4 of the CC treatment.

[9] See endnote 9 for interpretation of symbols

[10] The alternative hypothesis is that participants in the GI treatment exhibited more localism than participants in the NI treatment

[11] Eckel and Grossman (forthcoming) conclude that a group introduction alone does not significantly affect participants' behavior in a public goods experiment.

[12] See endnote 8 for interpretation of symbols

[13] Averages across sessions NI1, NI2, NI3 and NI4.

[14] Averaged across sessions CC1, CC2 & CC3. Session CC4 is excluded because, unlike the other CC sessions, participants in session CC4 did not discuss their allocations decisions during the communication sessions.

[15] We counted the number of times at least three members of each local group made the exact same allocation decision and divided it by the total number of periods in sessions CC1, CC2 and CC3 (30) times 2 (since there are two local groups per session). We did not look at session CC4 because participants in that session did not discuss their allocation decisions.

[16] In two of the local groups one of the participants decided to allocate all his tokens to the global exchange no matter what the group decided on, which is why we counted the number of cases in which at least 3 members of the group made the same allocation decision (instead of all four)

[17] Because the global group consists of only two local groups, members of each local group receive a higher return from investing their tokens in the global exchange than they do by investing in the private exchange even if members of the other group do not allocate any tokens to the global exchange. Nonetheless, allocating tokens to the local exchange yields higher payoffs than allocating tokens to the global exchange no matter how members of the other local group allocate their tokens. Our global group consists of only two local groups because of budgetary constraints.