Multi-Level Trust Game with "Insider" Communication*

Roman M. Sheremeta[a] and Jingjing Zhang[b]

[a]Argyros School of Business and Economics, Chapman University,
One University Drive, Orange, CA 92866, U.S.A.
[b]Department of Economics, McMaster University,
1280 Main Street West, Hamilton, ON L8S 4M4, Canada

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Abstract

This experiment studies the internal and external effects of communication in a multi-level trust game. In this trust game, the first player can send any part of his endowment to the second player. The amount sent gets tripled. The second player decides how much to send to the third player. The amount is again tripled, and the third player then decides the allocation among the three players. The baseline treatment with no communication shows that the first and second players send significant amounts and the third player reciprocates. When we allow communication only between the second and third players, the amounts sent and returned between these two increase. The new interesting finding is that there are external effects of communication: the first player who is outside communication sends 60% more and receives 140% more than in the no communication treatment. As a result, social welfare and efficiency increase from 48% to 73%.

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Corresponding author: Jingjing Zhang; E-mail: jjzhang@mcmaster.ca
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1. Introduction

Trust and reciprocity play important roles in economic interactions. The most frequently used measure of trust and reciprocity is based on a two-player trust game, proposed by Berg et al. (1995). In this game, the first player receives an endowment and can send any portion of it to the second player. The amount sent gets tripled. The second player then decides how much to send back. The first player is said to be trusting if he sends any positive amount to the second player. The second player is said to be trustworthy if the amount he returns is at least as great as the amount he receives (McCabe et al., 2003). Berg et al. (1995), as well as many replications, show that most participants display trust and trustworthiness contrary to self-interested profit-maximizing behavior (McCabe et al., 1998, 2000, 2003; Glaeser et al., 2000; Burks et al., 2003). Although there is a substantial variance in the decisions made, a majority of the first players send positive amounts and a majority of the second players return positive amounts. And the amount returned is typically increasing in the amount sent.

This study departs from the conventional two-player trust game by providing a framework for understanding trusting behavior in more complex environments involving direct and indirect interactions among multiple players. We extend the standard two-player trust game to a multi-level trust game by adding a third player. The three players move sequentially. The first player can send any portion of his endowment to the second player. The amount sent gets tripled. The second player then decides how much to send to the third player. The amount is again tripled. The third player then decides the allocation among the three players.

The results of our experiment indicate that with no communication some trusting behavior takes place in the multi-level trust game even though players are randomly regrouped every period. When we add communication between the second and third players, the amounts sent and returned between these two increase. The new interesting finding is that there are external effects of communication: the first player who is outside communication sends 60% more and receives 140% more than in the no communication treatment. As a result, social welfare and efficiency increase from 48% to 73%. Content analysis of the communication reveals that what drives the most efficient outcomes are the proposals of equal split among three players made by either the second or third player. The effect of this type of proposals is strong enough to overcome tendencies toward collusion between the second and third players.

The multi-level trust game studied in this paper captures both direct and indirect trust and reciprocity, which are commonly observed in real life. For example, the fund of funds (FoFs) industry where the manager of a mutual fund company invests in other mutual funds instead of individual securities has attracted a lot of publicity over the past few years (Gregoriou, 2003; Nicholas, 2004). Our game closely resembles the FoFs environment where, we have individual investor who has the opportunity to invest any amount of her endowment in Mutual Fund A. Manager of Mutual Fund A can invest in another Mutual Fund B any amount of his own endowment plus the invested amount by individual investors. Manager of Mutual Fund B finally decides how to allocate the return of total investment among the three parties. Since FoFs managers are specialized in assessing hedge funds and have access to better information and better funds, FoFs provide an efficient and cost-effective way for individual investors to access a diversified group of hedge funds. This efficiency cannot be achieved without FoFs because the majority of these funds have minimum investment requirements and thus are closed to individual investors.

The multi-level trust game also allows us to study the internal and external effects of communication in a group when only a subgroup is allowed to communicate. In the FoFs example, managers of mutual funds frequently communicate with each other about investments and returns on investments, establishing a “closer relationship”. As a result, a strong possibility of collusion arises between manager of Mutual Fund A and manger of Mutual Fund B. This could cause an adverse effect on the level of trust that individual investors might have on managers.[1] Would communication between managers of mutual funds have any effect on managerial decisions and investment decisions of individual investors who don’t get the first hand information about the conversation?[2] Our experiment helps to answer these questions. To examine internal effects of communication, we measure trust and reciprocity among group members who communicate with each other. To examine the external effects of communication, we analyze the behavior of those who are left out of the communication.

Our multi-level trust game is related to the three-player centipede game studied by Rapoport et al. (2003) and Murphy et al. (2004).[3] The three-player centipede game is a multi-stage trust game which can be used to address some aspects of indirect trust (Camerer 2003). Yet, the strategy space of each player in the three-player centipede game is restricted to a binary choice, whether to end the game and take some percentage of the available surplus, or to increase the surplus and allow other players a chance to end the game. Thus, it allows observing only whether indirect trust exists but not the magnitude of indirect trust. The multi-level trust game proposed in this study is general enough to capture both the degrees of direct and indirect trust

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[1] A typical readers’ response from Harvard Professor James Heskett’s column article “Is This the Twilight Era for the Managed Mutual Fund?” is “As a small individual investor, I feel powerless to control or even understand how my mutual funds operate. I believe fund managers generally have others' interests, including their own, ahead of mine. Most importantly, I am skeptical of the ability of fund managers to consistently beat the market”. http://hbswk.hbs.edu/archive/3825.html

[2] Another example of multi-level trust game can be found in the workplace. In some companies, a CEO determines the bonus for a manager and his workers. When workers decide how much effort to exert, they must not only trust their manager to report their performance truthfully to the CEO, but also trust that the CEO will reward them appropriately. It is also often the case that the detailed discussions the CEO and managers have in the board room are often not revealed to workers or delivered as second hand information via managers to workers.

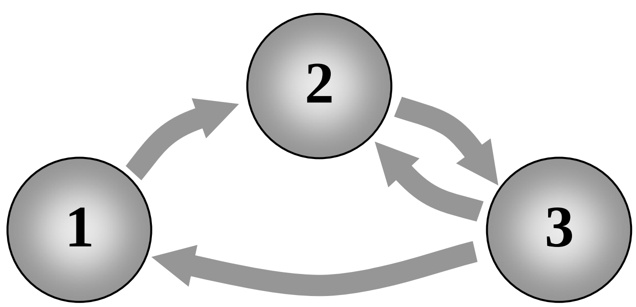
[3] In a repeated three-player centipede game, Rapoport et al. (2003) find that neither full cooperation nor full non-cooperation is supported. In a mixed population of human players and robots, Murphy et al. (2004) find that there is an increase in the propensity of human players to cooperate over time when a handful of cooperative robots are added while adding a handful of non-cooperative robots does not change the cooperation rate.

and reciprocity by using a continuous strategy space for each player. Moreover, our game gives us the flexibility to analyze different communication channels and we focus on the external effects of communication in this paper which is new to the communication literature.

2. Multi-Level Trust Game

We introduce a new version of a trust game – a multi-level trust game (Figure 2.1). This is a three-player trust game, where player 1 acts as a trustor, player 2 embodies both trustor's and trustee's characteristics, and player 3 always acts as a trustee. All players 1, 2, and 3 are endowed with e_1, e_2, and e_3. Player 1 can send a portion α_{12} of his endowment e_1 to player 2. The amount sent by player 1 is multiplied by k_1. Then player 2 can send a portion α_{23} of his total income to player 3. The amount sent by player 2 is multiplied by factor k_2. Then player 3 can reciprocate to players 1 and 2 by sending back portions of the total money received ($\alpha_{31} > 0$ and $\alpha_{32} > 0$), where α_{32} measures the amount of direct reciprocity and α_{31} measures the amount of indirect reciprocity.

Figure 2.1 – Multi-Level Trust Game



The unique Nash equilibrium in the multi-level trust game, which assumes that all players maximize their earnings, is for all players to send nothing. By backwards induction, player 2 knows that a rational player 3 will not send anything back (α_{32}= α_{31} =0) and therefore player 2 should send nothing (α_{23}=0). Anticipating this, player 1 should send nothing to player 2 (α_{12} = 0).

In this multilateral setting, if player 1 sends any positive amount ($\alpha_{12} > 0$), it means he is willing to take a risky bet that both players 2 and 3 will reciprocate. In other words, player 1 exhibits direct trust in player 2 and indirect trust in player 3. It is riskier to trust in this game than in the two-player game because player 1 is repaid by player 3 and not by player 2. Therefore, player 1 has to trust that player 2 will pass the money to player 3 and also trust that player 3 will be trustworthy. The most efficient outcome is when both players 1 and 2 fully trust player 3 by sending all of their endowments.

3. Experimental Design and Hypothesis

We conducted an experiment in which each session had two treatments: a no communication treatment (NC) and a communication treatment (C). Both treatments lasted for 10 periods. After completing all 20 decision periods, 4 periods were randomly selected for payment (2 periods for each treatment). In the NC treatment, all subjects were randomly assigned to a specific role, designated as player 1, player 2, or player 3. Each subject remained in the same role throughout the experiment. At the beginning of each period, each player was endowed with $e_1 = e_2 = e_3 = 100$ experimental francs and was randomly regrouped with two other players to form a three-player group, with each player in a different role. Player 1 made a decision on how many francs between 0 and 100 to send to player 2 and how many francs to keep. Each franc sent by player 1 was tripled ($k_1 = 3$). After players 2 and 3 learned the amount of francs sent by player 1, player 2 then made a decision on how many francs to send to player 3. The amount sent by player 2 was also tripled ($k_2 = 3$). Finally, player 3 made a decision on how many francs to send back to player 1, how many francs to send back to player 2, and how many francs to keep. All subjects were told that player 1, player 2, and player 3 can send some, all, or none of the francs available to them. At the end of each period, the amounts sent and returned by all players were reported for everyone to see. Instructions, available in Appendix I, explain the structure of the game in detail.

We applied the same design to the C treatment except that, after player 1 made his decision, player 2 and player 3 were able to communicate for 90 seconds in a text based “chat room”. Communication took place only after players 2 and 3 learned the decision made by player 1. Subjects were told that only players 2 and 3 would see the messages. In sending messages back and forth, we requested subjects to be civil to each other and not to reveal their identities.

Previous studies have shown that subjects care about treating others fairly (Fehr and Gachter, 2000), they display trust and trustworthiness contrary to self-interested profit-maximizing behavior (Berg et al., 1995; McCabe et al., 1998), they are concerned about efficiency (Engelmann and Strobel, 2004), and they have unconditional other-regarding preferences (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Cox, 2004). In evolutionary literature it is found that people exhibit direct and indirect trust in other people (Buchner et al., 2004; Greiner and Levati, 2005).[4] Based on these observations we conjecture that players 1 and 2 will trust player 3 by sending positive amounts. It is also documented in a two-player trust game that the levels of direct trust and reciprocity are higher than the levels of indirect trust and reciprocity (Wedekind and Milinski, 2000; Dufwenberg et al., 2001; Guth et al., 2001; Seinen

[4] Greiner and Levati (2005) use a variant of a trust game in order to implement a cyclical network of indirect reciprocity where the first individual may help the second, the second help the third, and so on until the last, who in turn may help the first. Like in a two-player trust game, the authors find that pure indirect reciprocity enables mutual trust in the multi-player environment. Buchner et al. (2004) compare the trust-reciprocity regimes with the explicit incentive schemes in the context of a 3-person ultimatum game. They find that mutual trust is as good as incentive contracts in inducing costly actions by employees.

and Schram, 2006).[5] Therefore, we expect that player 2 will trust more than player 1. And player 3 will reciprocate to player 2 more than to player 1.

We base our hypothesis of the effects of communication in the multi-level trust game on previous findings in the communication literature. Several experimental studies of one-shot two-player trust games show that cheap talk communication increases cooperation between trustor and trustee (Glaeser et al., 2000; Charness and Dufwenberg, 2006; Buchan et al., 2006; Ben-Ner et al., 2009).[6] Communication also improves cooperation in prisoner dilemma games (Wichman, 1972), public good games (Isaac and Walker, 1988), common-pool resource games (Hackett et al., 1994), and voting experiments (Schram and Sonnemans, 1996; Zhang, 2009). Social psychologists have identified several means by which communication can increase cooperation: communication creates group identity, thus improving group welfare, and communication elicits commitments, creating a promise-keeping norm (Bornstein 1992, Kerr and Kaufman-Gilliland 1994 and Bicchieri 2002). In our multi-level trust game communication occurs between players 2 and 3. Thus, players 2 and 3 should identify each other as in-group members, while categorizing player 1 as an out-group. According to social identity theory, group members tend to favor the

[5] Dufwenberg et al. (2001) perform an experiment based on a trust game with direct and indirect reciprocity treatments. By allowing receivers to reciprocate towards the other donors, they find that indirect reciprocity induces only insignificantly smaller donations than direct reciprocity and that receivers are more rewarding in the case of indirect reciprocity. Guth et al. (2001) find that indirect reward reduces significantly mutual cooperation compared to the direct reward. In the same line of research, Seinen and Schram (2006) and Wedekind and Milinski (2000) provide experimental evidence on indirect reciprocity in “repeated helping game” developed by Nowak and Sigmund (1998). In this game, donors decide whether or not to provide costly help to the recipients they are matched with, based on information about the recipient’s behavior in encounters with third parties.

[6] Ben-Ner et al. (2009) find that trust and trustworthiness are increased when verbal communication is allowed. Similarly, Ben-Ner and Putterman (2009) find that verbal communication helps subjects to reach agreement even without visual or auditory contact. In these two studies, two-way communication is implemented. That is, both trustor and trustee can exchange pre-play messages. Glaeser et al. (2000) permit face to face communication before playing trust games. They find that when individuals are closer socially, both trust and trustworthiness increase. They conclude that trusting behavior in the experiments is predicted by past trusting behavior outside of the experiments. Buchan et al. (2006) allow subjects to engage in personal but not task-relevant communication before playing trust games and find significant increase of trust and trustworthiness. Charness and Dufwenberg (2006) allow either trustor or trustee, but not both, to send free-form messages in a binary trust game. They find that the messages sent by trustees increase both trust and trustworthiness. However, no such effect is found when only trustors can send messages.

in-group at the expense of the out-group members. This finding is supported by many social psychology experiments.[7] Therefore, one should expect that with communication, player 2 exhibits more trust, by sending more to player 3, and player 3 exhibits more trustworthiness to player 2, by sending back larger proportions of his endowment. On the other hand, the out-group player 1 should contribute less to player 2 considering the possible collusion formed between players 2 and 3 via communication.

To test the conjectures raised in this study, we conducted an experiment which involved 72 undergraduate student subjects from Purdue University. The computerized experimental sessions were run using z-Tree (Fischbacher, 2007). We ran two NC-C sessions, in which a total of 36 subjects were engaged in 10 interactions with no communication and then 10 interactions with communication. The other 36 subjects participated in two C-NC sessions, where we reversed the order of the treatments.[8] After completing all 20 decision periods, 4 periods were randomly selected for payment (2 periods for each treatment). The earnings were converted into US dollars at the rate of 100 francs to $1. On average, subjects earned $16 each and the experiment session lasted for about 90 minutes.

4. Results

Table 4.1 summarizes the average amount sent and the profit earned by all players in the C and NC treatments. Among three players, player 1 earned the lowest profit while player 3 earned the highest profit in the experiment. In line with our conjecture, players 1 and 2 trust player 3 by sending significant amounts in the NC treatment. Moreover, the level of indirect trust exhibited by player 1, which is represented by 43 francs sent to player 2 (43% of income), is

[7] Social identity theory was first developed by Tajfel and Turner (1979). Chen and Li (2009) provide a detailed review of the literature.
[8] Two sessions (one NC-C and one C-NC) had 12 subjects and two other sessions had 24 subjects.

lower than the level of direct trust by player 2, which is represented by 117 francs sent to player 3 (52% of income). Based on the estimation of a random effect model, where the dependent variable is the amount sent and the independent variable is a player type dummy, the difference is significant in absolute terms (*p-value* < 0.01) but it is not significant in relative to income terms (*p-value* = 0.29).[9]

Table 4.1– Summary of Average Amount Sent and Profit

Decision	Amount Sent		Share of Income Sent		Player	Profit		Share of Total Profit	
	NC	C	NC	C		NC	C	NC	C
P1 to P2	43 (42)	69 (41)	0.43 (0.42)	0.69 (0.41)	P1	121	185	0.20	0.20
P2 to P3	117 (131)	256 (152)	0.52 (0.45)	0.84 (0.33)	P2	202	324	0.33	0.34
P3 to P1	65 (161)	154 (185)	0.10 (0.19)	0.13 (0.15)	P3	296	441	0.48	0.46
P3 to P2	90 (160)	274 (205)	0.14 (0.19)	0.29 (0.18)					

Standard deviations are in parentheses

Table 4.2 – Communication Treatment Effects

Regression	(1) RE	(2) RE	(3) RE	(4) RE	(5) RE	(6) RE	(7) RE	(8) RE
Dependent variable	Amount Sent				Amount Sent Relative to Income			
	P1 to P2	P2 to P3	P3 to P1	P3 to P2	P1 to P2	P2 to P3	P3 to P1	P3 to P2
C-treatment	25.6**	139.3**	89.6**	183.8**	0.26**	0.32**	0.04**	0.16**
[1 if treatment is C]	(3.2)	(11.9)	(14.4)	(15.9)	(0.03)	(0.04)	(0.01)	(0.02)
Constant	43.1**	116.8**	64.5**	89.7**	0.43**	0.52**	0.10**	0.13**
	(5.1)	(14.3)	(18.0)	(16.6)	(0.05)	(0.03)	(0.02)	(0.02)

Standard errors in parentheses. * significant at 5%, ** significant at 1%
In each regression we control for period, subject, and session effects
All models include a random effects error structure, with the individual subject effects

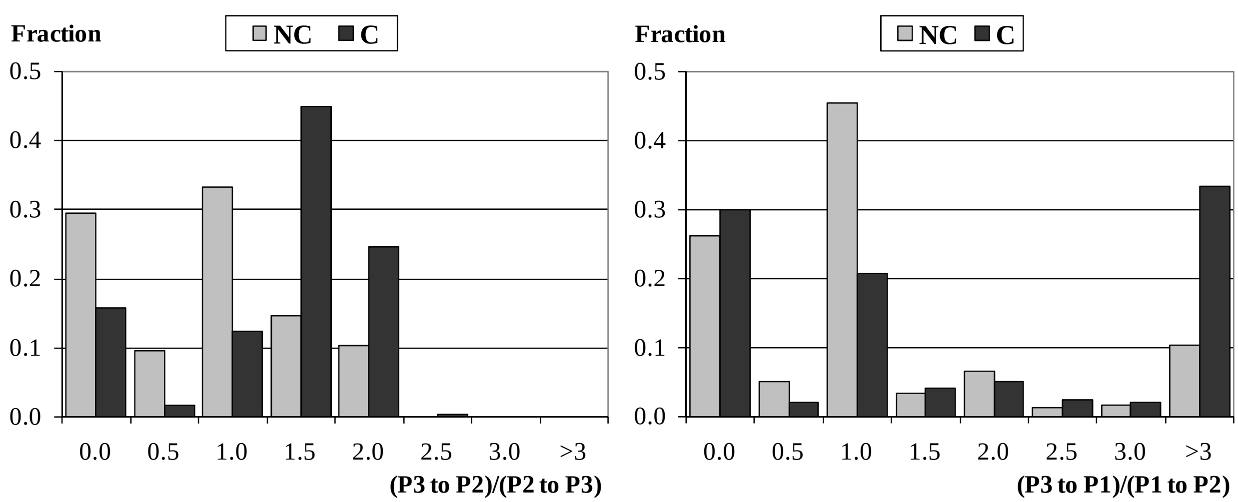
The main question posed in this study is the direct and indirect effects of communication on a multi-level trust game. Table 4.2 reports the estimation results of random effects models, where the dependent variable is the amount sent and the independent variable is a treatment dummy. As we expected, when communication is allowed, player 2 exhibits more trust in player

[9] We use pooled data from C-NC and NC-C sessions in Table 4.1 and Table 4.2. The order effect does not prevent us from drawing the conclusion that communication has significant effects on trusting behavior in our experiment. By using data only from the first treatment in each session (first 10 periods from C-NC and NC-C sessions) we receive very similar and statistically significant estimates as in Table 4.2.

3. The average amount sent by player 2 is increased by 139 francs (specification 2). Controlling for the amount player 2 received from player 1, in the NC treatment player 2 sends only 52% of income to player 3 while this amount is increased by 32% in the C treatment (specification 6).

How does communication affect the behavior of player 3? Table 4.1 shows that in the NC treatment, player 3 returns 77% back to player 2 of the amount player 2 sent to player 3. When communication is introduced, player 3 returns 107% back to player 2. The same conclusion can be drawn about the behavior of player 3 towards player 1. With communication, player 3 sends higher absolute and relative amounts back to player 1. The two panels in Figure 4.1 show that the distribution of return ratio is shifted towards more generous behavior of player 3 in the C treatment as compared to the NC treatment. These findings provide full support for the conjecture that communication enhances trust and trustworthiness.

Figure 4.1 – Distribution of Return Ratio in the NC and C Treatments



Although only players 2 and 3 are allowed to communicate, we find that the amount player 1 sends to player 2 in the C treatment is increased by 60% (Table 4.1). In relative terms, player 1 sends 43% of income to player 2 in the NC treatment and 69% in the C treatment. This result is contrary to our prior conjecture that the trust level of player 1 would fall in the C treatment because communication would serve as a collusion device between players 2 and 3. In fact, we find evidence that communication increases the collusion between players 2 and 3. In the C treatment, player 3 sends half of his income to player 2 and nothing to player 1 in around 10% of the instances. In the NC treatment, this number is less than 1%, indicating much lower collusion. Then the question is why would communication increase the trust level of player 1? The answer turns out to be very simple. In the NC treatment, player 3 splits the income equally between three players around 5% of the instances. In the C treatment, this rate is around 25%. Therefore, in the C treatment, player 1 receives 140% more than in the NC treatment. This means that communication has two opposite effects on the amount player 3 sends to player 1: it enhances collusion between players 2 and 3, and it also activates fairness norms and thus increases cooperation between all players.[10] The cooperation effect dominates the collusion effect, which is supported by estimation of specifications (3) and (7) in Table 4.2.

As a result of communication, all players earn higher payoffs. In the C treatment, the sum of total earnings is around 950, while it is 619 in the NC treatment (Table 4.1).[11] Therefore, the efficiency in the NC treatment is 48% (619/1300), while in the C treatment it is 73% (950/1300). Communication also results in more equal split of earnings between players 2 and 3. In the NC treatment the difference between earnings of players 2 and 3 is around 15%, while in the C treatment this difference is around 12%.

We conducted a C-NC session to see whether cooperation which subjects have achieved during the communication treatment could be sustained when communication is removed. Figures 4.2a and 4.2b display the time trend of average amount sent by all players. Figure 4.2a suggests that communication in the C treatment indeed influences the behavior of players in the

[7] Cason and Mui (1997) also documents that communication makes groups more altruistic than individuals in a dictator game.

[11] Based on the estimation of random effect models, where the dependent variable is the profit and the independent variable is a treatment dummy, the differences in payoffs are significant (*p-value* < 0.01).

consecutive NC treatment. The average amount sent by each player in the NC treatment is higher in C-NC session (Figure 4.2a) than in NC-C session (Figure 4.2b). However, this difference is significant only for the first 5 periods based on the estimation results of a random effect model.

Figure 4.2a – Average Amount Sent Over the Periods in C-NC Order

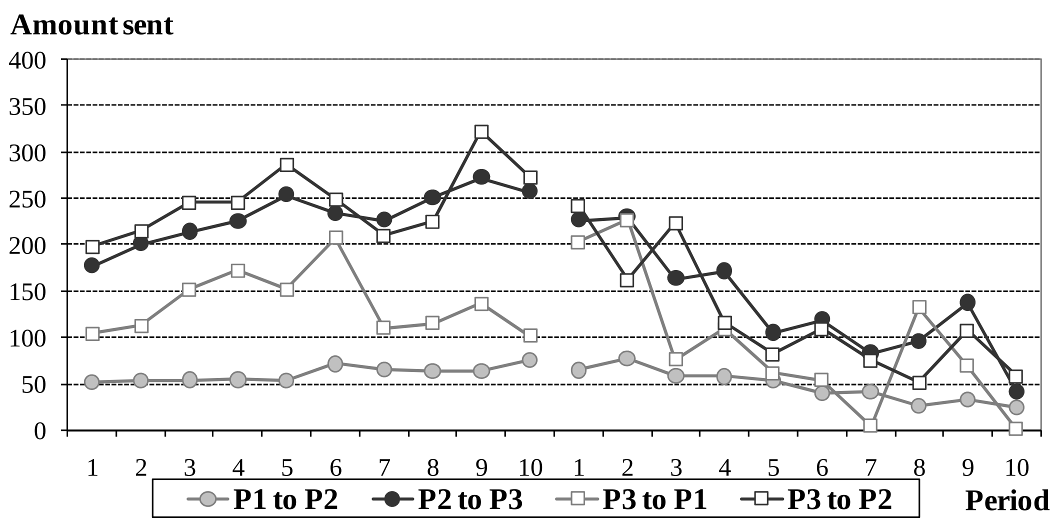
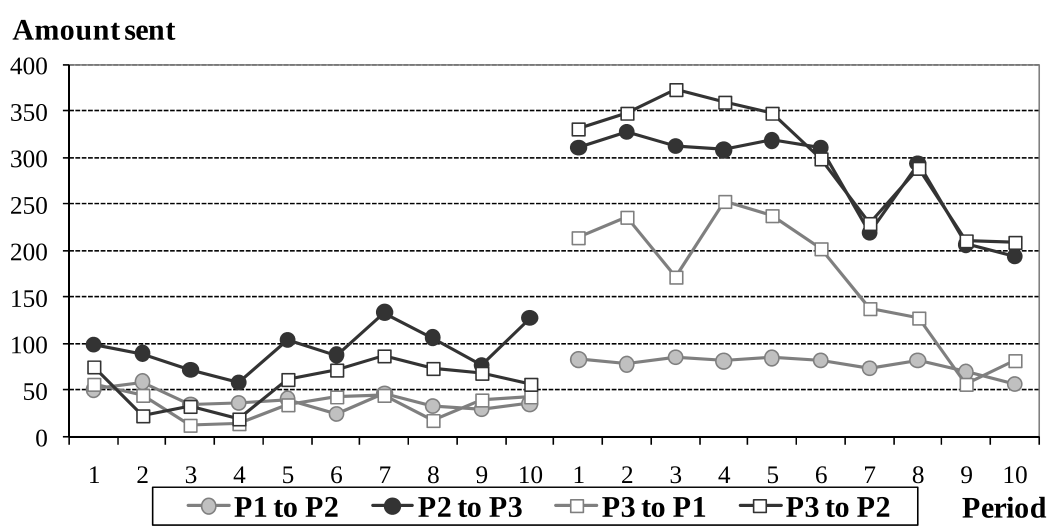


Figure 4.2b – Average Amount Sent Over the Periods in NC-C Order



To further account for order effects, Table 4.3 reports random effects regressions of the amount all players sent on treatment and order variables. The variable *C-treatment* x *NC-C* is equal to 1 if treatment is C and the order in which treatments were run is NC-C. The variable *C-*

treatment x *C-NC* is equal to 1 if treatment is C and the order in which treatments were run is C-NC. The *p-values* at the bottom of Table 4.3 indicate that order has a significant effect on the behavior of all players.[12] In particular, communication is more effective in NC-C sessions than in C-NC sessions. A possible explanation is that in NC-C sessions, after 10 periods of the NC treatment, subjects understand better the efficiency cost of poor cooperation, and thus they significantly increase cooperation in the following C treatment.

Table 4.3 – Order Effect

Regression	(1) RE	(2) RE	(3) RE	(4) RE	(5) RE	(6) RE	(7) RE	(8) RE
Dependent variable	Amount Sent				Amount Sent Relative to Income			
	P1 to P2	P2 to P3	P3 to P1	P3 to P2	P1 to P2	P2 to P3	P3 to P1	P3 to P2
C-treatment x NC-C	37.6**	178.1**	127.7**	228.8**	0.38**	0.41**	0.06**	0.18**
[1 if C treatment and NC-C session]	(4.3)	(16.0)	(19.4)	(21.0)	(0.04)	(0.04)	(0.02)	(0.02)
C-treatment x C-NC	13.7**	100.4**	51.4**	138.8**	0.14**	0.23**	0.02	0.14**
[1 if C treatment and C-NC session]	(4.3)	(16.0)	(19.4)	(21.0)	(0.04)	(0.04)	(0.02)	(0.02)
Constant	43.1**	116.8**	64.5**	89.7**	0.43**	0.52**	0.10**	0.13**
	(5.2)	(14.6)	(18.3)	(16.9)	(0.05)	(0.05)	(0.02)	(0.02)
p-value	0.000	0.000	0.004	0.001	0.000	0.002	0.105	0.130

Standard errors in parentheses. * significant at 5%, ** significant at 1%
In each regression we control for period, subject, and session effects
All models include a random effects error structure, with the individual subject effects

5. Beliefs and Messages

5.1 Beliefs

In both C and NC treatments, after making the decision on how much to send to player 2, we asked player 1 to make a prediction about the actions of players 2 and 3 before seeing the outcome screen. Player 1 was asked to guess how much player 2 would send to player 3, how much player 3 would send back to player 2, and how much player 3 would send back to player 1. Subjects were financially motivated to make correct predictions. They were paid 10 francs for each prediction if the prediction differed by no more than 5% from the actual decision made. We

[12] We used standard Wald test to see whether these two variables are significantly different from each other.

chose this belief-elicitation protocol instead of the quadratic-scoring rule mainly because it is simple and rather easy for subjects to understand. As argued by Charness and Dufwenberg (2006), this form of belief elicitation sharpens the incentives in comparison with quadratic-scoring rules.

Table 5.1– Summary of Average Expected Amount Sent and Percentage Difference

Decision	Expected Amount Sent		Actual Amount Sent		Percentage Difference From Actual Decisions	
	NC	C	NC	C	NC	C
P2 to P3	133	265	117	256	13.9%	3.4%
P3 to P2	130	287	90	274	45.4%	4.8%
P3 to P1	101	229	65	154	56.2%	48.6%

Table 5.1 reports the average predictions of player 1 on the amounts sent by player 2 and player 3 and the average percentage differences from the actual decisions made. On average player 1 makes good predictions on the amount player 2 sends to player 3 in both treatments and on the amount player 3 sends back to player 2 in the C treatment. However, in both C and NC treatments, player 1 overestimates the amount player 3 sends back to players 1.[13] This overestimation may partially explain the high level of trust exhibited by player 1 in the multi-level trust game.

5.2 Content Analysis of Communication

At this point we know that communication enhances cooperation in the group of three people although only a subgroup of two people is allowed to communicate. This brings us to the question of what kinds of messages cause this cooperation. We use content analysis to answer this question.

[13] We have also looked at this overestimation across periods and found that it does not disappear with experience.

The procedure that we used to quantify the recorded messages is as follows. First, we randomly selected a session to develop a coding scheme. We classified the messages into 18 categories, shown in Table 5.2. Then we employed two undergraduate students to code all messages into the coding categories independently. The unit of observation for coding was all messages sent out in a given period before subjects made decisions. Coders were asked not to start coding until they had finished reading all messages in a given period. If a unit of observation was deemed to contain the relevant category of content, it was coded as 1 and 0 otherwise. Each unit was coded under as many or few categories as the coders deemed appropriate. The coders were not informed about any hypotheses of the study.[14]

Table 5.2 – Coding Table, Reliability Indexes, and Frequency of Coding

Category	Description	Cohen's Kappa *K*	*p* -value	Frequency of coding
1a	P2 proposed to send nothing to P1 and (almost) equal split between P2 and P3	0.53	0	21.3%
1b	P2 proposed (almost) equal split between P1, P2 and P3	0.75	0	17.9%
1c	P2 proposed to send some to P1 and (almost) equal split between P2 and P3	0.81	0	7.1%
1d	P2 made a positive comment or showed concern for well-being of P1	0.76	0	2.7%
1e	P2 made a negative comment about P1	0.50	0	6.3%
1f	P2 showed trust in P3	0.37	0	4.2%
1g	P2 used threat	0.39	0	2.1%
1h	P2 pleaded or appealed to P3	0.53	0	9.4%
2a	P3 proposed to send nothing to P1 and (almost) equal split between P2 and P3	0.74	0	31.5%
2b	P3 proposed (almost) equal split between P1, P2 and P3	0.77	0	24.2%
2c	P3 proposed to send some to P1 and (almost) equal split between P2 and P3	0.77	0	5.8%
2d	P3 made a positive comment or showed concern for well-being of P1	0.52	0	4.6%
2e	P3 made a negative comment about P1	0.50	0	4.8%
2f	P3 made any promises or showed trustworthiness	0.57	0	6.3%
2g	P3 mentioned about his or her good qualities	0.32	0	1.3%
3a	Agreement was reached on the first proposal	0.70	0	74.8%
3b	Agreement was reached on a different proposal than the first proposal	0.67	0	18.3%
3c	Agreement was not reached	0.00	0.53	0.4%

Following Neuendorf (2002), we adopt Cohen's Kappa K as a reliability measurement of the between-coder agreement. This measurement determines to which extent the coders agree that a certain message belongs to a particular coding category. Cohen's reliability measurement

[14] The instructions for coders are attached in Appendix II.

accounts for the between-coder agreement by chance (Hayes, 2005).[15] Reliability K greater than zero indicates that the proportion of agreements exceeds the proportion of agreements expected by chance. According to Landis and Koch (1977), K between 0.4 and 0.6 corresponds to a moderate agreement level and K greater than 0.6 corresponds to full agreement. Table 5.2 displays the coding scheme along with Cohen's reliability indexes and the frequency of coding for the C treatment. For the vast majority of categories, K is greater than 0.5. As a result of infrequent coding there are few categories that have unsatisfactory agreement levels. In further discussions of categories we use the average of the two independent codings. Specifically, the value of coding is treated as 1 if two coders agree that a message belongs to a given category, 0 if two coders agree that a message does not belong to a given category and 0.5 if the two coders disagree with each other.

Table 5.3 reports the estimation results of random effect models with individual subject effects. The dependent variable is the amount sent by either player 2 or player 3 and the independent variables are various categories of messages. In all regressions we control for period and session effects. Specifications (1) and (2) indicate that player 2 sends more to player 3 and player 3 reciprocates more to player 2 when either player 2 or player 3 proposes an equal split between all players (categories 1b and 2b). Specification (1) also indicates that the more often player 3 makes promises or shows his trustworthiness to player 2, the more player 2 sends to player 3 (category 2f). Some typical quotes from player 3 are "send all yours, I'll give you back more. I promise I won't screw you out of anything. You can trust me", or "I'll double your money if you send me 100." It is also important to note that the magnitude of this influence is very high. When player 3 sends a message which falls into category 2f then player 2, on average, sends an additional 72 francs to player 3. Player 3 also reciprocates by sending 99 francs more to

[15] For binary 0 or 1 coding, agreement by chance is 50%.

player 2.These findings are consistent with the argument made by Charness and Dufwenberg (2006) that promises affect the behavior of both trustees and trustors, resulting in much higher cooperation.

Table 5.3 – Random Effects Regressions on Categories of Messages

Regression		(1) RE	(2) RE	(3) RE
Dependent variable		P2 to P3	P3 to P2	P3 to P1
1a	P2 proposed to send nothing to P1 and (almost) equal split between P2 and P3	-21.15	-25.56	-102.88***
		(25.24)	(40.14)	(29.23)
1b	P2 proposed (almost) equal split between P1, P2 and P3	132.44***	75.37*	141.70***
		(25.64)	(39.51)	(29.35)
1c	P2 proposed to send some to P1 and (almost) equal split between P2 and P3	36.07	21.51	-49.39
		(39.72)	(53.97)	(40.28)
1d	P2 made a positive comment or showed concern for well-being of P1			-3.92
				(59.56)
1e	P2 made a negative comment about P1			5.68
				(44.21)
1f	P2 made any promises or showed trust to P3	-20.5	87.57	
		(48.20)	(75.05)	
1g	P2 used threat	-80.6	-139.62	
		(70.95)	(104.88)	
1h	P2 pleaded or appealed to P3	-58.99*	-53.11	
		(32.54)	(49.34)	
2a	P3 proposed to send nothing to P1 and (almost) equal split between P2 and P3	4.56	-9.32	-117.74***
		(21.41)	(36.32)	(25.00)
2b	P3 proposed (almost) equal split between P1, P2 and P3	125.59***	96.58***	150.07***
		(22.29)	(36.53)	(26.01)
2c	P3 proposed to send some to P1 and (almost) equal split between P2 and P3	50.84	88.4	-2.14
		(35.89)	(59.26)	(44.09)
2d	P3 made a positive comment or showed concern for well-being of P1			22.16
				(49.42)
2e	P3 made a negative comment about P1			-56.31
				(38.52)
2f	P3 made any promises or showed trustworthiness	72.44*	99.33	
		(38.83)	(63.58)	
2g	P3 mentioned about his or her good qualities	-20.96	33.28	
		(86.83)	(144.36)	

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
In each regression we also control for period and session effects

Another interesting finding is that the more player 2 pleads or appeals to player 3, the less player 2 sends to player 3. Some typical quotes from player 2 are “don’t screw me”, “don’t be greedy”. Intuitively, player 2 who sends less to player 3 is the one who doesn’t trust player 3 in the first place. Therefore, pleads and appeals of player 2 may be revealing player 2’s not-trusting type.

Finally, specification (3) indicates that when either player 2 or player 3 proposes to send nothing to player 1 then player 3 sends significantly lower amounts to player 1 (categories 1a and 2a). On the other hand, when either player 2 or player 3 proposes an equal split between three players then player 3 sends significantly higher amounts to player 1 (categories 1b and 2b).

6. Conclusion

This paper presents an experimental study of a novel multi-level trust game. In this game, player 1 acts as a trustor, player 2 embodies characteristics of both trustor and trustee, and player 3 always acts as the trustee. We investigate the internal and external effects of communication on direct and indirect trust and reciprocity. Although the multi-level trust game requires additional layers of trust than the standard two-player trust game, we still find a substantial level of direct and indirect trust in the multi-level trust game even when there is no communication. Consistent with other studies, we find that the level of direct trust and reciprocity is higher than the level of indirect trust and reciprocity.

Regarding communication, we find that players 2 and 3 who are engaged in nonbinding communication exhibit more trust and trustworthiness. The most unexpected and positive result of our experiment is the effect communication has on player 1’s behavior. Although only players 2 and 3 are allowed to communicate, we find that player 1’s trust increases by 60%. This is because communication activates stronger preference for fairness than collusion between players 2 and 3. Expecting that, player 1 exhibits more trust in players 2 and 3. In response, player 3 sends higher absolute and relative amounts back to player 1. Belief elicitation reveals that player

1 persistently overestimates the trustworthiness of player 3, which might account for the high level of trust exhibited by player 1 in the communication treatment. We also find that the social norms developed during the communication stage carry over to the no communication stage. However, the difference disappears after 5 periods of play.

Finally, we use content analysis to study what kinds of messages enhance cooperation. In the multivariate analysis of communication, we find that the messages that significantly increase cooperation between players 2 and 3 are the ones that indicate player 3's trustworthiness, and messages that indicate willingness to split all earnings equally.

Our study provides evidence that economic agents exhibit direct and indirect trust in multi-level interactions among strangers. One mechanism that can further promote trust and reciprocity is communication even when only a subgroup of the economic agents can afford to communicate with each other. Since communication between insiders may raise the concerns of forming collusion at the cost of the outsiders, to better use this mechanism, insiders should deliver the idea that communication activates more fairness norms toward the outsiders. This suggests that to rebuild trust with individual investors in FoFs, managers have to send clear signals to investors that their interests of obtaining cooperative, fair and efficient outcomes from the investment are perfectly aligned.

The findings of our experiment can also explain the emergence of many web-based auctions and other forms of online businesses which are built on trust and reciprocity among strangers (Resnick and Zeckhauser, 2002). For example, in the wholesale eBay online auction, as a consumer wholesale distributor, you can buy products at an unbeatable wholesale price from suppliers and then set your sale price in online auctions. A good reputation on fair trade between you and the wholesale suppliers helps to attract more buyers.

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Appendix I – The Instructions for the Experiment

Treatment (NC-C)

INSTRUCTIONS

This is an experiment in the economics of multi-person strategic decision making. Various research agencies have provided funds for this research. The instructions are simple. If you follow them closely and make appropriate decisions, you can earn an appreciable amount of money. The currency used in the experiment is francs. Francs will be converted to U.S. Dollars at a rate of **_100_** francs to one dollar. At the end of today's experiment, you will be paid in private and in cash. **_24_** participants are in today's experiment.

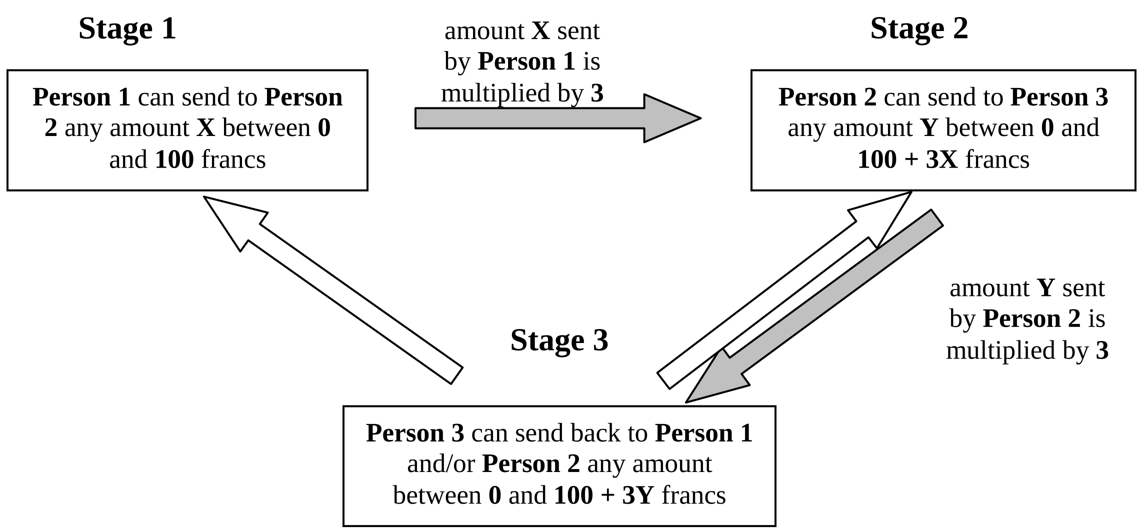
It is very important that you remain silent and do not look at other people's work. If you have any questions, or need assistance of any kind, please raise your hand and an experimenter will come to you. If you talk, laugh, exclaim out loud, etc., you will be asked to leave and you will not be paid. We expect and appreciate your cooperation.

The experiment is composed of 2 parts. Each part consists of 10 decision making periods. At this time we proceed to Part 1 of the experiment.

INSTRUCTIONS FOR PART 1

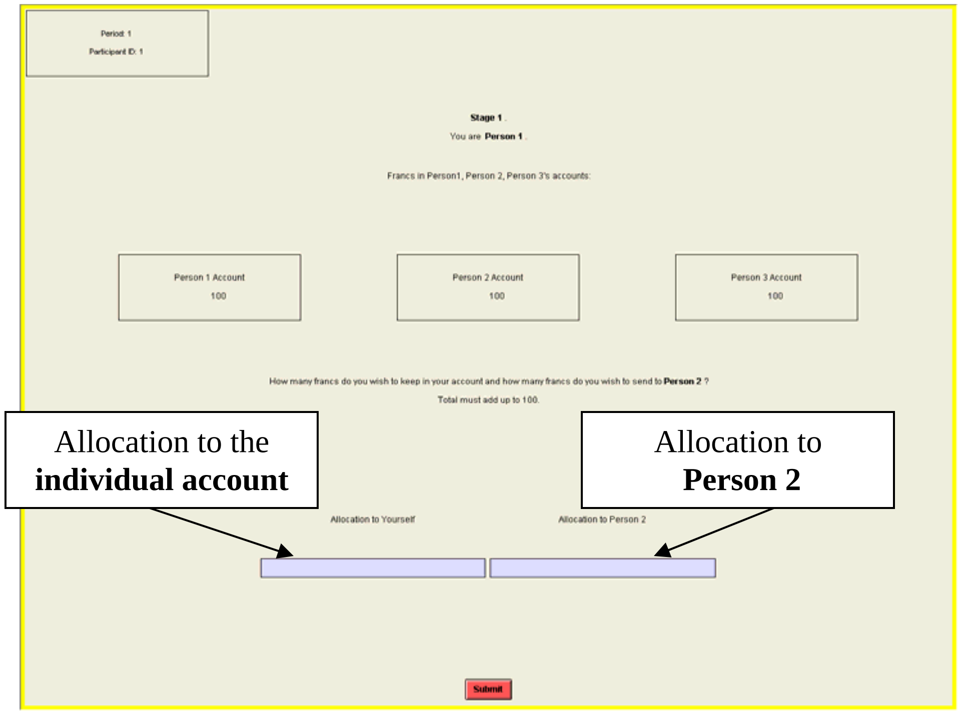
The first part of the experiment consists of **10** decision-making periods. The **24** participants will be randomly assigned into **8** three-person groups. In addition to the group assignment each participant will also be randomly assigned to a specific **type** in the group, designated as **Person 1**, **Person 2**, and **Person 3**. You will remain in the same type throughout the experiment. At the beginning of each period you will be randomly re-grouped with two other participants to form a three-person group, with one person of each type in each group.

The following diagram shows how this part of the experiment proceeds:



During each period, you and the other two participants in your group will make choices which will determine your payoffs. Each period is comprised of three stages. At Stage 1 Person 1 can send to Person 2 any amount X between 0 and 100 francs. Amount X sent by Person 1 is multiplied by 3. At Stage 2 Person 2 can send to Person 3 any amount Y between 0 and 100 + 3X francs. Amount Y sent by Person 2 is multiplied by 3. At Stage 3 Person 3 can send back to Person 1 and/or Person 2 any amount between 0 and 100 + 3Y francs.

More specifically, Person 1, 2 and 3 are given the initial of **100** francs in their individual accounts. At **Stage 1 Person 1** makes a decision how many francs to send to **Person 2** and how many francs to allocate to his or her **individual account**, as shown on the screen below.

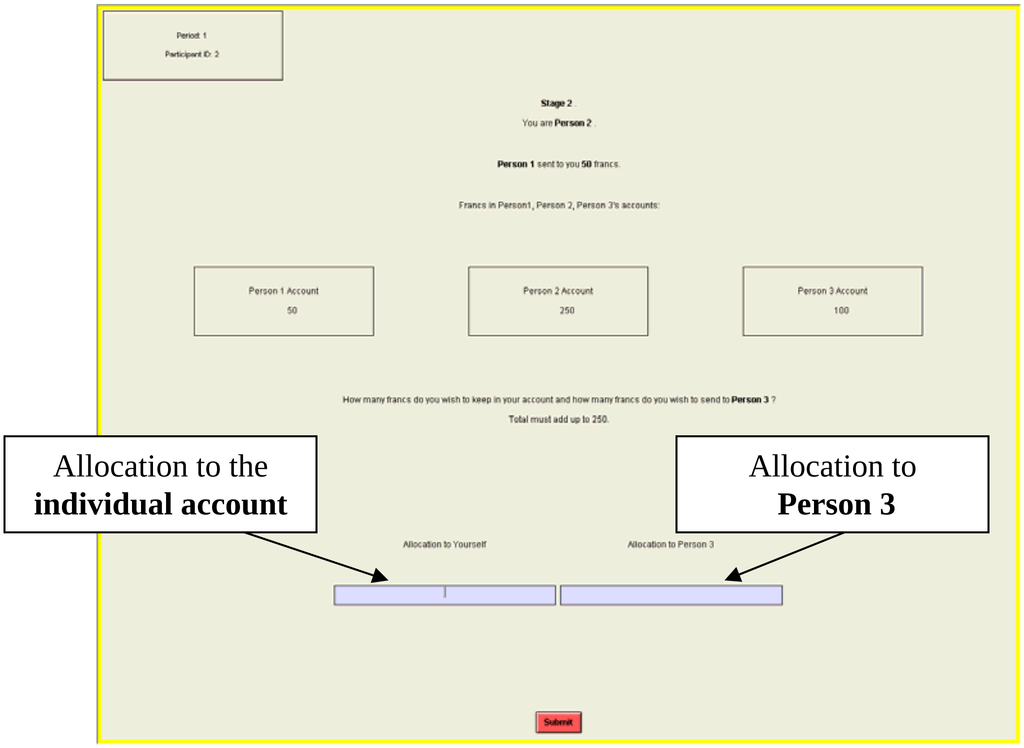


Decision Screen for Person 1 at Stage 1

Person 1 has the opportunity to send any number of francs between **0** and **100** to Person 2's account. Each franc sent by Person 1 is multiplied by **3**. For example, if Person 1 sends 40 francs to Person 2, the amount received by Person 2 is 120 francs (40×3=120). At the end of Stage 1 Person 2 and 3 learn the decision made by Person 1 and the total amount of francs in all three individual accounts.

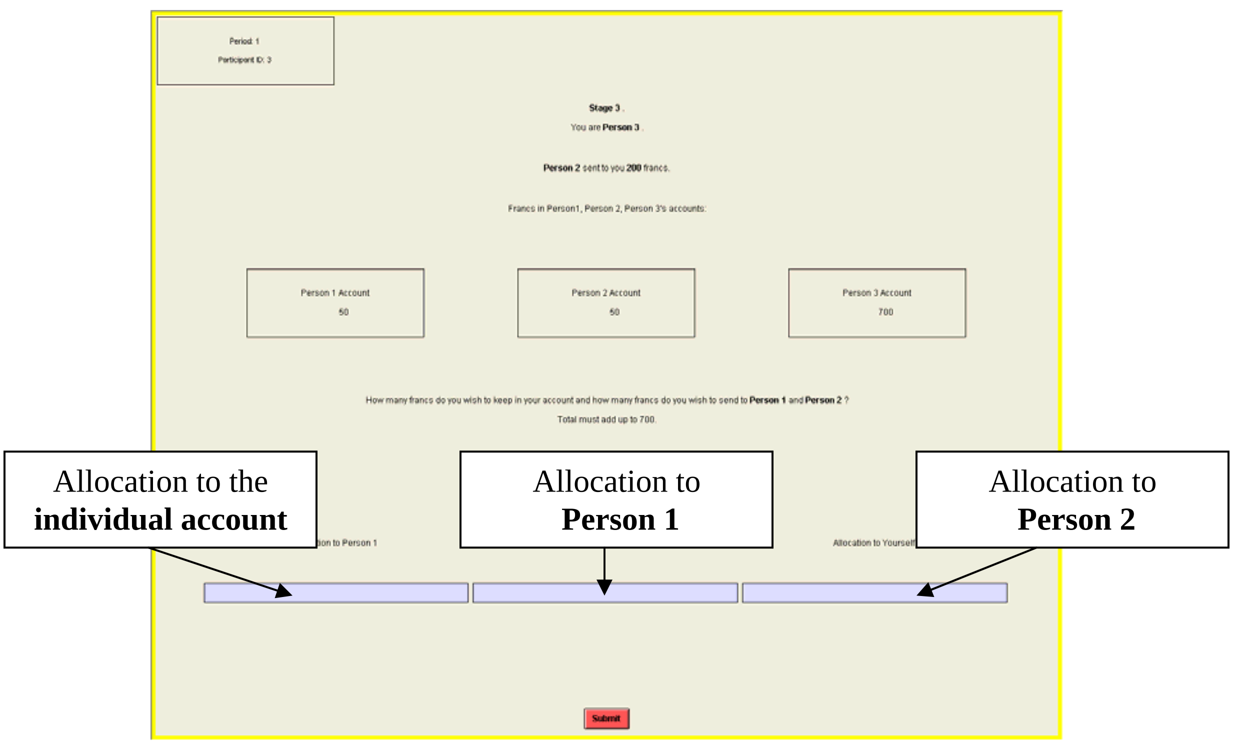
At **Stage 2 Person 2** will then decide how many francs to send to **Person 3** and how many francs to allocate to his or her individual account. Person 2 can send any amount of francs available in his/her account at that time. Each franc sent by Person 2 is multiplied by **3**. For example, if Person 2 sends 60 francs, the amount received by Person 3 is 180 francs (60×3=180). At the end of Stage 2 Person 3 and 1 learn the decisions made by Person 2 and the total amount of francs in all three individual accounts.

The decision screen for Person 2 is as following:



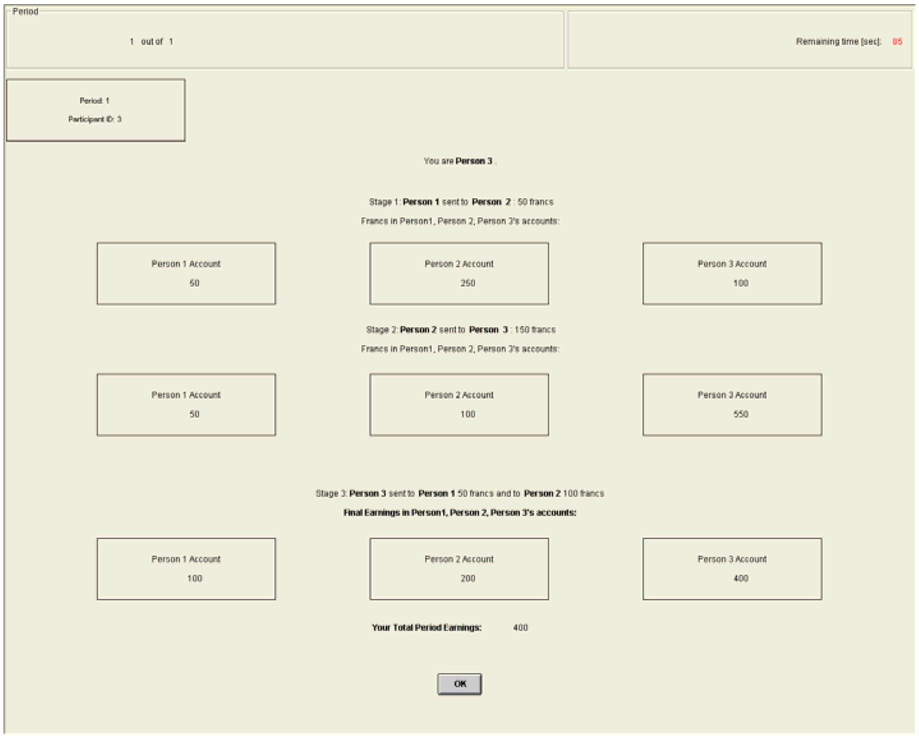
Decision Screen for Person 2 at Stage 2

At **Stage 3 Person 3** will then decide how many francs to send back to **Person 1**, how many francs to send back to **Person 2**, and how many francs to allocate to his or her individual account as shown in the following screen:



Decision Screen for Person 3

Finally, at the end of the Stage 3 the total period earnings and the decisions of all three participants in the group made at each stage are reported to each person as shown in the outcome screen below:



Outcome Screen

Once the outcome screen is displayed, please record your results for the period on your **record sheet** under the appropriate heading.

IMPORTANT NOTES

You will not be told which of the participants in this room are assigned to which group. All three Persons in the group have the opportunity to send some, all, or none of the francs available to them. You will remain in the same role throughout the experiment. At the beginning of each period you will be randomly re-grouped with two other participants to from a three-person group, with one person of each type in each group.

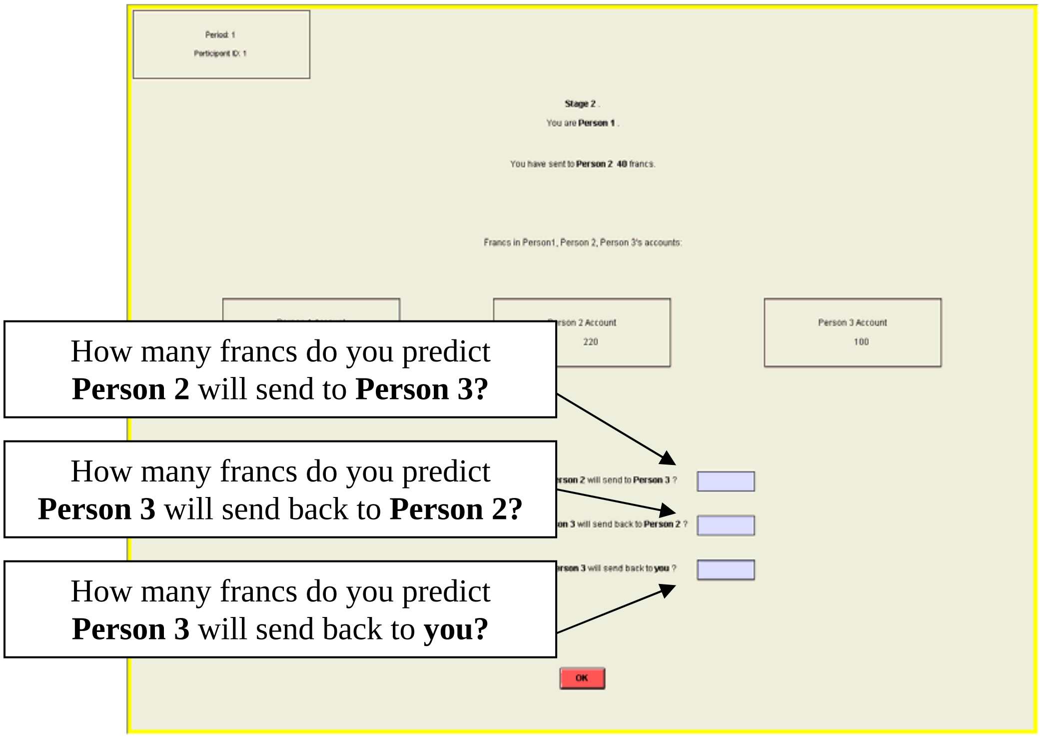
At the end of the experiment we will randomly choose **2 of the 10** periods for actual payment in **Part 1** using dice roll (ten-sided die with numbers from 1 to 10). You will sum the total earnings for these 2 periods and convert them to a U.S. dollar payment, as shown on the last page of your record sheet.

Are there any questions?

PREDICTIONS BY PERSON 1 (This part of the instructions was given only to person 1)

You are assigned to be Person 1. After you make your decision in Stage 1, you will be asked to enter three predictions in Stage 2: prediction about how many francs will Person 2 send to Person 3, prediction about how many francs will Person 3 send back to Person 2, and prediction about how many francs will Person 3 send back to you. **In addition** to your earnings from the individual account you will be paid for the **number of correct predictions** you make. In particular, at the end of the period, we will look at the choices actually made by Person 2 and 3 you are paired with and compare their choices to your predictions. You will be paid **10 francs** for each prediction if your prediction differs by no more than 5 percent from the actual decision made. If your prediction differs by more than 5 percent from the actual decision made, you will receive **0 francs** for that prediction.

The decision screen for prediction is as following:



Note that since your prediction is made before you know what actual decisions are made by Person 2 and Person 3 you are paired with, you maximize the expected size of your prediction payoff by simply stating your true beliefs about what you think Person 2 and Person 3 will do. Any other prediction will decrease the amount you can expect to earn from your prediction payoff.

INSTRUCTIONS FOR PART 2

The second part of the experiment consists of **10** decision-making periods. The rules for **Part 2** are exactly the same as the rules for **Part 1**.

The only difference is that in this part of the experiment, after **Stage 1**, Person 2 and Person 3 will have an opportunity to communicate with each other in a chat window. The communication will take place only after Person 2 and 3 have learned the decision made by **Person 1**. Person 2 and 3 will have **90** seconds to chat with each other anonymously. Although we will record the messages, only Person 2 and 3 will see them. Note, in sending messages back and forth we request that you follow two simple rules: (1) Be civil to each other and use no profanity and (2) Do not identify yourself.

After the chat period is over, at **Stage 2 Person 2** will decide how many francs to send to **Person 3** and how many francs to allocate to his or her individual account. At the end of Stage 2 Person 3 and 1 learn the decisions made by Person 2 and the total amount of francs in all three individual accounts.

At **Stage 3 Person 3** will then decide how many francs to send back to **Person 1**, how many francs to send back to **Person 2**, and how many francs to allocate to his or her individual account.

Finally, at the end of the Stage 3 the earnings for all three participants in the group are reported to each person. Please record your results for the period on your **record sheet** under the appropriate heading.

IMPORTANT NOTES

You will not be told which of the participants in this room are assigned to which group. All three Persons in the group have the opportunity to send some, all, or none of the francs available to them. You will remain in the same role throughout the experiment. At the beginning of each period you will be randomly re-grouped with two other participants to from a three-person group, with one person of each type in each group.

At the end of the experiment we will randomly choose **2 of the 10** periods for actual payment in **Part 2** using dice roll (ten-sided die with numbers from 1 to 10). You will sum the total earnings for these 2 periods and convert them to a U.S. dollar payment, as shown on the last page of your record sheet.

Are there any questions?

Appendix II – Instructions for Coders

Coding Instructions

Purpose: To study how communication affects the play of the game.

Game: Refer to the attached instructions for the experiment.

Coding Rules:

(1) The unit of observation is all messages in a given period. You should not start to code until you finish reading all messages in a given period. It is very important to look at the context of the messages across lines to properly interpret and code them.
(2) If a unit of observation is deemed to contain the relevant category of content, enter the code for the category in the relevant column beside the first line of the unit.
(3) Each unit can be coded under as many or few categories as you deem appropriate. Enter the additional codes in columns to the right.
(4) You should **independently** code all messages. Do not discuss with anyone about which statements should fall into which categories.
(5) Your job is to capture what had been said rather than why it was said or what effect it had. Think of yourself as a "coding machine."
(6) Code the sessions in the chronological order that the sessions were conducted, as explained and presented by your coding supervisor.

Please track the time you spend on coding the messages and training. You will be paid **$12** for each hour working on this project.

Thanks a lot for your participation in the coding task!