

# Institution formation in public goods games

Citation for published version (APA):

Kosfeld, M., Okada, A., & Riedl, A. M. (2006). *Institution formation in public goods games*. IZA Bonn. IZA discussion papers No. 2288

## Document status and date:

Published: 01/01/2006

## Document Version:

Publisher's PDF, also known as Version of record

## Please check the document version of this publication:

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Web Appendices of  
Institution Formation in Public Goods Games

*By* MICHAEL KOSFELD, AKIRA OKADA, AND ARNO RIEDL

## A. Web Appendix A: Proofs of Propositions

**Proof of Proposition 1.** We proceed by backward induction and first characterize a Nash equilibrium of the implementation stage. It follows from the unanimity rule and the definition of  $s^*$  that there exist two types of Nash equilibria if the number  $s$  of participants is greater than or equal to the threshold  $s^*$ : with and without an organization. The first one is a strict Nash equilibrium in which all participants accept the implementation of an organization. The second one is a non-strict Nash equilibrium in which at least two participants reject it. If  $s < s^*$ , the action profile that all participants agree to implement an organization is not a Nash equilibrium since every participant is better-off by rejection. In this case, all other action profiles without an organization are non-strict Nash equilibria.

The “only-if” claim in the first part of the proposition follows from the fact that there exists no Nash equilibrium with an organization in the implementation stage if  $s < s^*$ . The “if” claim is proved as follows. Suppose that  $s \geq s^*$ . Define the following strategies:

- $s$  players participate in an organization, and the others do not.
- If exactly  $s$  players participate in an organization, each participant accepts to implement an organization. Otherwise, each participant rejects it.
- All members of an organization (if any) contribute fully, and non-members choose zero contribution.

The above strategies induce Nash equilibria in the implementation and in the contribution stage where members contribute everything and non-members contribute nothing. Consider the participation stage. Participants receive  $asw - c/s$ . Since  $s \geq s^*$ , this is strictly greater than  $w$ , the deviation payoff a participating player could receive. Since also non-participating players are strictly worse off when participating, the above strategies induce a Nash equilibrium in the participation stage.

To prove the last part of the proposition, consider a non-strict Nash equilibrium without an organization in the implementation stage (independent of the number of participants). In

this case, every player is indifferent between participation and non-participation, no matter how the other players behave. Therefore, all action profiles are non-strict Nash equilibria of the participation stage.

**Proof of Proposition 2.** The proof of Proposition 1 shows that in any strict subgame perfect equilibrium an organization is implemented if and only if the number  $s$  of participants is greater than or equal to the threshold  $s^*$ . Given this result, a player's payoff in the participation stage is as follows:

$$u_i = \begin{cases} asw - \frac{c}{s} & \text{if } i \in S \\ w + asw & \text{if } i \notin S, \end{cases}$$

if  $s \geq s^*$ , and  $u_i = w$  if  $s < s^*$ . Let  $s > s^*$  and an organization be implemented. If one participant deviates, the remaining participants still implement the smaller organization with  $s - 1$  members. Therefore, each participant can increase his payoff by not participating from  $asw - c/s$  to  $w + a(s - 1)w$ . The situation is thus not supported by a Nash equilibrium in the participation stage. If  $s = s^*$ , no participant has an incentive to deviate from the organization, because by doing so his payoff decreases from  $as^*w - c/s^*$  to  $w$ . At the same time, no non-participant has an incentive to join the organization, because this reduces his payoff from  $w + as^*w$  to  $a(s^* + 1)w - c/(s^* + 1)$ . Thus, every action profile in the participation stage with exactly  $s^*$  participants is a strict Nash equilibrium. If  $s = s^* - 1$ , any single non-participant has an incentive to participate, since by doing so his payoff increases from  $w$  to  $as^*w - c/s^*$ . Hence, the situation is not supported by a Nash equilibrium. Finally, it is easy to see that any action profile with strictly less than  $s^* - 1$  participants is a Nash equilibrium, but not a strict one.

We next prove Propositions 3 and 4 where we assume that some of the players have social preferences. An organization  $S$  of size  $s$  is called *profitable* if (8) holds for all participants  $i \in S$ . A participant  $i$  of an organization  $S$  is called *pivotal* if  $S$  is profitable but  $S - \{i\}$  is not. Proposition 2 is generalized as follows.

**Lemma 1** *Suppose that  $\beta_i < 1 - a$  for all  $i = 1, \dots, n$ . An organization  $S$  is implemented in a*

strict subgame perfect equilibrium if and only if every participant is pivotal.

**Proof.** First, suppose that an organization  $S$  is implemented in a strict subgame perfect equilibrium. This trivially implies that  $S$  is profitable. We will next show that every participant of  $S$  is pivotal. On the contrary, suppose that there exists some participant  $i$  who is not pivotal. If player  $i$  participates in  $S$  he receives utility

$$U_i^p(s) = asw - \frac{c}{s} - \frac{\alpha_i}{n-1}(n-s) \left( w + \frac{c}{s} \right).$$

If this player  $i$  does not participate in  $S$ , then the organization  $S - \{i\}$  of the remaining participants is still profitable, and is thus implemented in a strict Nash equilibrium of the implementation stage. Hence, player  $i$  can obtain the following utility by not participating in the organization:

$$U_i^{np}(s) = w + a(s-1)w - \frac{\beta_i}{n-1}(s-1) \left( w + \frac{c}{s-1} \right).$$

Note that

$$\begin{aligned} U_i^{np}(s) - U_i^p(s) &= (1-a)w + \frac{c}{s} + \frac{n-s}{n-1}\alpha_i \left( w + \frac{c}{s} \right) - \frac{s-1}{n-1}\beta_i \left( w + \frac{c}{s-1} \right) \\ &> \left( 1-a - \frac{s-1}{n-1}\beta_i \right) w + \frac{c}{s} - \frac{c}{n-1}\beta_i \\ &> 0, \end{aligned}$$

because  $\beta_i < 1-a$  and  $1/n < a$  (and thus,  $\beta_i < \frac{n-1}{n}$ ). Since participant  $i$  can increase his utility by not participating, the organization  $S$  is not an equilibrium. A contradiction. Conversely, assume that every participant of  $S$  is pivotal. It is easy to see that there exists a strict subgame perfect equilibrium in which all players in  $S$  participate in the first stage and all profitable organizations are implemented in the second stage (on and off equilibrium paths).

**Proof of Proposition 3.** The grand organization is profitable since  $s = n$  satisfies condition (8). If any player  $j$  deviates, each of the remaining participants  $i$  in the organization of size  $n-1$  receives utility

$$U_i^p(n-1) = a(n-1)w - \frac{c}{n-1} - \frac{\alpha_i}{n-1} \left( w + \frac{c}{n-1} \right).$$

It can be seen without much difficulty that  $U_i^P(n-1) < w$  if and only if  $\alpha_i > \tilde{\alpha}$ . Therefore, all participants of the grand organization are pivotal if and only if there exist at least two players with  $\alpha_i > \tilde{\alpha}$ .<sup>a</sup> The first part of the proposition now follows from Lemma 1.

The second part can be proved as follows. If  $\alpha_i > \tilde{\alpha}$ , the utility of a participant in an organization of size  $n-1$  is strictly smaller than  $w$ . Since  $U_i^P(s)$  is monotonically increasing in  $s$ , it holds that  $U_i^P(s) < w$  for all  $s \leq n-1$ . Thus, if at least  $n-1$  players satisfy  $\alpha_i > \tilde{\alpha}$ , no organization except the grand organization is profitable, and thus the latter is the unique organizational equilibrium.

**Proof of Proposition 4.** We first remark that if any organization fails to form, the contribution stage has a Nash equilibrium in which no player contributes, regardless of parameters  $\alpha_i$  and  $\beta_i$ . In what follows, we select this Nash equilibrium with zero contributions in the contribution stage, whenever an organization fails to form. Suppose that any player  $i$  deviates from the grand organization. There are two cases: (1)  $i \in B$  and (2)  $i \notin B$ . In case (1), if the organization  $N - \{i\}$  is not profitable, then  $N - \{i\}$  is not implemented and thus the utility of the deviating player  $i$  decreases. If the organization  $N - \{i\}$  is profitable,  $N - \{i\}$  is implemented and the  $(n-1)$  members contribute fully. If the deviating member  $i$  contributes  $g_i$ ,  $i$ 's utility is equal to

$$\begin{aligned} U_i &= w - g_i + ag_i + a(n-1)w - \beta_i \left( w - g_i + \frac{c}{n-1} \right) \\ &= w + a(n-1)w - \beta_i \left( w + \frac{c}{n-1} \right) - (1-a-\beta_i)g_i. \end{aligned}$$

Since  $\beta_i > 1-a$ , it is optimal for  $i$  to contribute fully. In this case, player  $i$  receives utility  $anw - \frac{\beta_i c}{n-1}$ , which is strictly smaller than  $anw - \frac{c}{n}$  (the utility player  $i$  receives in the grand organization) if and only if  $\beta_i > 1 - 1/n$ . In case (2), the organization  $N - \{i\}$  is never profitable if at least two players have  $\alpha_i > \tilde{\alpha}$ . Therefore, player  $i$ 's utility decreases if he deviates from the grand organization.

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<sup>a</sup>We ignore the degenerate cases where  $\alpha_i = \tilde{\alpha}$  for some  $i$ .

## Web Appendix B: Additional treatment IF40<sup>+</sup>

In our main experimental treatments, players who are not a member of an organization are free to choose their contribution to the public good. Members of an organization, however, are bound to their dominant action of full contribution. The main advantage of this experimental design is that it allows us to focus on the problem of institution formation keeping the complexity of the experiment low. The potential disadvantage is that it introduces some asymmetry between members and non-members of an organization. To examine whether this asymmetry affects our results, we conducted an additional treatment IF40<sup>+</sup>, which was identical to treatment IF40 except that members of an organization could now also choose any contribution level  $g_i \in [0, 20]$  and were punished if they contributed less than 20. In accordance with the theoretical model, punishment was set to  $w - g_i$  (cf. equation (3)) making full contribution the strictly dominant action. To keep changes relative to treatment IF40 at a minimum, the wording in the instructions was changed as little as possible (see Web Appendix C.) In total, 52 subjects participated in treatment IF40<sup>+</sup>, yielding 13 independent groups of size four. As the original sessions, the additional sessions were run at the CREED laboratory of the University of Amsterdam. Average earnings were €21.80. A session lasted a little bit more than 2 hours, on average.

Table 1 summarizes our main results of the additional treatment IF40<sup>+</sup> with regard to institution formation. As can be seen, initiation and implementation rates are similar to those in IF40 except that subjects in IF40<sup>+</sup> are a bit more reluctant to initiate organizations. Taken over all rounds, the percentage of initiated organizations in IF40<sup>+</sup> is 82 (compared to 100 percent in IF40) and the percentage of implemented organizations relative to initiated organizations is 51 (compared to 43 in IF40).<sup>b</sup>

If we look at the distribution of implemented organizations, we see that over all rounds, the distribution in IF40<sup>+</sup> is a bit less skewed towards full-size organizations than in IF40. Yet, full-size organizations still form the majority (46 percent) of all organizations. In final rounds 16 to

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<sup>b</sup>The difference with regard to implementation rates is not statistically significant (Mann-Whitney test,  $p = 0.37$ ), the difference with regard to initiation rates is significant (Mann-Whitney test,  $p = 0.03$ ).

Table 1: Percentage of initiated and implemented organizations

	All rounds	Rounds 16-20
Initiated organizations	82	85
Implemented organizations		
Total	51	53
One member	12	3
Two members	12	3
Three members	30	31
Four members	46	62

*Note:* The table presents the relative number of initiated and implemented organizations. Relative numbers are calculated as follows: initiated organizations relative to all rounds, implemented organizations relative to all initiated organizations, different size of organizations relative to all implemented organizations.

20, the distribution is close to (and statistically indistinguishable from) the distribution in our main treatment: we observe 3, 3, 31, and 62 percent of organizations of size one, two, three, and four, respectively in treatment IF40<sup>+</sup> compared to 0, 0, 14, and 86 percent in IF40.<sup>c</sup> As in IF40, the learning dynamic in treatment IF40<sup>+</sup> is corroborated by a Spearman rank order correlation between the number of full-size organizations and rounds ( $\rho = 0.73$ ,  $p = 0.00$ ).

Implementation rates in IF40<sup>+</sup> also follow a pattern similar to IF40. Taken over all rounds, the implementation rate of full-size organizations greatly outperforms with 88 percent the rate of implementation of all other organizations (37, 26, and 46 percent for organizations of size one, two, and three, respectively). In comparison, the implementation rate of full-size organizations in treatment IF40 is 69 percent (and 0, 3, and 23 percent for organizations of size one, two, and three, respectively). In the final five rounds, the implementation rate of the full size organization in IF40<sup>+</sup> increases to 90 percent whereas the implementation of all other organization sizes

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<sup>c</sup>Over all rounds, the difference in the percentage of full-size organizations is marginally significant (Mann-Whitney test,  $p = 0.09$ ). Over the final rounds 16 to 20 this difference is not statistically significant (Mann-Whitney test,  $p = 0.29$ ). The differences for other organization sizes are also not statistically significant for the final five rounds (Mann-Whitney tests,  $p > 0.34$ )

reach much smaller rates (14, 9, and 53 percent for organizations of size one, two, and three, respectively). These rates of implementation are similar and statistically indistinguishable from the implementation rates in IF40, which are 0, 0, 31, and 94 percent for organizations of size one, two, three, and four, respectively).<sup>d</sup>

Summing up, the results so far show that subjects's behavior concerning institution formation is very similar to our original treatment IF40, except that learning is somewhat more sluggish. Given that treatment IF40<sup>+</sup> is considerably more complex than IF40, the difference in learning should not come as a surprise. In fact, complexity was one of the main reasons why we implemented IF40. The additional treatment IF40<sup>+</sup> shows that this decision has had no significant effect on our main experimental findings concerning institution formation. Our final result shows that it has had no effect on contribution behavior either.

Our first observation is that members of an organization in treatment IF40<sup>+</sup> contribute on average 19.9 points of their 20-points endowment to the public good. Thus, members do not deviate from the dominant action of contributing fully. Figure 1 depicts the average contributions to the public good in IF40<sup>+</sup> together with average contributions in treatment IF40 and PG40. As the Figure shows, average contributions in IF40<sup>+</sup> and IF40 basically overlap until round 17, in which the end-game effect kicks in. Over all rounds, the average contribution is 9.9 in IF40<sup>+</sup>. This is significantly higher than the average contribution of 5.0 in the control treatment PG40 (Mann-Whitney test,  $p < .01$ ) and not significantly different from the average contribution of 10.6 in treatment IF40 (Mann-Whitney test,  $p = 0.84$ ). In consequence, achieved efficiency levels are similar, as well. On average, the efficiency level amounts to 0.48 in IF40<sup>+</sup>. This is statistically significantly higher than the efficiency level of 0.25 in PG40 (Mann-Whitney

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<sup>d</sup>Mann-Whitney test for final five rounds,  $p = 0.39$ ,  $p = 0.56$ ,  $p = 0.73$ , and  $p = 0.66$ , for organizations of size one, two, three, and four, respectively. Over all rounds, implementation rates are significantly higher only for organizations of size one and two (Mann-Whitney test,  $p = 0.01$  for size one and  $p = 0.04$  for size two, respectively). Implementation rates of organizations of size three and four over all rounds do not differ statistically from those in IF40 (Mann-Whitney test,  $p = 0.10$  for size three and  $p = 0.26$  for size four, respectively).

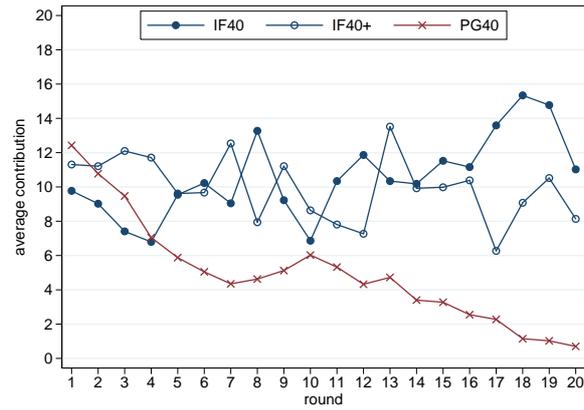


Figure 1: Average contribution to the public good in treatments IF40, IF40<sup>+</sup>, and PG40.

test,  $p < .01$ ) but statistically indistinguishable from the efficiency level of 0.51 in IF40 (Mann-Whitney test,  $p = 0.51$ ).

# Web Appendix C: Institution formation treatments (IF40, IF65, IF40<sup>+</sup>)

## INSTRUCTIONS (1/8)

### General information

Welcome! You are now going to participate in a decision making experiment. In this experiment you can earn money. How much money you will actually earn depends on your own decisions and the decisions of other participants of this experiment. During the experiment your earnings are counted in points. At the end of the experiment your earnings in points will be exchanged into Euros according to the following exchange rate:

**40 points = 1 Euro**

At the end of the experiment you will be paid out your earnings in cash confidentially. It is important that you understand these instructions correctly. We, therefore, ask you to read the instructions carefully. You have also received a short summary of these instructions.

**During the experiment it is not allowed to communicate with other participants in whatever way.**

If you have a question please raise your hand. An experimenter will then come to your table and answer your question personally.

The experiment consists of several rounds. In each round each participant forms a group of four with three other participants. The composition of these groups will be randomly determined at the beginning of the experiment. During the experiment the composition of the groups does not change. In each round you will be in a group of four with the same other participants. You will receive no information about the identity of the other group members, neither during the experiment nor after the experiment. The other members also receive no information about your identity. Thus, all interaction is anonymous during the experiment.

## INSTRUCTIONS (2/8)

### Detailed information about the experiment

At the beginning of the experiment all participants receive a starting capital of 300 points. This starting capital is allocated only once.

In total the experiment consists of **20 rounds**. All rounds are identical and each round is divided into **five phases**.

At the **beginning of each round** each participant receives **20 points**. For convenience, in the following we call these 20 points **initial endowment**.

In each round the situation each participant faces is as follows: In the **fourth phase** of a round, each member of the group of four decides how many points of the initial endowment he or she wants to contribute to a project and how many of the points he or she wants to keep for him- or herself. In the first **three phases** of a round all members of the group decide whether they want to commit themselves to contribute all points to the project or if they do not want to do that. [In IF40<sup>+</sup> added: If someone commits to contribute all points to the project then, in the **fourth phase**, this commitment will be enforced through the allocation of subtraction points.]<sup>e</sup>

In the **fifth phase**, everybody in the group gets information about the decisions made in this round.

## INSTRUCTIONS (3/8)

We are now first explaining how your earnings in a round depend on the decisions made in the fourth phase. Thereafter follows the explanation on how decisions in the different phases are made.

For convenience, we call the earnings in the fourth phase “**contribution earnings**”. In each round your “contribution earnings” are the **sum of two parts** minus possible **extra costs** (where these costs are coming from will be explained later) [In IF40<sup>+</sup> changed to: In each round your “contribution earnings” are the **sum of two parts** minus possible **extra costs** and minus possible **subtraction points** (where these costs and subtraction points are coming from will be explained later)]:

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<sup>e</sup>The instructions for IF40 and IF40<sup>+</sup> differed only in a few added or changed sentences. We indicate it in this way throughout.

1. **your private earnings** = the amount of points (of your initial endowment) that you keep for yourself

2. **your earnings from the project** = the total contributions to the project of all four group members  
*multiplied by 0.65 [0.40],<sup>f</sup>*

3. **possible extra costs**

[In IF40<sup>+</sup> added: 4. **possible subtraction points**]

Thus,

**contribution earnings** = **private earnings** + **earnings from the project** – **possible extra costs** [In  
IF40<sup>+</sup> added: - **possible subtraction points**].

For each member of the group the earnings are calculated in the same way.

Note: the points you keep for yourself *plus* the amount of points you contribute to the project sum up to the initial endowment of 20 points.

For each point you keep for yourself you earn 1 point. If, instead, you contribute 1 point to the project then the total contribution to the project increases with 1 point and your earnings from the project increase with  $1 \cdot 0.65$  points. At the same time also the earnings of each other group member increases with  $1 \cdot 0.65$ , such that the total earnings in the group increase with 2.6 points.

Thus, your contribution to the project raises the earnings of the other group members. The same holds the other way around: you get earnings for each point the other members of the group contribute to the project. For each point that is contributed by another group member you earn  $1 \cdot 0.65$  points.

## **INSTRUCTIONS (4/8)**

Now you receive explanations about the decisions you have to make in the different phases.

### **Phase 1**

In the first phase you decide if you **intend to commit yourself to contribute all your 20 points** of your initial endowment **to the project** in phase 4.

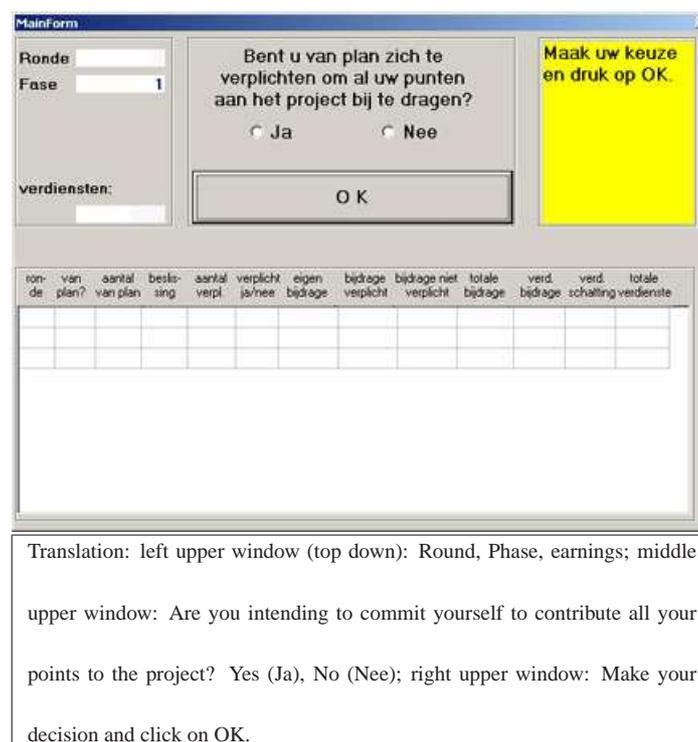
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<sup>f</sup>The instructions for IF65 and IF40 differed only in the marginal per capita return. We indicate this here by putting the numbers used in IF40 between brackets. These were, of course, not part of the original instructions.

[In IF40<sup>+</sup> added: If your intention to commit yourself to contribute all your points to the project becomes binding (see phase 3), then, in phase 4, this commitment will be enforced by way of the allocation of subtraction points. This means, that in phase 4 each point you do not contribute to the project – thus each point you keep for yourself – will be subtracted from your earnings.

For instance, if you commit yourself to contribute all your points to the project but in phase 4 decide to actually contribute only 12 points – thus to keep 8 points for yourself – then 8 points will be subtracted from your earnings. Similarly, if you commit yourself to contribute all your points to the project but in phase 4, for instance, decide not to contribute any points – thus to keep 20 points for yourself – then 20 points will be subtracted from your earnings. However, if you commit yourself to contribute all your points to the project and in phase 4 decide to actually contribute all 20 points – thus to keep no points for yourself – then there will also be no points subtracted from your earnings.]

In the experiment you make this decision with the help of a computer screen and the mouse. Below you find an example of such a computer screen.



On this screen you find in the middle upper part the “decision window” where you have to make your decision. In this window you click – with the help of the mouse – on the button “yes” if you intend to commit yourself to contribute all your points to the project and on the button “no” if you do not intend to contribute all your points to the project.

When you are satisfied with your decision you have to click on “OK. When everybody has made his or her decision the next phase follows.

Next to the decision window you find three other windows on your computer screen. These windows show similar information in all phases. Therefore we explain them shortly here.

In the left-upper window you see the “information window”. There you receive information about the round and the phase you are currently in and – below – your total earnings up to this moment.

In the right-upper window you see the “extra information window”. When this window turns yellow you have to make a decision.

The large window in the lower part of the computer screen is the “history window”. This window will be further explained at the end of the instructions.

## INSTRUCTIONS (5/8)

### Phase 2

In phase 2 we ask you to indicate your estimates about **how many of the other group members** intend to commit themselves to contribute all points of their initial endowment to the project.

You indicate your estimates with the help of a computer screen. Below you find an example of such a computer screen.

ronde van de plan?	aantal van plan	beslissing	aantal verplicht ja/nee	eigen bijdrage	bijdrage verplicht	bijdrage niet verplicht	totale bijdrage	verd. bijdrage	verd. schatting	totale verdiensite

Translation: left upper window (top down): Round, Phase, earnings; middle upper window: Fill in your estimates of the likelihood that 0, 1, 2, or 3 of the others in your group are intending to commit themselves; right upper window: Make your decision and click on OK.

For each possible number of other group members (0, 1, 2, or 3) you have to indicate, what – according to you – the likelihood is that precisely this number intend to commit themselves to contribute all their points to the project. Thus, you have to indicate what **according to you the likelihood is** that **none** of the others, that **precisely one** of the others, that **precisely two** of the others and that **precisely three** of the others intend to commit themselves to contribute all their points to the project in phase 4. You have to indicate your estimates in percentages, i.e. as an integer number between 0 and 100 (inclusive). Note: The four numbers have to sum up to 100.

You can earn points with your estimates. These earnings depend on how many of the others actually intend to commit themselves and your indicated percentages. The earnings are calculated with the help of a mathematical formula. It is not important for you to know this formula. It is sufficient that you realize that **your expected earnings from the estimates are as large as possible if you indicate your actual estimates of the likelihoods**. It is to your advantage if you fill in the estimates truthfully. You cannot make losses with your estimates. When your estimates are precisely correct you earn 4 points. If your estimates are completely wrong you earn 0 points.

For those who are interested we have stated the above mentioned formula that is used to calculate the earnings on the summary sheet of these instructions you have received from us.

When you have filled in your estimates you have to click on the OK button. When everybody has made his or her decision phase 3 follows.

## **INSTRUCTIONS (6/8)**

### **Phase 3**

In this phase you receive information about the total number of participants in the group that intend to commit themselves to contribute all points of the initial endowment to the project in phase 4.

Those who have indicated in phase 1 that they intend to commit themselves to contribute all their points to the project have now to decide if they **actually want to commit** themselves to contribute all their 20 points. This is done as follows.

If you have indicated in phase 1 that you intend to commit yourself then you have to decide now if you **still intend** to commit yourself to contribute all your 20 points to the project.

If **all group members** who **have indicated in phase 1 that they want to commit themselves** still indicate that they intend to commit themselves then this commitment becomes **binding**.

If **at least one** of those who have indicated in phase 1 that they intend to commit themselves now indicates that he or she does **not anymore** intend to commit him- or herself then **none** of the planned commitments becomes binding.

**If the commitments become binding** then for those who have committed themselves the decision in phase 4 concerning the contributions to the project will be automatically executed. These group members automatically contribute all their points of their initial endowment to the project. [In IF40<sup>+</sup> changed to: **If the commitments become binding** then for those who have committed themselves, in phase 4, the commitment will be enforced by way of allocating subtraction points. This means, that for those who have committed themselves to contribute all their points to the project, any points they keep for themselves will be subtracted from their earnings.] Furthermore, those who have committed themselves have to pay **extra costs**. These costs are always 2 points. These costs are equally distributed among those who have committed themselves.

Example: The total extra costs are 2 points. If 1 person commits him- or herself, then this person pays  $2/1 = 2$  points extra costs; if two persons commit themselves, then each of them pays  $2/2 = 1$  point; if 3 persons commit themselves, then each of them pays (rounded)  $2/3 = 0.67$  points; if all 4 persons commit themselves, then each of them pays  $2/4 = 0.50$  points extra costs.

If the commitments do not become binding then, in phase 4, everybody can contribute to the project as many points of the initial endowment as he or she wants to [In IF40<sup>+</sup> added: without any allocation of subtraction points]. In this case also nobody has to pay extra costs.

The decision whether to carry out the plan to commit oneself or not is made with the help of a computer screen as shown below.



## INSTRUCTIONS (7/8)

### Phase 4

In this phase you receive information about the total number of group members who have committed themselves to contribute all their points of their initial endowment to the project. Furthermore, all other decisions concerning the contributions to the project are made.

Note that two possible cases can emerge.

#### Case 1: commitments became binding

If eventual commitments became binding and if you are one of those who have committed themselves then the computer will automatically contribute all your points of your initial endowments to the project. You do not have to do anything other than click on the button “Read everything”. If you are not one of those who have committed themselves then you have to decide now how many points – of your initial endowment of 20 points – you want to contribute to the project. This decision is made with the help of a computer screen as shown below.

ron- de	van plan?	aantal van plan	beslis- sing	aantal verpl	verplicht ja/nee	eigen bijdrage	bijdrage verplicht	bijdrage niet verplicht	totale bijdrage	verd. bijdrage	verd. schalling	totale verdiensite

Translation: left upper window (top down): Round, Phase, earnings; middle upper window: In total  $X$  participants have committed themselves to contribute all their points to the project. Fill in your contribution to the project. Your contribution;; right upper window: Make your decision and click on OK.

[In IF40<sup>+</sup> changed to:

### **Case 1: commitments became binding**

If eventual commitments became binding and if you are one of those who have committed themselves then this commitment will be enforced by way of allocating subtraction points. This means, that each point you do not contribute to the project, thus you keep for yourself, will be subtracted from your earnings. If you are not one of those who have committed themselves then you will not receive any subtraction points, independent of how much you contribute to the project.

The decision regarding the contribution to the project is made with the help of a computer screen as shown below.

Platform

Ronde   
Fase

verdiensden:

In totaal hebben X deelnemers zich verplicht alle punten aan het project bij te dragen.  
U bent een van hen. Vul uw bijdrage aan het project in.  
Uw bijdrage:   
OK

Maak uw keuze en druk op OK

nom- de	van plan?	aantal van plan	beslis- sing	aantal verpl.	verplicht ja/nee	eigen bijdrage	bijdrage verplicht	bijdrage niet verplicht	totale bijdrage	verd. bijdrage	verd. schaling	totale verdiensde

Translation: left upper window (top down): Round, Phase, earnings; middle upper window: In total X participants have committed themselves to contribute all their points to the project. You are one of them.<sup>a</sup> Fill in your contribution to the project. Your contribution.; right upper window: Make your decision and click on OK.

<sup>a</sup>For those who did not commit this sentence read: You are not one of them.

]

In the field next to the text “Your contribution” you have to fill in the number of points you want to contribute to the project. When you are satisfied with your decision you have to click on the button “OK”.

### **Case 2: commitments became not binding**

If eventual commitments did not become binding then each group member is free to choose how many points of the initial endowment he or she wants to contribute to the project [In IF40<sup>+</sup> added: without

anybody receiving any subtraction points]. This decision is made with the help of a computer screen as shown above. Everybody in the group has to fill in the number of points he or she wants to contribute to the project in the field next to the text “Your contribution”. When you are satisfied with your decision you have to click on the button “OK”.

## INSTRUCTIONS (8/8)

### Phase 5

After all participants have confirmed their decisions you will see an “information window” in the middle-upper part of your computer screen. This window contains all important information of the round.

Translation: left upper window (top down): Round, Phase, earnings; middle upper window (top down): Number of participants that actually committed themselves:, Your contribution for your self:, Your contribution to the project:, Total contribution to the project:, Your extra costs:, [In IF40<sup>+</sup> an extra row: Your subtraction points:,] Your earnings from the contributions:, read everything; right upper window: Click on the button <read everything> when you have read everything.

In the most upper part of this window you find the information about the total number of people in the group that has committed themselves to contribute all their points of the initial endowment to the project. In the following two rows you find how many points of the initial endowment you kept and how many points you contributed to the project.

In the row below you can see how many points in total are contributed to the project in your group.

Beneath you receive information about possible extra costs you had to pay.

[In IF40<sup>+</sup> added: In the row before last you receive information about your eventual subtraction points.]

Finally, in the last row you see how high your “contribution earnings” are in this round.

In the lower part of the computer screen you receive extensive information about decisions in this round and all previous rounds. We shortly explain what kind of information you receive here (from left to right):

“round” = round

“intend?” = your decision concerning your plan whether or not to commit yourself (decision phase 1)

“number intending” = total number of group members who indicated intending to commit themselves

“decision” = your decision to execute the possible plan to commit yourself (decision phase 3)

“number com.” = total number of group members who actually executed their plan to commit themselves

“committed yes/no” = information about whether possible commitments became binding or not

“own contribution” = your contribution to the project

“contribution committed” = total number of points that are contributed to the project by those who have committed themselves to contribute all their points

“contribution not committed” = total number of points that are contributed to the project by those who have not committed themselves to contribute all their points

“total contribution” = total number of points that are contributed to the project by all members of the group (sum of “contribution committed” and “contribution not committed”)

“earn. contribution” = your “contribution earnings”

“earn. estimation” = your earnings from the likelihood estimates (phase 2)

“total earnings” = your total earnings in this round (sum of “earn. contribution” and “earn. estimation”)

If you have a question now raise your hand.

If you do not have any question click on CONTROL QUESTIONS. You then have to answer a few questions concerning the instructions.

## CONTROL QUESTIONS

You are now going to see a few questions and we ask you to answer these questions. The questions are only meant to control whether you have understood the instructions correctly. All questions are based on completely arbitrary examples. For convenience, in these questions we label the members of a group of four with the letters “A”, “B”, “C”, and “D”.

If you have a question raise your hand.

### **Control question 1/5** [In IF40<sup>+</sup>: 1/6]

Suppose that in a round nobody has committed him- or herself to contribute all points to the project. Additionally, in phase 4 all four people in the group contribute 0 points to the project.

What are the ‘contribution earnings of “A”?

What are the ‘contribution earnings of “B”?

What are the ‘contribution earnings of “C”?

What are the ‘contribution earnings of “D”?

(Fill in only integer numbers and then click on “confirm”.)

### **Control question 2/5** [In IF40<sup>+</sup>: 2/6]

Suppose that in a round nobody has committed him- or herself to contribute all points to the project. Additionally, in phase 4 all four people in the group contribute 20 points to the project.

What are the ‘contribution earnings of “A”?

What are the ‘contribution earnings of “B”?

What are the ‘contribution earnings of “C”?

What are the ‘contribution earnings of “D”?

(Fill in only integer numbers and then click on “confirm”.)

**Control question 3/5** [In IF40<sup>+</sup>: 3/6]

Suppose that in a round nobody has committed him- or herself to contribute all points to the project. Additionally, in phase 4 group member “A” contributes 3 points, group member “B” contributes 7 points, group member “C” contributes 11 points, and group member “D” contributes 19 points to the project.

What are the ‘contribution earnings’ of “A”?

What are the ‘contribution earnings’ of “B”?

What are the ‘contribution earnings’ of “C”?

What are the ‘contribution earnings’ of “D”?

(Fill in only integer numbers and then click on “confirm”.)

**Control question 4/5**

Suppose that in a round, in phase 1, two group members (e.g. “B” and “C”) have indicated to plan to commit themselves to contribute all their 20 points to the project. Suppose further that in phase 3 these commitments became binding and that in phase 4 both other group members “A” and “D” contributes 0 points to the project.

How many points does “C” contribute to the project in phase 4?

(Fill in only integer numbers.)

What are the individual extra costs of “B” in phase 4?

(Use always two digits after the decimal point.)

What are the individual extra costs of “A” in phase 4?

(Use always two digits after the decimal point.)

What are the ‘contribution earnings’ of “C” in this round?

(Fill in only integer numbers.)

What are the ‘contribution earnings’ of “D” in this round?

(Fill in only integer numbers.)

(When you have filled in all numbers click on “confirm”.)

[In IF40<sup>+</sup> replaced by:

**Control question 4/6**

Suppose that in a round, in phase 1, three group members (e.g. “B”, “C”, and “D”) have indicated to plan to commit themselves to contribute all their 20 points to the project. Suppose further that in phase 3 these commitments became binding and that in phase 4 group member “A” contributes 0 points to the project and that group members “B”, “C”, and “D” each contributes 20 points to the project.

How many subtraction points does “C” receive in phase 4?

(Fill in only integer numbers.)

What are the individual extra costs of “B” in phase 4?

(Use always two digits after the decimal point.)

What are the individual extra costs of “A” in phase 4?

(Use always two digits after the decimal point.)

What are the ‘contribution earnings’ of “C” in this round?

(Fill in only integer numbers.)

What are the ‘contribution earnings’ of “A” in this round?

(Fill in only integer numbers.)

(When you have filled in all numbers click on “confirm”.)]

**Control question 5/5**

Suppose that in a round, in phase 1, two group members (e.g. “A” and “D”) have indicated to plan to commit themselves to contribute all their 20 points to the project. Suppose further that in phase 3 group member “D” decides not to execute the plan to commit him- or herself and that all group members contribute 0 points to the project in phase 4.

What are the individual extra costs of “A” in phase 4?

(Use always two digits after the decimal point.)

What are the ‘contribution earnings’ of “D” in this round?

(Fill in only integer numbers.)

What are the ‘contribution earnings’ of “B” in this round?

(Fill in only integer numbers.)

(When you have filled in all numbers click on “confirm”.)

[In IF40<sup>+</sup> replaced by:

**Control question 5/6**

Suppose that in a round, in phase 1, three group members (e.g. “A”, “B”, and “D”) have indicated to plan to commit themselves to contribute all their 20 points to the project. Suppose further that in phase 3 group member “D” decides not to execute the plan to commit him- or herself and that all group members contribute 0 points to the project in phase 4.

How many subtraction points does “A” receive in phase 4?

(Fill in only integer numbers.)

How many subtraction points does “D” receive in phase 4?

(Fill in only integer numbers.)

What are the individual extra costs of “B” in phase 4?

(Use always two digits after the decimal point.)

What are the ‘contribution earnings’ of “D” in this round?

(Fill in only integer numbers.)

What are the ‘contribution earnings’ of “A” in this round?

(Fill in only integer numbers.)

(When you have filled in all numbers click on “confirm”.)]

[In IF40<sup>+</sup> added:

**Control question 6/6**

Suppose that in a round, in phase 1, three group members (e.g. “A”, “B”, and “D”) have indicated to plan to commit themselves to contribute all their 20 points to the project. Suppose further that in phase 3 these commitments became binding. Furthermore, assume that in phase 4 group members “A” and “B” each contribute 20 points, group member “C” contributes 0 points and group member “D” contributes 5 points to the project.

How many subtraction points does “A” receive in phase 4?

(Fill in only integer numbers.)

How many subtraction points does “D” receive in phase 4?

(Fill in only integer numbers.)

What are the ‘contribution earnings’ of “B” in this round?

(Use always two digits after the decimal point.)

What are the ‘contribution earnings of “C” in this round?

(Fill in only integer numbers.)

What are the ‘contribution earnings’ of “D” in this round?

(Use always two digits after the decimal point.)

Assume now that in phase 4 “D” contributes all 20 points (instead of 5 points).

What would have been his ‘contribution earnings’?

(Use always two digits after the decimal point.)

(When you have filled in all numbers click on “confirm”.)]

# Control treatments (PG40, PG65)

## INSTRUCTIONS (1/5)

### General information

Welcome! You are now going to participate in a decision making experiment. In this experiment you can earn money. How much money you will actually earn depends on your own decisions and the decisions of other participants of this experiment. During the experiment your earnings are counted in points. At the end of the experiment your earnings in points will be exchanged into Euros according to the following exchange rate:

**40 points = 1 Euro**

At the end of the experiment you will be paid out your earnings in cash confidentially. It is important that you understand these instructions correctly. We, therefore, ask you to read the instructions carefully. You have also received a short summary of these instructions.

**During the experiment it is not allowed to communicate with other participants in whatever way.**

If you have a question please raise your hand. An experimenter will then come to your table and answer your question personally.

The experiment consists of several rounds. In each round each participant forms a group of four with three other participants. The composition of these groups will be randomly determined at the beginning of the experiment. During the experiment the composition of the groups does not change. In each round you will be in a group of four with the same other participants. You will receive no information about the identity of the other group members, neither during the experiment nor after the experiment. The other members also receive no information about your identity. Thus, all interaction is anonymous during the experiment.

## INSTRUCTIONS (2/5)

### Detailed information about the experiment

At the beginning of the experiment all participants receive a starting capital of 300 points. This starting capital is allocated only once.

In total the experiment consists of **20 rounds**. All rounds are identical and each round is divided into **two phases**.

At the **beginning of each round** each participant receives **20 points**. For convenience, in the following we call these 20 points **initial endowment**.

In each round the situation each participant faces is as follows: In the **first phase** of a round, each member of the group of four decides how many points of the initial endowment he or she wants to contribute to a project and how many of the points he or she wants to keep for him- or herself. In the **second phase**, everybody in the group gets information about the decisions made in this round.

## INSTRUCTIONS (3/5)

We are now explaining how your earnings in a round depend on the decisions made in the first phase. Thereafter follows the explanation on how decisions in this phase are made.

In each round your “earnings” are the **sum of two parts**:

1. **your private earnings** = the amount of points (of your initial endowment) that you keep for yourself
2. **your earnings from the project** = the total contributions to the project of all four group members *multiplied by 0.65 [0.40]*,<sup>§</sup>

Thus,

$$\text{earnings} = \text{private earnings} + \text{earnings from the project}$$

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<sup>§</sup>The instructions for PG65 and PG40 differed only in the marginal per capita return. We indicate this here by putting the numbers used in PG40 between brackets. These were, of course, not part of the original instructions.

For each member of the group the earnings are calculated in the same way.

Note: the points you keep for yourself *plus* the amount of points you contribute to the project sum up to the initial endowment of 20 points.

For each point you keep for yourself you earn 1 point. If, instead, you contribute 1 point to the project then the total contribution to the project increases with 1 point and your earnings from the project increase with  $1 \cdot 0.65$  points. At the same time also the earnings of each other group member increases with  $1 \cdot 0.65$ , such that the total earnings in the group increase with 2.6 points.

Thus, your contribution to the project raises the earnings of the other group members. The same holds the other way around: you get earnings for each point the other members of the group contribute to the project. For each point that is contributed by another group member you earn  $1 \cdot 0.65$  points.

## INSTRUCTIONS (4/5)

### Phase 1

In this phase you make a decision with regards to the contributions to the project. (The other group members take their decisions at the same time.)

You have to decide how many points – of your initial endowment of 20 points – you want to contribute to the project. This decision is made with the help of a computer screen as shown below.

ronde	eigen bijdrage	bijdrage anderen	totale bijdrage	verdiensite

In the field next to the text “Your contribution” you have to fill in the number of points you want to contribute to the project. When you are satisfied with your decision you have to click on the button “OK”.

## INSTRUCTIONS (5/5)

### Phase 2

After all participants have confirmed their decisions you will see an “information window” in the middle-upper part of your computer screen. This window contains all important information of the round.

ronde	eigen bijdrage	bijdrage anderen	totale bijdrage	verdiensite
1				
2				

In the first two rows you see how many points of the initial endowment you kept and how many points you contributed to the project.

In the next row you find how many points in total are contributed to the project in your group.

Finally, in the last row you find how high your “earnings” are in this round.

In the lower part of the computer screen you receive information about decisions in this round and all previous rounds. We shortly explain what kind of information you receive here (from left to right):

“round” = round

“own contribution” = your contribution to the project

“contribution others” = total number of points that are contributed to the project by the other group members

“total contribution” = total number of points that are contributed to the project by the members of the group

“earnings” = your earnings in this round

If you have a question raise your hand.

If you do not have any question click on CONTROL QUESTIONS. You have then to answer a few questions concerning the instructions.

### **CONTROL QUESTIONS**

You are now going to see a few questions and we ask you to answer these questions. The questions are only meant to control whether you have understood the instructions correctly. All questions are based on completely arbitrary examples. For convenience, in these questions we label the members of a group of four with the letters “A”, “B”, “C”, and “D”.

If you have a question raise your hand.

#### **Control question 1/3**

Suppose that in a round all four people in the group contribute 0 points to the project.

What are the ‘earnings’ of “A”?

What are the ‘earnings’ of “B”?

What are the ‘earnings’ of “C”?

What are the ‘earnings’ of “D”?

(Fill in only integer numbers and then click on “confirm”.)

#### **Control question 2/3**

Suppose that in a round all four people in the group contribute 20 points to the project.

What are the ‘earnings’ of “A”?

What are the ‘earnings’ of “B”?

What are the ‘earnings’ of “C”?

What are the ‘earnings’ of “D”?

(Fill in only integer numbers and then click on “confirm”.)

**Control question 3/5**

Suppose that in a round group member “A” contributes 3 points, group member “B” contributes 7 points, group member “C” contributes 11 points, and group member “D” contributes 19 points to the project.

What are the ‘earnings’ of “A”?

What are the ‘earnings’ of “B”?

What are the ‘earnings’ of “C”?

What are the ‘earnings’ of “D”?

(Fill in only integer numbers and then click on “confirm”.)