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Reciprocity and the tragedies of maintaining and providing the commons

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Supplementary Information for

Reciprocity and the Tragedies of Maintaining and Providing the Commons

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1. Supplementary Methods

1.1 Supporting Statistical Analysis

We analyse cooperation in the strategy method experiment treating each participant's effective contribution schedule (the vector a_i) as an independent observation. In the One-shot direct interaction, we treat each belief (b_i) and effective contribution (c_i) as an independent observation. Finally, in the repeated interactions we treat beliefs and effective contributions at the matching group level as independent observations. Matching groups are composed of 16 participants in Strangers (see Methods in main text) and of 4 participants in Partners and Partners with Punishment, respectively.

<u>*Figure 2 Panels 2-3 – Comparisons across treatments and experiments*</u>

To <u>compare the size of the public good across Maintenance and Provision</u> <u>**(Figure 2, Panels 2-3)**</u>, we run linear mixed-effects models with a random intercept at the matching group level. For each condition (Strangers and Partners) we estimate the following specification:

$$PG_{jt} = \beta_0 + u_{0m} + \beta_1 Provision + \varepsilon_{jt} \quad (1)$$

where PG_{jt} is the size of the public good in group j at round t; β_0 is a constant; u_{0m} is a random intercept at the matching group level. $Provision$ is a treatment dummy that takes value one for Provision and zero for Maintenance. We estimate this model separately for Strangers and Partners.

To <u>compare the size of the public good across Strangers and Partners</u> <u>**(Figure 2, Panels 2-3)**</u> we estimate the following specification:

$$PG_{jt} = \beta_0 + u_{0m} + \beta_1 Partners + \varepsilon_{jt} \quad (2)$$

where PG_{jt} is the size of the public good in group j at round t; β_0 is a constant; u_{0m} is a random intercept at the matching group level. $Partners$ is a treatment dummy that takes value one for Partners and zero for Strangers. We estimate this model separately for Maintenance and Provision. The results of the estimates from models 1 and 2 are reported in **Supplementary Table 2**.

Figure 3a - Cooperation attitudes

Following previous literature[1-3], we classify cooperation attitudes into three main behavioral types: *conditional cooperators*, *free riders*, and *others*. Specifically, we classify a participant as a (i) *conditional cooperator* if either his/her effective contribution schedule (the vector a_i) exhibits a (weakly) monotonically increasing pattern, or if the Spearman correlation coefficient between his/her schedule and the others' average contribution is positive and significant at the 1% level; (ii) *free rider* if he/she never contributes anything (always withdraws everything) irrespective of how much the others contribute (withdraw); (iii) *other* if neither (i) nor (ii) applies (see Section 2.1 for robustness checks on the classification procedure).

Figure 3b – Linear mixed-effects models

To obtain a measure of estimated reciprocity, we estimate the following linear mixed-effects model:

$$C_{ijt} = \beta_0 + u_{0m} + u_{0i} + \beta_1 \bar{C}_{-ij,t-1} + \beta_4 Round + \varepsilon_{ijt} \tag{3}$$

where C_{ijt} is the effective contribution of individual i in group j at round t; β_0 is a constant; u_{0m} and u_{0i} are random intercepts at the matching group and individual level, respectively. $\bar{C}_{-i,t-1}$ is the average contribution of the other three group members from the previous round. The variable $Round$ indicates the round of the experiment and estimates a time trend. The coefficient β_1 is our measure of estimated reciprocity that we depict in **Figure 3b** in the main text.

We also estimated a model where contributions in period *t* are explained by beliefs about others' contribution in period *t*. We find significantly lower reciprocity (a positive contributions-belief correlation) in Maintenance than Provision in Strangers; in Partners reciprocity in Maintenance is also lower than in Provision, but not significantly so. The problem is, however, that beliefs in period t are strongly influenced by contributions of others in t-1 but the coefficients on contributions of others in t-1 are less than 1 in all treatments. This implies that beliefs in t are revised downwards beyond the observation of others' contributions in t-1. One possible reason is that beliefs in t are to some extent a rationalization of planned own contributions in t, that is, beliefs are not fully exogenous but to some extent endogenous. We believe that this problem arises mainly in the repeated games, while in One-shot we interpret elicited beliefs as an exogenous component of the ABC framework.

A. Smith[4] proposed a solution to the endogeneity problem in repeated public goods games by using beliefs and effective others' contributions in periods t-2 and t-3 as instruments for beliefs in period t. For the instruments to be valid, they need to be causal for beliefs but not for contributions. Following Smith[4], p. 422, we run Sargan and Basmann χ^2 tests to determine the validity of the set of instruments. However, the null hypothesis of valid instruments is clearly rejected in our dataset (all $P < 0.001$), making this approach infeasible. We therefore use lagged effective contributions of the other group members, which are less likely to cause endogeneity problems and do not suffer from issues of reverse causality. As a consequence, our estimates might be seen as a combination of the differences in reciprocal responses to others' previous contributions and beliefs about others' contributions in the current period.

To <u>compare reciprocity across Maintenance and Provision **(Figure 3b, all panels),**</u> we estimate the following model:

$$C_{ijt} = \beta_0 + u_{0m} + u_{0i} + \beta_1 \bar{C}_{-ij,t-1} + \beta_2 Provision + \beta_3 \bar{C}_{-ij,t-1} \times Provision + \beta_4 Round + \beta_5 Round \times Provision + \varepsilon_{ijt} \tag{4}$$

where the dummy $Provision$ indicates the treatment. We control for different time trends across Maintenance and Provision. We estimate the model above separately for Strangers and Partners both in the full sample and for each attitude type separately. The results of the estimations from model 4 are reported in **Supplementary Table 3**.

<u>To compare reciprocity across Strangers and Partners **(Figure 3b, all panels)**,</u> we use the following model:

$$C_{ijt} = \beta_0 + u_{0m} + u_{0i} + \beta_1 \bar{C}_{-ij,t-1} + \beta_2 Partners + \beta_3 \bar{C}_{-ij,t-1} \times Partners + \beta_4 Round + \beta_5 Round \times Partners + \varepsilon_{ijt} \tag{5}$$

where $Partners$ is a dummy that takes value one in Partners and zero in Strangers. We estimate the model above separately for Maintenance and Provision both in the full sample and for each type separately. We report the results of these estimations in **Supplementary Table 4**.

Finally, we compare reciprocity across attitude types in each treatment and experiment **(Figure 3b, Panels 2-4)** by estimating the following model:

$$C_{ijt} = \beta_0 + u_{0m} + u_{0i} + \beta_1 \bar{C}_{-ij,t-1} + \beta_2 CC + \beta_3 \bar{C}_{-ij,t-1} \times CC + \beta_4 OT + \beta_5 \bar{C}_{-ij,t-1} \times OT + \beta_6 Round + \beta_7 Round \times CC + \beta_8 Round \times OT + \varepsilon_{ijt} \tag{6}$$

where CC and OT are dummies that indicate whether the subject is classified in the attitude categories of *conditional cooperators* or *others*, respectively. We use *free riders* as the omitted category. We report results of these estimations in **Supplementary Table 5**.

Comparing effective contributions across types (Supplementary Figure 1)

To compare effective contributions across attitude types in One-shot **(Supplementary Figure 1a and 1b, Panel 1)** we run the following ordinary least squares (OLS) model:

$$C_i = \beta_0 + \beta_1 CC + \beta_2 OT + \varepsilon_i \tag{7}$$

where C_i is the effective contribution of participant *i* and CC and OT are dummies for *conditional cooperators* and *others*, respectively. We use *free riders* as the omitted category. We estimate this model separately for Maintenance and Provision.

To compare effective contributions across attitude types in Strangers and Partners **(Supplementary Figure 1a and 1b, Panels 2 and 3)** we run the following linear mixed-effects model:

$$C_{ijt} = \beta_0 + u_{0m} + u_{0i} + \beta_1 CC + \beta_2 OT + \varepsilon_{ijt} \tag{8}$$

where C_{ijt} is the effective contribution of participant i in group j at round t. β_0 is a constant; u_{0m} and u_{0i} are random constants at the matching group and individual level, respectively. CC and OT are dummies for *conditional cooperators* and *others*, respectively. We use *free riders* as the omitted category. We estimate this model separately for Maintenance and Provision. The results from models 7 and 8 are reported in **Supplementary Table 6**.

Figure 5a – Linear mixed-effects models in Partners with Punishment

To investigate whether punishment behavior differs across Maintenance and Provision for given levels of positive/negative deviations between the contribution of the punisher and the punished person **(Figure 5a, all panels)**, we estimate the following linear mixed-effects model:

$$\begin{aligned} Y_{ijkt} = {} & \beta_0 + u_{0m} + u_{0i} + \beta_1 \max(c_{ijt} - c_{kjt}, 0) + \beta_2 \max(c_{kjt} - c_{ijt}, 0) + \beta_3 Provision \\ & + \beta_4 \max(c_{ijt} - c_{kjt}, 0) \times Provision + \beta_5 \max(c_{kjt} - c_{ijt}, 0) \times Provision \\ & + \beta_6 Round + \beta_7 Round \times Provision + \beta_8 \bar{C}_{-i-kj,t} + \beta_9 \bar{C}_{-i-kj,t} \times Provision \\ & + \varepsilon_{ijt} \end{aligned} \tag{9}$$

where Y_{ijkt} is the number of punishment points assigned by individual i in group j to individual k at round t; β_0 is a constant; u_{0m} and u_{0i} are random intercepts at the matching group and individual level, respectively. The coefficient β_1 estimates the effect of a negative deviation of individual k's contribution compared to individual i's contribution on the number of punishment points assigned from individual i to individual k. The coefficient β_2 is analogous but for positive deviations. The coefficient β_1 is our estimate of negative reciprocity, that is pro-social punishment, while β_2 is an estimate for anti-social punishment. We depict estimates of β_1 and β_2 in Figure 5B. We also include the dummy $Provision$ and we interact the dummy with the negative and positive deviation variables. We additionally control for the time trend including the variable $Round$ and for the average contribution of the other two group members ($\bar{C}_{-i-kjt}$) as well as the interaction terms between these variables and $Provision$. We estimate this model both for the entire sample and for each attitude type separately. We report the results from model 9 in **Supplementary Table 7**.

To compare negative reciprocity across attitude types **(Figure 5a, Panels 2-4)**, we estimate a model similar to 9 including interaction terms for attitude types:

$$
\begin{aligned}
Y_{ijkt} = \ & \beta_0 + u_{0m} + u_{0i} + \beta_1 \max(c_{ijt} - c_{kjt}, 0) + \beta_2 \max(c_{kjt} - c_{ijt}, 0) + \beta_3 CC + \beta_4 OT \\
& + \beta_5 \max(c_{ijt} - c_{kjt}, 0) \times CC + \beta_6 \max(c_{kjt} - c_{ijt}, 0) \times CC \\
& + \beta_7 \max(c_{ijt} - c_{kjt}, 0) \times OT + \beta_8 \max(c_{kjt} - c_{ijt}, 0) \times OT + \beta_9 Round \\
& + \beta_{10} Round \times CC + \beta_{11} Round \times OT + \beta_{12} \bar{C}_{-i-kjt} + \beta_{13} \bar{C}_{-i-kjt} \times CC \\
& + \beta_{14} \bar{C}_{-i-kjt} \times OT + \varepsilon_{ijt}
\end{aligned}
\tag{10}
$$

where CC and OT are dummies that indicate whether the subject is classified in the attitude categories of *conditional cooperators* or *others*, respectively. We use *free riders* as the omitted category. We estimate this model separately for Maintenance and Provision. We report estimates of this model in **Supplementary Table 8**.

Figure 5b – Treatment comparisons in Partners with Punishment

To compare the size of the public good between Maintenance and Provision **(Figure 5b)**, we run linear mixed-effects models with random intercepts at the matching group level. Similar to Partners and Strangers, we estimate the following specification:

$$
PG_{jt} = \beta_0 + u_{0m} + \beta_1 Provision + \varepsilon_{jt} \tag{11}
$$

where PG_{jt} is the size of the public good in group j at round t; β_0 is a constant; u_{0m} is a random intercept at the matching group level. $Provision$ is a treatment dummy that takes value one for Provision and zero for Maintenance.

To compare the public good size between Partners with Punishment and Partners, we estimate the following specification:

$$PG_{jt} = \beta_0 + u_{0m} + \beta_1 Partners\ with\ Punishment + \varepsilon_{jt} \tag{12}$$

where PG_{jt} is the size of the public good in group j at round t; β_0 is a constant; u_{0m} is a random intercept at the matching group level. $Partners\ with\ Punishment$ is a treatment dummy that takes value one for Partners with Punishment and zero for Partners. We estimate the model separately for Maintenance and Provision. The regression results from models 11 and 12 are reported in **Supplementary Table 10**.

Reactions to received punishment

As a final step in our analysis, we investigate the effectiveness of punishment by analyzing whether the change in contribution from round *t - 1* to *t* is different in Maintenance and Provision given the same number of punishment points received in round *t - 1*. To compare Maintenance and Provision, we estimate the following model:

$$\begin{aligned} C_{ij,t} - C_{ij,t-1} = {} & \beta_0 + u_{0m} + u_{0i} + \beta_1 PunReceived_{ij,t-1} + \beta_2 Provision \\ & + \beta_3 PunReceived_{ij,t-1} \times Provision + \beta_4 Round + \beta_5 Round \times Provision \\ & + \varepsilon_{ijt} \end{aligned} \tag{13}$$

where $C_{ij,t} - C_{ij,t-1}$ is the change in contribution of individual i in group j from round $t-1$ to round t; β_0 is a constant; u_{0m} and u_{0i} are random intercepts at the matching group and individual level, respectively. The coefficient β_1 estimates the impact of the number of punishment points received at round $t-1$ on the subsequent change in contribution at round t. We also include the dummy $Provision$ and we interact the dummy with the variable $PunReceived_{ij,t-1}$. We additionally control for the time trend including the variable $Round$ as well as the interaction terms between this variable and $Provision$. To control for differential effects of pro-social and anti-social punishment, we run the above model separately for contributions that are below or above the average contribution of the group in a given round. The estimates from these models are reported in **Supplementary Table 11**.

Reactions to deviations of the average contribution of others from own contributions in Partners

To investigate whether contribution behavior differs across Maintenance and Provision in reaction to positive/negative deviations between the average contribution of others and own contributions in the previous period, similar to model 9 in Partners with Punishment we estimate the following linear mixed-effects model:

$$
\begin{aligned}
C_{ijt} = {} & \beta_0 + u_{0m} + u_{0i} + \beta_1 \max\left(\bar{C}_{-ij,t-1} - c_{ij,t-1}, 0\right) + \beta_2 \max\left(c_{ij,t-1} - \bar{C}_{-ij,t-1}, 0\right) \\
& + \beta_3 Provision + \beta_4 \max\left(\bar{C}_{-ij,t-1} - c_{ij,t-1}, 0\right) \times Provision \\
& + \beta_5 \max\left(c_{ij,t-1} - \bar{C}_{-ij,t-1}, 0\right) \times Provision + \beta_6 Round + \beta_7 Round \\
& \times Provision + \beta_8 c_{ij,t-1} + \beta_9 c_{ij,t-1} \times Provision + \varepsilon_{ijt}
\end{aligned}
\tag{14}
$$

where C_{ijt} is the effective contribution of individual i in group j at round t; β_0 is a constant; u_{0m} and u_{0i} are random intercepts at the matching group and individual level, respectively. The coefficient β_1 estimates the effect of a positive deviation of average effective contribution of the other group members compared to individual i's contribution in round $t-1$ on i's contribution in round t. The coefficient β_2 is analogous but for negative deviations. We also include the dummy $Provision$ and we interact the dummy with the positive and negative deviation variables. We additionally control for the time trend including the variable $Round$ and for the average contribution of individual i in round $t-1$ ($c_{ij,t-1}$) as well as the interaction terms between these variables and $Provision$. We report the results from model 14 in the main text and in **Supplementary Table 12.**

1.2 Robustness Checks

Robustness checks for elicited attitudes (Figure 3a)

To verify that our results on cooperation attitudes are robust, we perform two checks. In the first one, we do not classify participants but simply compare the effective average schedule (the vector a_i) between Maintenance and Provision. Recall that for each participant we have a vector a_i comprised of 21 effective contributions, one for each possible rounded average effective contribution of the other group members. We specify elements of the vector a_i as C_{ik}, where $k = 1, ..., 21$. We estimate the following linear mixed-effects model:

$$C_{ik} = \beta_0 + u_{0i} + \beta_1 \bar{C}_{-ik} + \beta_2 Provision + \beta_3 Provision \times \bar{C}_{-ik} + \varepsilon_{ik} \qquad (15)$$

where C_{ik} is the contribution of the individual i in entry k of the strategy method table. Our regressors are the average contribution of the others $\bar{C}_{-ik}$ in entry k, a treatment dummy $Provision$, and the interaction term between the average contribution of others and the treatment dummy. We also include a constant β_0 and a random intercept at the individual level u_{0i} .

We report the results of these estimates in **Supplementary Table 13**. We find a positive and highly significant coefficient $\hat{\beta}_2$, indicating that in Maintenance participants behave on average reciprocally, i.e., they cooperate more the higher the other group members' effective contributions. We further find a positive and highly significant coefficient $\hat{\beta}_3$ indicating that the reaction to an increase in average contribution of other group members is stronger in Provision than in Maintenance. This confirms the result of higher reciprocity in Provision than in Maintenance.

In our second robustness check, we use hierarchical clustering to classify participants into attitude types [5]. Hierarchical clustering allows to partition the data into subsets, so-called clusters, according to measures of proximity in behavior. The advantage of this method is that it groups data according to their similarity without making any ex-ante assumptions on how behavior looks like. As a measure of proximity between any two effective contribution schedules (a_i), we use the 'city block distance' measure [5]:

$$d_{ij} = \sum_{k=1}^{21} |x_{ik} - x_{jk}|$$

where d_{ij} is an index of proximity between any two effective contribution schedules, k indexes each entry in the effective contribution schedule, and x_{ik} indicates entry k for individual i. Using a different proximity measure (Euclidean distance), does not affect our results.

We then used an agglomerative method to create clusters according to our proximity measure. Agglomerative methods are probably the most widely used type of hierarchical methods. These methods start from *n* single-observation clusters and merge sequentially clusters until obtaining only one cluster with *n* observations. In particular, we use Ward's linkage[5] method in which the merger of two clusters is based on the minimization of an error term equivalent to the total within-cluster sum of squares, that is:

$$\min E = \sum_{m=1}^{M} E_m$$

where $m = 1, \ldots, M$ indexes the number of clusters and

$$E_m = \sum_{i=1}^{N} \sum_{k=1}^{21} |x_{ikm} - \bar{x}_{km}|$$

where $i = 1, \ldots, N$ indexes the number of observations (in our data one observation means one effective contribution schedule, a_i); k indexes each entry in the effective contribution schedule; x_{ikm} indicates entry k for individual i in cluster *m*; and $\bar{x}_{km}$ indicates the average entry k for cluster *m*. Clearly, at the start of the routine where we have *n* single-observation clusters, the error E is equal to zero and it increases as the routine starts merging observations to form clusters. The objective of the method is to merge observations to minimize the increase in E.

Finally, we used a formal method to assess the optimal number of clusters to partition our dataset. In particular, we use the Duda and Hart Je(2)/Je(1) and pseudo T-squared indexes, that indicate six clusters as optimal number in our dataset.

To label the six categories we plot the average effective contribution schedule (a_i) for each type classified according to the cluster analysis (the figure is available upon request). From visual observation of the average schedule, we label the six groups created in the cluster analysis as *strong conditional cooperators*, *weak conditional cooperators*, *selfish*, *altruists*, *midrange,* and *triangle contributors*. *Strong conditional cooperators* start out with a contribution of 0.3 when the effective contribution of others is equal to zero and increase their contribution to 18.3 when other group members' effective contribution is equal to twenty. *Weak conditional cooperators* start similarly with a contribution of 0.1 on average and increase to 12.7 when the other group members are fully cooperative. Subjects categorized as *selfish* contribute very low amounts for the entire average effective contribution schedule with a maximum of 0.25. *Altruists* are at the other end of the spectrum contributing very high amounts with a minimum of 18.7. *Midrange* exhibit a slightly decreasing contributing pattern with average effective contributions of 14.6 when the other group members contribute on average zero tokens and 10.5 when the others contribute on average twenty tokens. Finally, *triangle contributors* are hump-shaped with a contribution of 1.2 when the others contribute zero, a maximum at 7.6 when the others contribute ten tokens, and a contribution of 2.6 when the others are fully cooperative.

The distribution of attitude types classified in the cluster analysis is significantly different across Maintenance and Provision ($\chi^2(5) = 35.31$, $P < 0.001$). We find significantly less *strong* and *weak conditional cooperators* in Maintenance than Provision (32% vs. 39%; $\chi^2(1) = 3.93$, $P = 0.048$, and 7% vs. 20%; $\chi^2(1) = 18.36$, $P < 0.001$, respectively). We also find significantly more *selfish* (30% vs. 22%; $\chi^2(1) = 5.01$, $P = 0.025$) and *midrange* (13% vs. 7%; $\chi^2(1) = 11.23$, $P = 0.001$) in Maintenance than Provision. We find weak and no significant differences for *altruists* and *triangle contributors*, respectively (5% vs. 2%; $\chi^2(1) = 2.95$, $P = 0.086$; and 12% vs. 11%; $\chi^2(1) = 0.34$, $P = 0.560$). Overall, these results confirms weaker conditional cooperation in Maintenance compared to Provision.

Interestingly, if we compare the distribution of attitudes from our original classification with the one obtained from the cluster analysis, we find that 100% of participants classified as *free riders* according to the former criterion are classified as *selfish* in the latter. Furthermore, 92% of participants classified as *conditional cooperators* in the former are classified as either *strong* or *weak conditional cooperators* in the latter. Participants classified as *others* are mostly classified as *triangle contributors* or *midrange* (38% *triangle contributors,* 32% *midrange,* 14% *selfish,* 13% *altruists,* 2% *strong conditional cooperators*, and 1% *weak conditional cooperators*,). Overall, this shows high consistency with the classification method used in the main text.

<u>Robustness checks for estimated reciprocity (Figure 3b)</u>

To check the robustness of the results of different reciprocity between Maintenance and Provision in Strangers and Partners, we estimate finite mixture models. Following[6], we assume three types: *conditional cooperators* (CC) whose effective contribution depends on the average effective contribution of the other group members in the previous round, *strategic free riders* (STR) who contribute at the beginning but reduce their contributions over time no matter what the other group members do and *free riders* (FR) who contribute zero for all rounds.

We estimate two-limit Tobit models with limits at 0 and 20. The latent variable is the effective contribution of individual *i* in round *t*, C_{it}^{*}. For each type, it depends linearly on a set of variables:

CC: $C_{it}^{*} = \beta_0 + \beta_1 \bar{C}_{-i,t-1} + \beta_2 Round + \varepsilon_{it}$

STR: $C_{it}^{*} = \gamma_0 + \gamma_1 Round + \nu_{it}$

Effective contributions of *conditional cooperators* depend positively on the average effective contribution of the other group members in the previous round and negatively on a time trend (we expect $\beta_1 > 0$ and $\beta_2 < 0$). *Strategic free-riders* start with high effective contributions in the first rounds but then lower their effective contributions over time to exploit the other group members ($\gamma_1 < 0$). Hence, their behavior depends only on the time trend and not on others' effective contributions.

The relationship between the latent variable and the observed effective contribution for CC and STR is as follows:

$$C_{it} = \begin{cases} 0 & if \quad C_{it}^{*} \leq 0 \\ C_{it}^{*} & if \quad 0 < C_{it}^{*} < 20 \\ 20 & if \quad C_{it}^{*} \geq 0 \end{cases}$$

For free riders (FR):

$$C_{it} = 0 \quad \forall t$$

To take into account censoring, the maximum likelihood function is the combination of three estimation regimes, depending on the value of C_{it}:

Regime 1 ($C_{it} = 0$):

$$P(C_{it} = 0|i = CC) = \Phi\left(-\frac{\beta_0 + \beta_1 \bar{C}_{-i,t-1} + \beta_2 Round}{\sigma_1}\right)$$

$$P(C_{it} = 0|i = STR) = \Phi\left(-\frac{\gamma_0 + \gamma_1 Round}{\sigma_2}\right)$$

$$P(C_{it} = 0|i = FR) = 1$$

Regime 2 ($0 < C_{it} < 20$):

$$f(C_{it}|i = CC) = \frac{1}{\sigma_1}\phi\left(\frac{C_{it} - \beta_0 + \beta_1 \bar{C}_{-i,t-1} + \beta_2 Round}{\sigma_1}\right)$$

$$f(C_{it}|i = STR) = \frac{1}{\sigma_1}\phi\left(\frac{C_{it} - \gamma_0 + \gamma_1 Round}{\sigma_2}\right)$$

$$f(C_{it}|i = FR) = 0$$

Regime 3 ($C_{it} = 20$):

$$P(C_{it} = 20|i = CC) = 1 - \Phi\left(\frac{20 - \beta_0 + \beta_1 \bar{C}_{-i,t-1} + \beta_2 Round}{\sigma_1}\right)$$

$$P(C_{it} = 20|i = STR) = 1 - \Phi\left(\frac{20 - \gamma_0 + \gamma_1 Round}{\sigma_2}\right)$$

$$P(C_{it} = 20|i = FR) = 0$$

For subject i, the likelihood function is:

$$L_i = p_{CC} \prod_{t=1}^{T} P(C_{it} = 0|CC)^{I_{C_{it}=0}} f(C_{it}|CC)^{I_{0<C_{it}<20}} P(C_{it} = 20|CC)^{I_{C_{it}=20}} \quad +$$

$$p_{STR} \prod_{t=1}^{T} P(C_{it} = 0|STR)^{I_{C_{it}=0}} f(C_{it}|STR)^{I_{0<C_{it}<20}} P(C_{it} = 20|STR)^{I_{C_{it}=20}} \quad +$$

$$p_{FR} \prod_{t=1}^{T} P(C_{it} = 0|FR)^{I_{C_{it}=0}} f(C_{it}|FR)^{I_{0<C_{it}<20}} P(C_{it} = 20|FR)^{I_{C_{it}=20}}$$

where $I(.)$ is an indicator function, taking value 1 if the subscript is true and 0 otherwise.

In **Supplementary Table 14** we report the maximum likelihood estimations and the resulting estimated mixing proportions of types separately for Strangers and Partners. In both cases, the distribution of types deduced from posterior probabilities is significantly different between Provision and Maintenance (χ^2 (2) = 22.05, P < 0.001 and χ^2(2) = 16.78, P < 0.001 in Strangers and Partners, respectively). In particular, we find significantly more *conditional cooperators* (45% vs. 18%, χ^2(1) = 21.84, P < 0.001 and 55% vs. 30%, χ^2(1) = 10.23, P = 0.001 in Strangers and Partners, respectively) and significantly less *free riders* in Provision than in Maintenance (22% vs. 36%, χ^2(1) = 6.16, P = 0.013 and 5% vs. 25%, χ^2(1) = 12.55 and P < 0.001 in Strangers and Partners, respectively). In Strangers, we also find significantly less *strategic free-riders* in Provision than in Maintenance (33% vs. 46%, χ^2(1) = 0.48, P = 0.029), while this is not the case in Partners (40% vs. 45%, χ^2(1) = 0.41, P = 0.552).

1.3 Simulation Analysis

Each simulated contribution is derived by matching one randomly drawn attitude and one randomly drawn belief from our sample. Each simulated contribution $\tilde{c}^F$ is therefore given by:

$$\tilde{c}^F = a_i^F\left(b_j^F\right) \tag{16}$$

where the superscript F indicates the sample (P for Provision and M for Maintenance) from which each component is randomly drawn.

Our procedure comprises the following steps which are also summarized in the diagram below:

a. Fix a sample size n (observations per game).

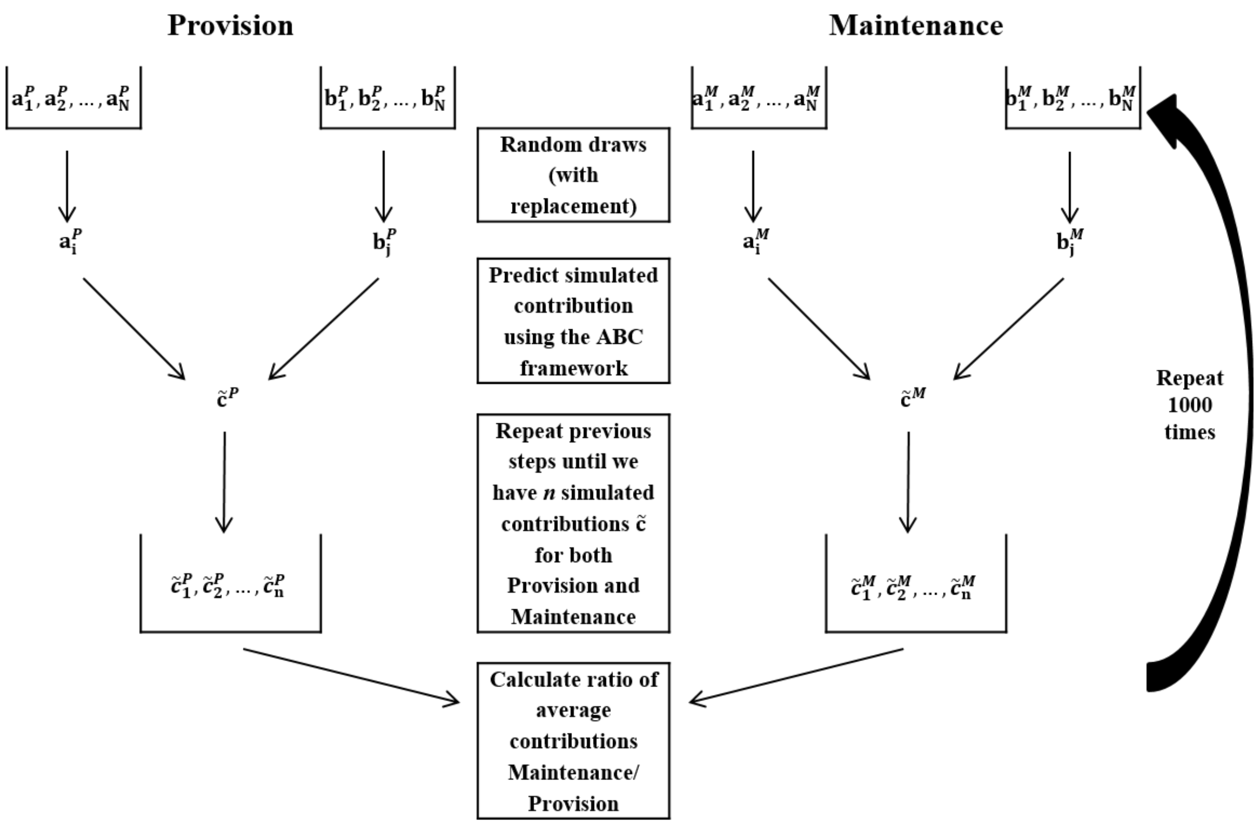
b. Set $F = P$ for a_i^F and b_j^F, and randomly draw (with replacement) one a_i^P and one b_j^P from the Provision distribution of attitudes and beliefs, respectively. Use equation (16) to calculate $\tilde{c}^P$. Repeat this step until we have n simulated contributions.

c. Redo step b. setting $F = M$ for all components, i.e., a_i^M and b_j^M. Use equation (16) to calculate $\tilde{c}^M$. Repeat this step until we have n simulated contributions.

d. Compare the two samples of size n derived from b. (Provision) and c. (Maintenance) by calculating the ratio of average effective contributions between Maintenance and Provision.

e. Repeat steps b. - d. 1000 times.

Figure 4 in the main text reports simulation results of 1000 random samples of size n = 60, the median sample size in previous related literature (see refs. 14-23 in the main text). As a robustness check, we also ran a simulation with a sample size of n = 100.The results from this simulation are shown in **Supplementary Figure 4**.


Provision
Maintenance
$\mathbf{a}_1^P, \mathbf{a}_2^P, \ldots, \mathbf{a}_N^P$
$\mathbf{b}_1^P, \mathbf{b}_2^P, \ldots, \mathbf{b}_N^P$
$\mathbf{a}_1^M, \mathbf{a}_2^M, \ldots, \mathbf{a}_N^M$
$\mathbf{b}_1^M, \mathbf{b}_2^M, \ldots, \mathbf{b}_N^M$
Random draws (with replacement)
$\mathbf{a}_i^P$
$\mathbf{b}_j^P$
$\mathbf{a}_i^M$
$\mathbf{b}_j^M$
Predict simulated contribution using the ABC framework
$\tilde{\mathbf{c}}^P$
$\tilde{\mathbf{c}}^M$
Repeat 1000 times
Repeat previous steps until we have *n* simulated contributions $\tilde{\mathbf{c}}$ for both Provision and Maintenance
$\tilde{c}_1^P, \tilde{c}_2^P, \ldots, \tilde{c}_n^P$
$\tilde{c}_1^M, \tilde{c}_2^M, \ldots, \tilde{c}_n^M$
Calculate ratio of average contributions Maintenance/ Provision

1.4 Experimental Instructions

Here, we document the experimental instructions we used in the experiments. We document the exact texts used in Provision and show the changed texts used in Maintenance in *[italics]*.

<u>Part 1 – Introduction to Provision [Maintenance]</u>

Instructions

You are participating in a study in which you will earn some money. The amount will depend on the outcome of a game you will play. The amount of money which you earned with your decisions will be paid to you in cash at the end of the experiment. We will not speak of Pounds during the experiment, but rather of points. At the end, the total number of points you have earned will be converted to Pounds at the following rate:

1 point = £0.2

These instructions are solely for your private information. **You are not allowed to communicate during the experiment.** If you have any questions, please raise your hand. A member of the experimental team will come to you and answer them in private.

All participants will be divided into groups of four members. **Only the experimenters will know who is in which group.**

<u>The decision situation</u>

We first introduce you to the basic decision situation. Then, you will complete a pre-study questionnaire on the screen in front of you, which is intended to help you understand the decision situation.

In each group, every member has to decide the allocation of 20 tokens. You can put these 20 tokens into your **private account** or you can put some or all of them into a **project**. [*In each group, there are 80 tokens in a project. You can withdraw up to 20 tokens from the* ***project*** *and put them into your* ***private account*** *or you can leave them fully or partially in the* ***project.***] The other three members of your group have to make the same decision.

<u>Your income from the private account</u>

You will earn 1 point for each token you put into your private account. For example, if you put all 20 tokens into your private account, your income from your private account would be 20 points. If you put 6 tokens into your private account, your income from this account would be 6 points. **No one except you earns anything from tokens you put in your private account.**

<u>Your income from the project</u>

Each group member will profit equally from the amount you or any other group member put into [*leave in*] the project. The income for each group member from the **project** will be determined as follows:

Income from the project *= 0.4 × (sum of contributions)* [*0.4 × (80 - sum of all tokens withdrawn from the project)*]

If, for example, the sum of all contributions to the project [*tokens withdrawn from the project*] by you and your other group members is 60 [*20*] tokens, then you and each other member of your group would earn 60 [*80-20*] × 0.4 = 24 points out of the project. If the four members of the group contribute [*withdraw*] a total of 10 [*70*] tokens to [*from*] the project, you and the other members of your group would each earn 10 [*80-70*] × 0.4 = 4 points.

Total income

Your total income is the sum of your income from your private account and from the project:

Your Total Income *= Income from your private account + Income from the project*

=20 – your contribution to the project + 0.4 × sum of all contributions to the project

[= Tokens withdrawn from the project by you + 0.4 × (80-sum of all tokens withdrawn from the project)

Comprehension test

Please answer all the following questions, to help you understand the determination of your income.

1. Each group member has 20 tokens. Assume that none of the four group members (including you) contributes anything to the project. [*There are 80 tokens in the project. Assume that everyone in your group withdraws 20 tokens from the project.*]

a) What will your total income (in points) be?

b) What will the total income (in points) of each of the other group members be?

2. Each group member has 20 tokens. You contribute 20 tokens in the project. Each of the other three members of the group also contributes 20 tokens to the project. [*There are 80 tokens in the project. You withdraw 0 tokens from the project. Each of the other three members of the group also withdraws 0 tokens from the project.*]

a) What will your total income (in points) be?

b) What will the total income (in points) of each of the other group members be?

3. Each group member has 20 tokens. The other three members contribute a total of 30 tokens to the project. [*There are 80 tokens in the project. The other three members withdraw 30 tokens from the project.*]

a) What will your total income (in points) be, if - in addition to the 30 tokens contributed by others - you contribute 0 tokens to the project? [*What will your total income (in points) be, if - in addition to the 30 tokens withdrawn by others - you withdraw 20 tokens from the project?]*

b) What will your total income (in points) be, if - in addition to the 30 tokens contributed by others - you contribute 8 tokens to the project? [*What will your total income (in points) be, if - in addition to the 30 tokens withdrawn by others - you withdraw 12 tokens from the project?*]

c) What will your total income (in points) be, if - in addition to the 30 tokens contributed by others - you contribute 15 tokens to the project? [*What will your total income (in points) be, if - in addition to the 30 tokens withdrawn by others - you withdraw 5 tokens from the project?]*

4. Each group member has 20 tokens. Assume you invest 8 tokens to the project. [*There are 80 tokens in the project. Assume you withdraw 12 tokens from the project.*]

a) What will your total income (in points) be, if the other group members - in addition to your 8 tokens - contribute another 7 tokens to the project? [*What will your total income (in points)? be, if the other group members - in addition to your 12 tokens - withdraw another 53 tokens from the project.*]

b) What will your total income (in points) be, if the other group members - in addition to your 8 tokens - contribute another 12 tokens to the project? [*What will your total income (in points) be, if the other group members - in addition to your 12 tokens - withdraw another 48 tokens from the project?*]

c) What will your total income (in points) be, if the other group members - in addition to your 8 tokens - contribute another 22 tokens to the project? [*What will your total income (in points) be, if the other group members - in addition to your 12 tokens - withdraw another 38 tokens from the project?*]

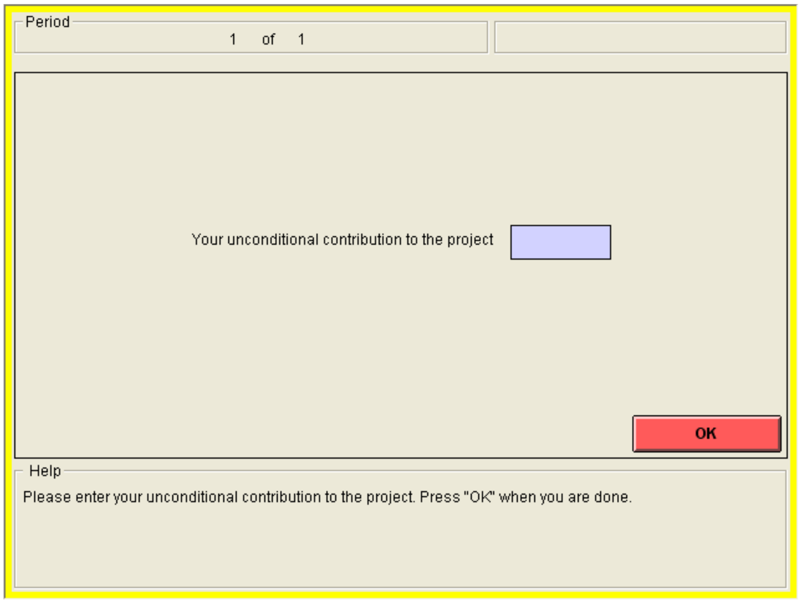
Part 2 – Strategy method experiment (elicitation of attitudes)

The Experiment

The experiment is based on the decision situation just described to you, conducted **once.** You will enter your decisions in the screen in front of you.

As you know, you will have 20 tokens at your disposal. You can put them into a private account or into a project. [*As you know, there are 80 tokens in a project. You can withdraw tokens from the project which will be automatically placed into your private account or you can leave them in the project.*] Each subject has to make **two types** of decisions in this experiment, which we will refer to below as the **"unconditional contribution [*withdrawal*]"** and the **"contribution [*withdrawal*] table"**.

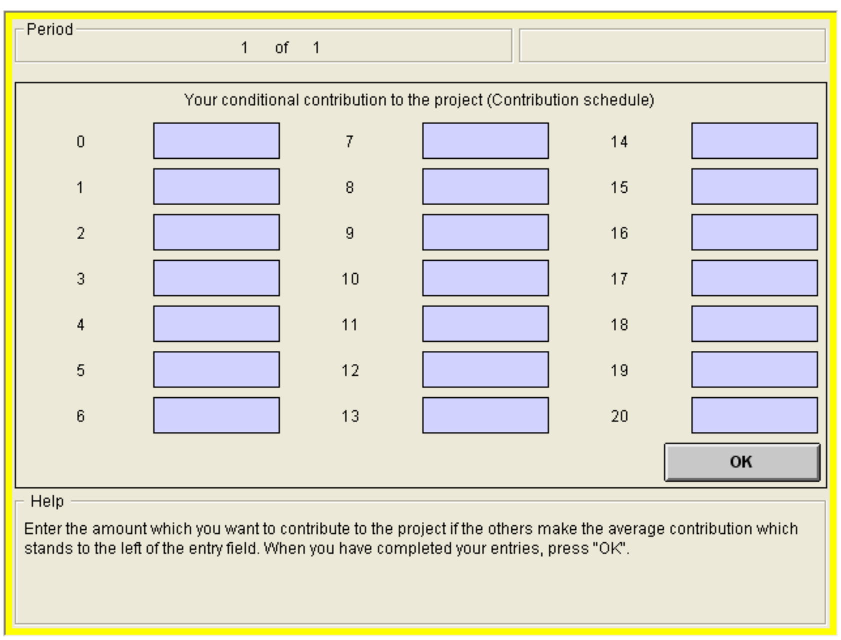
- In the **unconditional** contribution [*withdrawal*] you simply decide how many of the 20 [*80*] tokens you want to put in [*withdraw from*] the **project**. Please indicate your contribution [*withdrawal*] in the following screen (*screenshot taken from the Provision treatment only*):



After you have determined your unconditional contribution [*withdrawal*], please click “OK”.

- Your second task is to fill in a “contribution [*withdrawal*] table” where you indicate how many tokens **you want to contribute [*withdraw*]** to [*from*] the project **for each possible average contribution [*withdrawal*] of the other group members** (rounded to the next integer). Here, you can condition your contribution [*withdrawal*] on that of the other group members. This will be immediately clear to you if you take a look at the following table.

  This table will be presented to you in the experiment (*screenshot taken from the Provision treatment only*):



The numbers to the left of the blue cells are the possible (rounded) average contributions [*withdrawals*] of the **other** group members to the project. You have to insert how many tokens you want to contribute to [*withdraw from*] the project into each input box – conditional on the indicated average contribution [*withdrawal*] by the other members of your group. **You must enter a number between 0 and 20 inclusive in each input box**. For example, you have to indicate how much you contribute to [*withdraw from*] the project if the others contribute [*withdraw*] 0 tokens on average to [*from*] the project; how much you contribute [*withdraw*] if the others contribute [*withdraw*] 1, 2, or 3 tokens on average; etc. Once you have made an entry in each input box, click "OK".

After all participants of the experiment have made an unconditional contribution [*withdrawal*] and have filled in their contribution [*withdrawal*] table, a random mechanism will select one member from every group. For **this** group member, it is his **contribution** [***withdrawal***] **table** that will determine his actual contribution [*withdrawal*]; whereas, for the **other three** group members, it is their **unconditional contributions** [***withdrawals***] that will determine their actual contributions [*withdrawals*]. You will not know whom the random mechanism will select when you make your unconditional contribution [*withdrawal*] and fill in your contribution [*withdrawal*] table. You must therefore think carefully about both decisions because either could determine your actual contribution [*withdrawal*]. Two examples should make this clear.

EXAMPLE 1: Suppose that **the random mechanism selects you;** and that the other three group members made unconditional contributions [*withdrawals*] of 0, 2, and 4 [*20, 18, and 16*] tokens, respectively. The average contribution [*withdrawal*] of these three group members is, therefore, 2 [*18*] tokens. If you indicated in your contribution [*withdrawal*] table that you will contribute [*withdraw*] 1 [*19*] token[*s*] if the others contribute [*withdraw*] 2 [*18*] tokens on average, then the total contribution to the project is given by 0+2+4+1=7 [*the total number of tokens left in the project is given by 80-(20+18+16+19)=7*] tokens. Each group member would, therefore, earn 0.4×7=2.8 points from the project plus their respective income from their own private account. If, instead, you indicated in your contribution [*withdrawal*] table that you would contribute [*withdraw*] 19 tokens [*1 token*] if the others contribute [*withdraw*] 2 [*18*] tokens on average, then the total contribution of the group to the project would be given by 0+2+4+19=25 [*the total number of tokens left in the project would be given by 80-(20+18+16+1)=25*] tokens. Each group member would earn 0.4×25=10 points from the project plus their respective income from their own private account.

EXAMPLE 2: Suppose **that the random mechanism does not select you;** and that your unconditional [*withdrawal*] contribution is 16 [*4*] tokens, while those of the other two group members not selected by the random mechanism are 18 [*2*] and 20 [*0*] tokens, respectively. Your average unconditional contribution [*withdrawal*] and that of these two other group members is, therefore, 18 [*2*] tokens. If the group member whom the random mechanism did select indicates in her contribution [*withdrawal*] table that she will contribute [*withdraw*] 1 [19] token[s] if the other three group members contribute [*withdraw*] on average 18 [*2*] tokens, then the total contribution of the group to the project is given by 16+18+20+1=55 [*the total number of tokens left in the project is given by 80-(4+2+0+19)=55*] tokens. Each group member will therefore earn 0.4×55=22 points from the project plus their respective income from their own private account. If, instead, the randomly selected group member indicates in her contribution [*withdrawal*] table that she contributes [*withdraws*] 19 [*1*] if the others contribute [*withdraw*] on average 18 [*2*] tokens, then the total contribution of the group to the project is 16+18+20+19=73 [*the total number of tokens left in the project is 80-(4+2+0+1)=73*] tokens. Each group member would therefore earn 0.4×73=29.2 points from the project plus their respective income from their own private account.

The random selection of the group member whose contribution [***withdrawal***] **table will determine his actual contribution** [***withdrawal***] will be made as follows. Each group member is assigned a **Group**

Member ID between 1 and 4, which denote his/her number inside his group. Moreover, one participant was randomly selected at the very beginning of the experiment. This participant will draw a ball from an urn **after** all participants have made their unconditional contribution [*withdrawal*] and have filled out their contribution [*withdrawal*] table. Each ball in the urn has a different colour and each colour corresponds to a **Group Member ID**: orange=1, blue=2, yellow=3, green=4. The resulting number will be entered into the computer. If the randomly selected participant draws the Group Member ID that was assigned to you, then your contribution [*withdrawal*] table will determine your contribution [*withdrawal*] and their unconditional contributions [*withdrawals*] will determine the contribution [*withdrawals*] of the other group members. Otherwise, your unconditional [*withdrawal*] contribution determines your contribution [*withdrawal*].

Part 3 – Direct-response experiments

1) *One-shot*

Instructions

You are now taking part in a second experiment. The money you earn in this experiment will be added to what you earned in the first one. As before, we will not speak of Pounds during the experiment, but rather of points. At the end, the number of points you have earned will be converted to Pounds at the following rate:

1 point=£0.2

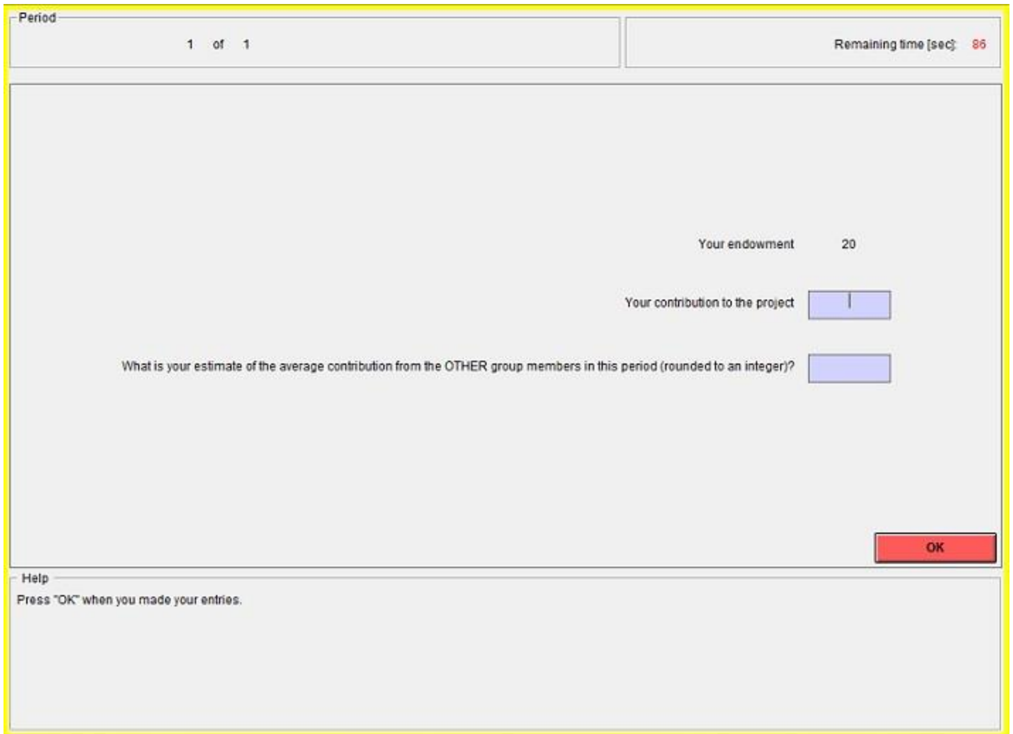
As in the previous experiment you are in a group composed by 4 people. However, the composition of the group is entirely new. None of the participants who were in your group in the second experiment will be in your group in this experiment.

The decision situation is the same as the one described on the first instruction sheet of the previous experiment. Each member of the group has to decide about the usage of the 20 tokens. [*In each group there are 80 tokens in a project.]* You can put these 20 tokens into your private account or you can put them fully or partially into a project. [*You can withdraw up to 20 tokens from the project or you can leave them fully or partially in the project.*] Each token you do not put into the project [*withdraw from the project*] is automatically placed into your private account. Your income will be determined in the same way as before.

Reminder:

Your Total Income *= Income from your private account + Income from the project*
=20 – your contribution to the project + 0.4 × sum of all contributions to the project
[=Tokens withdrawn from the project by you +0.4 × (80-sum of all tokens withdrawn from the project)]

The decision screen looks like this (*screenshot taken from the Provision treatment only*):



1. First you have to **decide on your contribution to [*withdrawal from*] the project**, that is, you have to decide how many of the 20 tokens you want to contribute to the project, and how many tokens you want to put into your private account. [*you have to decide how many of the 80 tokens you want to withdraw from the project and put into your private account*.] Each other member of your group has to make the corresponding decision. This is the only contribution [*withdrawal*] decision that you or they make in this experiment. There is **no contribution** [***withdrawal***] **table**.

2. Afterwards you have to estimate the average contribution to [*withdrawal from*] the project (rounded to an integer) of the other three group members. You will be paid for the accuracy of your estimate:
   - If your estimate is exactly right (that is, if your estimate is **exactly** the same as the actual average contribution [*withdrawal*] of the other group members), you will get **3 points** in addition to your other income from the experiment.
   - If your estimate deviates by one point from the correct result, you will get 2 additional points.
   - A deviation by 2 points still earns you 1 additional point.
   - If your estimate deviates by 3 or more points from the correct result, you will not get any additional points.

2) *Strangers*

Instructions

You are now taking part in a second experiment. The money you earn in this experiment will be added to what you earned in the first one. As before, we will not speak of Pounds during the experiment, but rather of points. At the end, the number of points you have earned will be converted to Pounds at the following rate:

1 point=£0.2

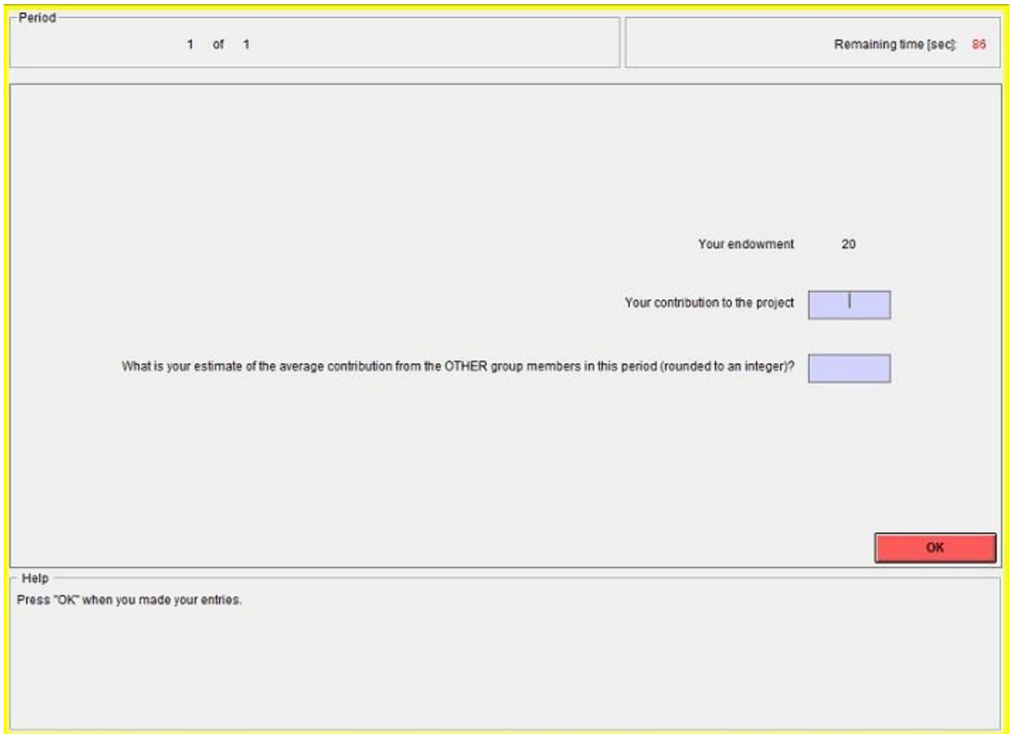
This experiment lasts **several rounds**, in which you and the other group members have to make decisions. You will not know how many rounds the experiment will last and will be told when the experiment is finished. As in the previous experiment, every group consists of **4 people**. The formation of the group changes at random after every round. **So your group will typically consist of different people every round**.

The decision situation is the same as the one described on the first instruction sheet of the previous experiment. Each member of the group has to decide about the usage of the 20 tokens. [*In each group there are 80 tokens in a project.]* You can put these 20 tokens into your private account or you can put them fully or partially into a project. [*You can withdraw up to 20 tokens from the project or you can leave them fully or partially in the project.*] Each token you do not put into the project [*withdraw from the project*] is automatically placed into your private account. Your income will be determined in the same way as before.

Reminder:

Your Total Income *= Income from your private account + Income from the project*
=20 – your contribution to the project + 0.4 × sum of all contributions to the project
[=Tokens withdrawn from the project by you +0.4 × (80-sum of all tokens withdrawn from the project)]

The decision screen looks like this (*screenshot taken from the Provision treatment only*):



1. First you have to **decide on your contribution to [*withdrawal from*] the project**, that is, you have to decide how many of the 20 tokens you want to contribute to the project, and how many tokens you want to put into your private account. [*you have to decide how many of the 80 tokens you want to withdraw from the project and put into your private account*.] Each other member of your group has to make the corresponding decision. This is the only contribution [*withdrawal*] decision that you or they make in this experiment. There is **no contribution** [***withdrawal***] **table**.

2. Afterwards you have to estimate the average contribution to [*withdrawal from*] the project (rounded to an integer) of the other three group members. You will be paid for the accuracy of your estimate:
   - If your estimate is exactly right (that is, if your estimate is **exactly** the same as the actual average contribution [*withdrawal*] of the other group members), you will get **3 points** in addition to your other income from the experiment.
   - If your estimate deviates by one point from the correct result, you will get 2 additional points.
   - A deviation by 2 points still earns you 1 additional point.
   - If your estimate deviates by 3 or more points from the correct result, you will not get any additional points.

3. You will receive information about the outcome at the end of each round.

3) *<u>Partners</u>*

Instructions

You are now taking part in a second experiment. The money you earn in this experiment will be added to what you earned in the first one. As before, we will not speak of Pounds during the experiment, but rather of points. At the end, the number of points you have earned will be converted to Pounds at the following rate:

1 point=£0.2

This experiment lasts **several rounds**, in which you and the other group members have to make decisions. You will not know how many rounds the experiment will last and will be told when the experiment is finished.

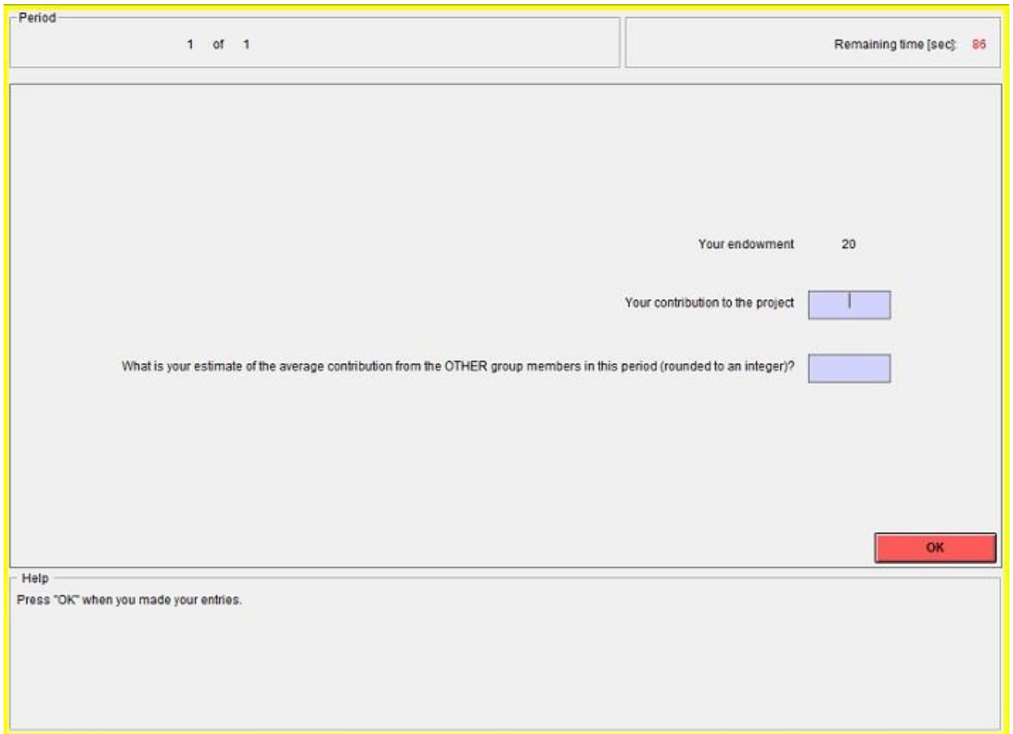
As in the previous experiment, every group consists of **4 people**. However, the composition of the group is entirely new. None of the participants who were in your group in the first experiment will be in your group in this experiment. You and the other three group members will **remain in this same group throughout the entire experiment. So your group will consist of the same people every round.**

The decision situation is the same as the one described on the first instruction sheet of the previous experiment. Each member of the group has to decide about the usage of the 20 tokens. [*In each group there are 80 tokens in a project.]* You can put these 20 tokens into your private account or you can put them fully or partially into a project. [*You can withdraw up to 20 tokens from the project or you can leave them fully or partially in the project.*] Each token you do not put into the project [*withdraw from the project*] is automatically placed into your private account. Your income will be determined in the same way as before.

Reminder:

Your Total Income *= Income from your private account + Income from the project*
=20 – your contribution to the project + 0.4 × sum of all contributions to the project
[=Tokens withdrawn from the project by you +0.4 × (80-sum of all tokens withdrawn from the project)]

The decision screen looks like this (*screenshot taken from the Provision treatment only*):



1. First you have to **decide on your contribution to [*withdrawal from*] the project**, that is, you have to decide how many of the 20 tokens you want to contribute to the project, and how many tokens you want to put into your private account. [*you have to decide how many of the 80 tokens you want to withdraw from the project and put into your private account*.] Each other member of your group has to make the corresponding decision. This is the only contribution [*withdrawal*] decision that you or they make in this experiment. There is **no contribution** [***withdrawal***] **table**.

2. Afterwards you have to estimate the average contribution to [*withdrawal from*] the project (rounded to an integer) of the other three group members. You will be paid for the accuracy of your estimate:
   - If your estimate is exactly right (that is, if your estimate is **exactly** the same as the actual average contribution [*withdrawal*] of the other group members), you will get **3 points** in addition to your other income from the experiment.
   - If your estimate deviates by one point from the correct result, you will get 2 additional points.
   - A deviation by 2 points still earns you 1 additional point.
   - If your estimate deviates by 3 or more points from the correct result, you will not get any additional points.

3. You will receive information about the outcome at the end of each round.

4) *Partners with Punishment*

Instructions

You are now taking part in a second experiment. The money you earn in this experiment will be added to what you earned in the first one. As before, we will not speak of Pounds during the experiment, but rather of points. At the end, the number of points you have earned will be converted to Pounds at the following rate:

1 point=£0.02

This experiment lasts **several rounds**, in which you and the other group members have to make decisions. You will not know how many rounds the experiment will last and will be told when the experiment is finished.

As in the previous experiment, every group consists of **4 people**. You and the other three group members will **remain in this same group throughout the entire experiment**. **So your group will consist of the same people every round.**

The decision situation is the same as the one described on the first instruction sheet of the previous experiment. Each member of the group has to decide about the usage of the 20 tokens. [*In each group there are 80 tokens in a project.]* You can put these 20 tokens into your private account or you can put them fully or partially into a project. [*You can withdraw up to 20 tokens from the project or you can leave them fully or partially in the project.*] Each token you do not put into the project [*withdraw from the project*] is automatically placed into your private account. Your income will be determined in the same way as before.

Reminder:

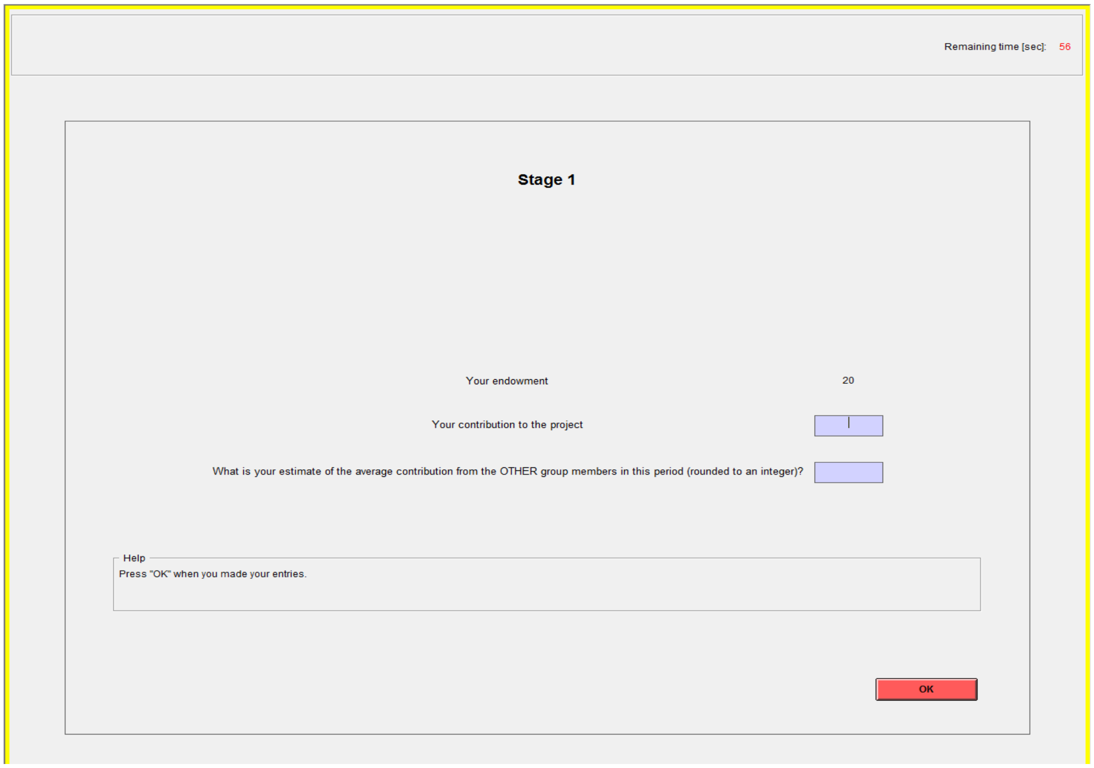
Your Total Income *= Income from your private account + Income from the project*
= 20 – your contribution to the project + 0.4 × sum of all contributions to the project
[=Tokens withdrawn from the project by you +0.4 × (80-sum of all tokens withdrawn from the project)]

The Experiment

Each round consists of **two stages**. In the first stage you will be endowed with tokens and have to decide how many tokens you would like to contribute to a project. [*In the first stage a project is endowed with tokens and you have to decide how many tokens you would like to withdraw from the project.*] In the second stage you will be informed about the contributions [*withdrawals*] of the other three group members. You will then decide whether or how much to reduce their earnings from the first stage by distributing points to them.

STAGE 1

The decision screen looks like this (*screenshot taken from the Provision treatment only*):

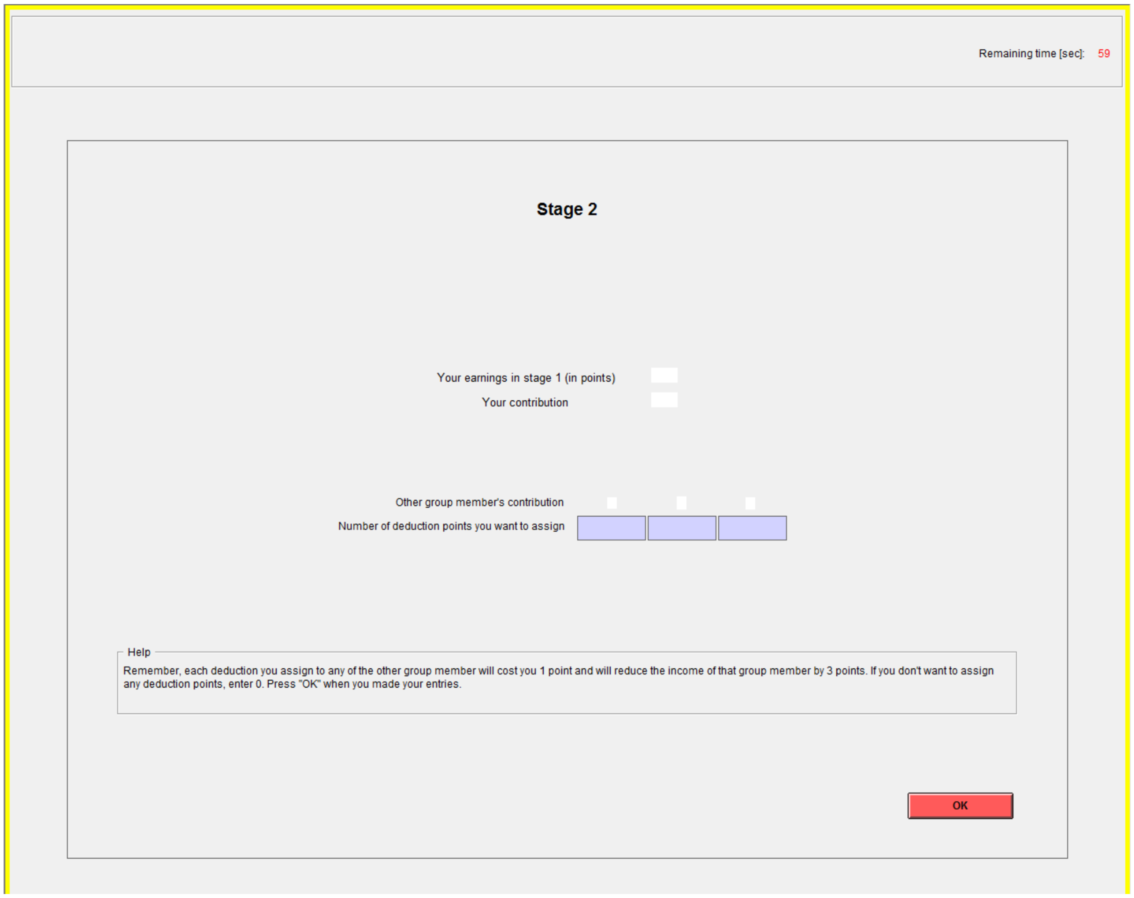


2. First you have to **decide on your contribution to [*withdrawal from*] the project**, that is, you have to decide how many of the 20 tokens you want to contribute to the project, and how many tokens you want to put into your private account. [*you have to decide how many of the 80 tokens you want to withdraw from the project and put into your private account*.] Each other member of your group has to make the same decision.
3. Afterwards you have to estimate the average contribution to [*withdrawal from*] the project (rounded to an integer) of the other three group members. You will be paid for the accuracy of your estimate:
   - If your estimate is exactly right (that is, if your estimate is **exactly** the same as the actual average contribution [*withdrawal*] of the other group members), you will get **3 points** in addition to your other income from the experiment.
   - If your estimate deviates by one point from the correct result, you will get 2 additional points.
   - A deviation by 2 points still earns you 1 additional point.
   - If your estimate deviates by 3 or more points from the correct result, you will not get any additional points.

After that the first stage is over and the second stage begins.

STAGE 2

In the second stage you will learn your income from the first stage and you will see how much each group member contributed to [*withdrew from*] the project. Moreover, in this stage you can decide whether to **decrease** the income of each other group member by assigning **deduction points**. The other group members can also decrease your income if they wish to. This is apparent from the input screen of the second stage displayed below:



Your income and your contribution [*withdrawal*] from the first stage are displayed **in the first two rows.** The contributions [*withdrawal*] of the other group members are shown in the three columns below. Note that the order in which others' contributions [*withdrawals*] are displayed will be determined at random in every round. The contribution [*withdrawal*] in the first column, for example, could represent a different group member in different rounds. The same holds true for the second and third column.
You will have to decide how many deduction points to assign to **each** of the other three group members. You must enter a number for each of them. If you do not wish to change the income of a specific group member then you must enter 0. You can **assign up to 5 points to each group member**.

You will incur costs from assigning deduction points. Every deduction point you assign costs you 1 point. For example, suppose you assign 2 deduction points to one member, this costs you 2 points; if, in addition, you assign 4 deduction points to another member this costs you an additional 4 points. Suppose further that you assign 0 deduction points to the third member. In total you will have assigned 6 points and your **total costs** therefore amount to 6 points.

If you assign 0 deduction points to a particular group member (i.e., enter "0"), you will not alter his or her income. However, if you assign **one deduction point** to a group member you will **decrease** the income of this group member by **3 points**. If you assign a group member **2 deduction points** you will **decrease** the group member's income by **6 points**, and so on. Each deduction point that you assign to another group member will reduce his or her income by 3 points. Similarly, each deduction point assigned to you by another group member will reduce your first stage income by three points:

Costs of received deduction points = 3 × Sum of received deduction points

How much the income at the second stage is decreased depends on the sum of deduction points received. For instance, if somebody receives a total of 3 deduction points (from all other group members), his or her income would be decreased by 9 points. If somebody receives a total of 4 deduction points, his or her income is reduced by 12 points.

There is one exception to this rule. If the cost of received deduction points exceeds the group member's first stage income, his or her first stage income will be reduced to zero. However, even in this case the group member must still incur the costs of any deduction points he or she assigned.

For each round, your total income from the two stages is therefore calculated as follows:

EITHER

Your income from the first stage is greater than or equal to the cost of received deduction points:

Total income = Income from the first stage – 3 × (sum of received deduction points) –
– sum of deduction points you have assigned

OR

Your income from the first stage is less than the cost of received deduction points:

Total income = 0 – sum of deduction points you have assigned

Please note that your income in points at the end of the second stage can be negative if the costs of your assigned points exceed your income from the first stage minus the income reduction by the received deduction points. You can, however, avoid such losses with certainty through your own decisions!

After all participants have made their decision, the results from the round including your final income from that round will be displayed. After you have viewed the income screen the round is over and the next round begins.

2. Supplementary References

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3. Supplementary Tables

Supplementary Table 1 (support for Figure 2, all panels)

Panel A: Public Good Size

	One-shot			Strangers			Partners		
	M	P		M	P		M	P	
Round 1	23.83 (16.00)	32.65 (13.81)	P = 0.014	22.69 (13.48)	29.53 (14.93)	P = 0.059	27.70 (14.07)	41.30 (14.94)	P = 0.005
Round 1-9				10.39 (9.61)	15.63 (10.73)	*P* = 0.053	14.83 (14.85)	23.69 (12.58)	*P* = 0.008
Round 10-18				5.65 (9.06)	5.21 (6.49)	*P* = 0.831	8.18 (13.17)	12.63 (12.38)	*P* = 0.177
Round 19-27				4.88 (8.31)	3.77 (6.02)	*P* = 0.541	8.69 (14.57)	14.31 (16.79)	*P* = 0.177
All rounds	23.83 (16.00)	32.65 (13.81)	*P* = 0.014	6.97 (8.99)	8.20 (7.75)	*P* = 0.503	10.56 (14.20)	16.87 (13.91)	*P* = 0.035

Panel B: Beliefs

	One-shot			Strangers			Partners		
	M	P		M	P		M	P	
Round 1	7.76 (5.82)	9.62 (5.32)	*P* = 0.005	6.70 (5.92)	8.71 (5.77)	*P* = 0.006	7.03 (6.28)	11.06 (5.91)	*P* < 0.001
Round 1-9				3.17 (3.13)	5.66 (4.07)	*P* = 0.002	4.13 (4.51)	7.49 (4.32)	*P* < 0.001
Round 10-18				1.04 (2.05)	1.72 (2.02)	*P* = 0.232	1.98 (3.36)	3.61 (3.65)	*P* = 0.059
Round 19-27				0.82 (1.83)	1.02 (1.82)	*P* = 0.632	1.94 (3.46)	3.81 (4.56)	*P* = 0.079
All rounds	7.76 (5.82)	9.62 (5.32)	*P* = 0.005	1.68 (2.34)	2.80 (2.64)	*P* = 0.030	2.68 (3.78)	4.97 (4.18)	*P* = 0.004

Supplementary Table 1 | Descriptive statistics and tests on the size of the public good (Panel A) and on beliefs (Panel B). Panel A: shown is the average (std. dev.) size of the public good in all conditions. Standard deviations are calculated using differences across groups within a period, averaged across periods. **Panel B**: shown are the participants' average (std. dev.) beliefs about the average effective contributions of the other group members. Standard deviations are calculated using differences across individuals within a period, averaged across periods. M = Maintenance, P = Provision. *P* values are based on two-sided t-tests for One-shot and the first round of Strangers and Partners. All the remaining *P* values are from linear mixed-effects models with random intercepts at the matching group level. Further details are in the Supplementary Analysis.

Supplementary Table 2 (support for Figure 2, Panels 2-3)

	Maintenance vs. Provision		Strangers vs. Partners	
	(1) Strangers	(2) Partners	(3) Maintenance	(4) Provision
Provision	1.230	6.309^{**}		
1 if Provision, 0 otherwise	(1.837)	(2.987)		
Partners			3.591	8.670^{***}
1 if Partners, 0 otherwise			(3.781)	(2.999)
Constant	6.973^{***}	10.56^{***}	6.973^{**}	8.204^{***}
	(1.299)	(2.112)	(3.188)	(2.528)
N	432	1080	756	756

Supplementary Table 2 | Comparing public good size between Maintenance and Provision, and between Strangers and Partners. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 - Equations 1-2). Dependent variable: public good size. Random intercepts are included for matching groups. Models (1) and (2) compare the public good size between Maintenance and Provision separately for Strangers and Partners. Models (3) and (4) compare the public good size between Strangers and Partners separately for Maintenance and Provision. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 3 (support for Figure 3b, all panels)

Panel A: Strangers				
	(1) All	(2) CC	(3) FR	(4) OT
Provision	-0.019	0.302	-0.706**	-0.197
1 if Provision, 0 otherwise	(0.383)	(0.539)	(0.283)	(1.079)
$\bar{C}_{-ij,t-1}$	0.172***	0.254***	0.038*	0.222***
	(0.020)	(0.033)	(0.021)	(0.046)
Provision × $\bar{C}_{-ij,t-1}$	0.257***	0.228***	0.190***	0.238***
	(0.028)	(0.043)	(0.033)	(0.073)
Round	-0.044***	-0.069***	-0.003	-0.056***
	(0.007)	(0.011)	(0.007)	(0.016)
Provision × Round	-0.022**	-0.017	0.045***	-0.093***
	(0.010)	(0.015)	(0.012)	(0.026)
Constant	1.920***	2.191***	0.138	3.589***
	(0.265)	(0.398)	(0.178)	(0.676)
N	6656	3172	1898	1586
Panel B: Partners				
	(1) All	(2) CC	(3) FR	(4) OT
Provision	-0.407	0.171	-0.623	-1.576
1 if Provision, 0 otherwise	(0.549)	(0.636)	(1.212)	(1.498)
$\bar{C}_{-ij,t-1}$	0.420***	0.621***	0.292***	0.202***
	(0.030)	(0.043)	(0.048)	(0.075)
Provision × $\bar{C}_{-ij,t-1}$	0.217***	0.096*	-0.002	0.339***
	(0.039)	(0.052)	(0.090)	(0.097)
Round	-0.027**	-0.001	-0.024	-0.103***
	(0.012)	(0.016)	(0.020)	(0.028)
Provision × Round	0.024	-0.023	0.069*	0.122***
	(0.017)	(0.021)	(0.040)	(0.040)
Constant	1.741***	1.188**	0.919	3.804***
	(0.381)	(0.479)	(0.608)	(1.052)
N	4160	2366	884	910

Supplementary Table 3 | Comparing estimated reciprocity between Maintenance and Provision. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 - Equation 4). **Panel A** reports estimates for Strangers, **Panel B** for Partners. Dependent variable: effective contributions. $\bar{C}_{-ij,t-1}$ is the average effective contribution of the other three group members from the previous round. Random intercepts are included for matching groups and individuals. Model (1) is estimated using the entire sample. Models (2-4) use only the subset of participants classified as *conditional cooperators* (CC), *free riders* (FR), and *others* (OT), respectively. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 4 (support for Figure 3b, all panels)

	(1) All Maintenance	(2) All Provision	(3) CC Maintenance	(4) CC Provision	(5) FR Maintenance	(6) FR Provision	(7) OT Maintenance	(8) OT Provision
Partners	-0.131	-0.557	-0.938	-1.120**	0.780	0.931	0.221	-1.165
1 if Partners, 0 otherwise	(0.514)	(0.427)	(0.700)	(0.487)	(0.487)	(1.214)	(1.326)	(1.192)
$\bar{C}_{-ij,t-1}$	0.170***	0.430***	0.252***	0.484***	0.040	0.235***	0.222***	0.460***
	(0.022)	(0.025)	(0.035)	(0.032)	(0.026)	(0.044)	(0.052)	(0.060)
Partners × $\bar{C}_{-ij,t-1}$	0.237***	0.206***	0.348***	0.233***	0.254***	0.062	-0.022	0.081
	(0.033)	(0.033)	(0.051)	(0.041)	(0.039)	(0.077)	(0.086)	(0.079)
Round	-0.044***	-0.066***	-0.069***	-0.086***	-0.003	0.043***	-0.056***	-0.149***
	(0.007)	(0.009)	(0.012)	(0.012)	(0.009)	(0.016)	(0.018)	(0.022)
Partners × Round	0.016	0.063***	0.066***	0.061***	-0.020	0.004	-0.047	0.168***
	(0.012)	(0.014)	(0.018)	(0.017)	(0.015)	(0.033)	(0.031)	(0.032)
Constant	1.925***	1.896***	2.195***	2.483***	0.126	-0.725	3.588***	3.391***
	(0.338)	(0.266)	(0.479)	(0.328)	(0.339)	(0.742)	(0.751)	(0.774)
N	5408	5408	2288	3250	1742	1040	1378	1118

Supplementary Table 4 | Comparing estimated reciprocity between Strangers and Partners. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 - Equation 5). Dependent variable: effective contributions. $\bar{C}_{-ij,t-1}$ is the average effective contribution of the other three group members from the previous round. Random intercepts are included for matching groups and individuals. Models (1-2) are estimated using the entire sample. Models (3-4), (5-6), and (7-8) use only the subset of participants classified as *conditional cooperators* (CC), *free riders* (FR), and *others* (OT), respectively. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 5 (support for Figure 3b, Panels 2-4)

	(1) Strangers Maintenance	(2) Strangers Provision	(3) Partners Maintenance	(4) Partners Provision
CC	2.076***	3.003***	0.231	1.077
1 if CC, 0 otherwise	(0.679)	(0.466)	(0.744)	(1.392)
OT	3.450***	3.924***	2.955***	1.969
1 if OT, 0 otherwise	(0.739)	(0.592)	(0.897)	(1.568)
$\bar{C}_{-ij,t-1}$	0.040	0.228***	0.285***	0.300***
	(0.031)	(0.044)	(0.050)	(0.084)
CC × $\bar{C}_{-ij,t-1}$	0.208***	0.258***	0.320***	0.419***
	(0.042)	(0.052)	(0.066)	(0.089)
OT × $\bar{C}_{-ij,t-1}$	0.181***	0.232***	-0.087	0.239**
	(0.046)	(0.065)	(0.082)	(0.100)
Round	-0.003	0.042***	-0.025	0.048
	(0.011)	(0.016)	(0.021)	(0.038)
CC × Round	-0.066***	-0.127***	0.022	-0.072*
	(0.014)	(0.019)	(0.026)	(0.041)
OT × Round	-0.053***	-0.191***	-0.079**	-0.029
	(0.016)	(0.024)	(0.032)	(0.046)
Constant	0.139	-0.533	0.997	0.274
	(0.508)	(0.386)	(0.606)	(1.298)
N	5512	5616	2080	2080

Supplementary Table 5 | Comparing estimated reciprocity across attitude types. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 - Equation 6). Dependent variable: effective contributions. $\bar{C}_{-ij,t-1}$ is the average effective contribution of the other three group members from the previous round. CC is a dummy for *conditional cooperators* and OT is a dummy for *others*. *Free riders* (FR) are the omitted category. Random intercepts are included for matching groups and individuals. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 6 (support for Supplementary Figure 1)

	(1) One-shot Maintenance	(2) One-shot Provision	(3) Strangers Maintenance	(4) Strangers Provision	(5) Partners Maintenance	(6) Partners Provision
CC	7.521***	8.318***	1.611**	1.872***	1.503***	1.923*
1 if CC, 0 otherwise	(1.396)	(1.437)	(0.634)	(0.345)	(0.584)	(1.088)
OT	6.464***	6.105***	3.159***	1.817***	1.846***	2.630**
1 if OT, 0 otherwise	(1.435)	(1.785)	(0.691)	(0.427)	(0.702)	(1.218)
Constant	0.379	1.455	0.226	0.643*	1.535**	2.353**
	(1.146)	(1.302)	(0.509)	(0.346)	(0.686)	(1.052)
N	140	148	3456	3456	2160	2160

Supplementary Table 6 | Comparing effective contributions across attitude types. Models (1-2) report estimates from ordinary least squares (OLS) models. Models (3-6) report fixed effects estimates from linear mixed-effects models with random intercepts for matching groups and individuals (details on the estimation can be found in section 1.1 – Equations 7-8). Dependent variable: effective contributions. CC is a dummy for *conditional cooperators* and OT is a dummy for *others*. Free riders (FR) are the omitted category. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 7 (support for Figure 5a, all panels)

	(1) All	(2) CC	(3) FR	(4) OT
Provision	0.076	-0.030	0.229**	0.214
1 if Provision, 0 otherwise	(0.066)	(0.078)	(0.106)	(0.144)
Positive deviation from c_i	-0.006**	-0.006	-0.006	-0.009**
max{c_k - c_i, 0}	(0.002)	(0.005)	(0.004)	(0.004)
Provision × positive deviation from c_i	0.003	-0.001	0.009	0.004
	(0.004)	(0.007)	(0.007)	(0.007)
Negative deviation from c_i	0.117***	0.119***	0.111***	0.117***
max{c_i – c_k, 0}	(0.002)	(0.003)	(0.005)	(0.004)
Provision × negative deviation from c_i	-0.045***	-0.034***	-0.022**	-0.084***
	(0.004)	(0.004)	(0.009)	(0.007)
Round	-0.005***	-0.003**	-0.009***	-0.003
	(0.001)	(0.002)	(0.002)	(0.002)
Provision × Round	0.001	0.002	0.001	-0.006**
	(0.001)	(0.002)	(0.003)	(0.003)
$\bar{C}_{-i-k,jt}$	0.007***	-0.003	0.006	0.022***
	(0.002)	(0.003)	(0.004)	(0.005)
Provision × $\bar{C}_{-i-k,jt}$	-0.006**	0.004	-0.018***	-0.011*
	(0.003)	(0.004)	(0.006)	(0.007)
Constant	0.109**	0.109*	0.177***	-0.013
	(0.047)	(0.061)	(0.061)	(0.098)
N	13932	6318	3645	3969

Supplementary Table 7 | Comparing negative reciprocity across Maintenance and Provision. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 – Equation 9). Dependent variable: assigned punishment points. Model (1) compares assigned punishment points from individual *i* to individual *k* across Maintenance and Provision in reaction to a negative or positive deviation of *k*'s contribution from *i*'s contribution. $\bar{C}_{-i-k,jt}$ is the average contribution of the other two members of the group (excluding *i* and *k*). Models (2-4) are the same as Model (1) but separately estimated for *conditional cooperators* (CC), *free riders* (FR), and *others* (OT), respectively. Random intercepts are included for matching groups and individuals. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 8 (support for Figure 5a, Panel 2-4)

	(1) Maintenance	(2) Provision
CC	-0.056	-0.382***
1 if CC, 0 otherwise	(0.106)	(0.096)
OT	-0.166	-0.237**
1 if OT, 0 otherwise	(0.109)	(0.108)
Positive deviation from c_i	-0.006	0.005
max(c_k - c_i, 0)	(0.004)	(0.005)
Positive deviation from c_i × CC	0.000	-0.012*
	(0.008)	(0.007)
Positive deviation from c_i × OT	-0.002	-0.009
	(0.006)	(0.007)
Negative deviation from c_i	0.111***	0.089***
max(c_i – c_k, 0)	(0.005)	(0.006)
Negative deviation from c_i × CC	0.008	-0.004
	(0.006)	(0.007)
Negative deviation from c_i × OT	0.006	-0.056***
	(0.006)	(0.008)
Round	-0.009***	-0.008***
	(0.002)	(0.002)
Round × CC	0.005**	0.007***
	(0.003)	(0.002)
Round × OT	0.006**	-0.001
	(0.003)	(0.003)
$\bar{C}_{-i-kjt}$	0.006	-0.016***
	(0.004)	(0.004)
$\bar{C}_{-i-kjt}$ × CC	-0.009	0.017***
	(0.006)	(0.005)
$\bar{C}_{-i-kjt}$ × OT	0.014**	0.026***
	(0.006)	(0.006)
Constant	0.171**	0.458***
	(0.077)	(0.087)
N	6804	7128

Supplementary Table 8 | Comparing negative reciprocity across attitude types. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 – Equation 10). Dependent variable: assigned punishment points. CC is a dummy for *conditional cooperators* and OT is a dummy for *others*. FR is the omitted category. Model (1) compares assigned punishment points from individual *i* to individual *k* across attitudes types in Maintenance. Model (2) reports the same estimates for Provision. Random intercepts are included for matching groups and individuals. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 9 (support for Figure 5b)

	Partners with Punishment – Size of the public good		
	M	P	
Round 1	42.43 (13.96)	37.05 (13.38)	*P* = 0.204
Round 1-9	39.17 (23.41)	41.39 (21.99)	*P* = 0.730
Round 10-18	42.28 (26.70)	43.81 (29.93)	*P* = 0.854
Round 19-27	48.00 (29.22)	46.95 (30.73)	*P* = 0.905
All rounds	43.15 (26.44)	44.05 (27.55)	*P* = 0.904

Supplementary Table 9 | Descriptive statistics on public good size in Partners with Punishment. Average (Std. Dev.) public good size in Partners with Punishment. Standard deviations are calculated using differences across groups within a period, averaged across periods. M = Maintenance, P = Provision. *P* values are based on two-sided t-test in Round 1. All remaining *P* values are from linear mixed-effects models with random intercepts at the matching group level.

Supplementary Table 10 (support for Figure 5b)

	Maintenance vs. Provision	Partners vs. Partners with Punishment	
	(1)	(2)	(3)
		Maintenance	Provision
Provision	0.902		
1 if Provision, 0 otherwise	(7.501)		
Partners with Punishment		32.59^{***}	27.18^{***}
1 if Partners with Punishment, 0 otherwise		(5.826)	(5.898)
Constant	43.15^{***}	10.56^{**}	16.87^{***}
	(5.365)	(4.169)	(4.269)
N	1161	1107	1134

Supplementary Table 10 | Comparing the public good size in Partners with Punishment. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 – Equations 11-12). Dependent variable: size of the public good. Random intercepts are included for matching groups. Model (1) compares the public good size between Maintenance and Provision. Models (2-3) compare the public good size between Partners and Partners with Punishment separately for Maintenance and Provision. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 11

	(1) Below average contribution	(2) Above average contribution
Received # punishment points	1.235***	0.257***
	(0.065)	(0.092)
Provision	1.454**	0.675***
1 if Provision, 0 otherwise	(0.617)	(0.261)
Provision × received # punishment points	-0.612***	-0.088
	(0.101)	(0.136)
Round	0.019	0.077***
	(0.019)	(0.009)
Provision × Round	-0.011	-0.039***
	(0.027)	(0.013)
Constant	-0.418	-1.795***
	(0.454)	(0.184)
N	1210	3262

Supplementary Table 11 | Comparing reaction to received punishment across Maintenance and Provision. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 – Equation 13). Dependent variable: change in contributions from round *t-1* to round *t*. Model (1) estimates the model for all cases where the contribution of individual *i* in round *t-1* is below the average contribution of the other three group members. Model (2) estimates the same model for the cases in which the contribution of individual *i* in round *t-1* is above the average contribution of the other three group members. Random intercepts are included for matching groups and individuals. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 12

	(1)
Positive deviation from c_i in *t-1*	0.172***
max($\bar{c}_{-i,t-1} - c_{i,t-1}$, *0*)	(0.04)
Negative deviation from c_i in *t-1*	-0.554***
max($c_{i,t-1} - \bar{c}_{-i,t-1}$, *0*)	(0.05)
Positive deviation from c_i in *t-1* × Provision	0.126**
	(0.05)
Negative deviation from c_i in *t-1* × Provision	-0.154**
	(0.06)
Lagged own contribution $c_{i,t-1}$	0.814***
	(0.04)
Round	-0.005
	(0.01)
Lagged own contribution $c_{i,t-1}$ × Provision	0.048
	(0.05)
Round × Provision	0.010
	(0.02)
Provision	0.116
1 if Provision, 0 otherwise	(0.43)
Constant	0.913***
	(0.29)
N	4160

Supplementary Table 12 | Comparing reactions to positive and negative deviations from own contributions in Partners. Shown are estimated fixed effects from linear mixed-effects models (details on the estimation can be found in section 1.1 – Equation 14). Dependent variable: effective contributions. Model (1) shows the reaction of contributions of individual *i* to positive and negative deviations from others' average contributions in the previous period, $\bar{c}_{-i,t-1}$. Random intercepts are included for matching groups and individuals. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

Supplementary Table 13 (Robustness check for Figure 3a)

	(1)
Avg. contribution others	0.333***
	(0.008)
Provision	-1.796***
1 if Provision, 0 otherwise	(0.403)
Avg. contribution others × Provision	0.176***
	(0.011)
Constant	3.057***
	(0.286)
N	14784

Supplementary Table 13 | Comparing cooperation attitudes between Maintenance and Provision. Shown are estimated fixed effects from a linear mixed-effects model (details on the estimation can be found in section 1.2 - Equation 15). Dependent variable: effective contribution in the contribution schedule C_{ik}. Random intercepts are included for each individual. Standard errors in parentheses. *** P < 0.01, ** P < 0.05, * P < 0.1.

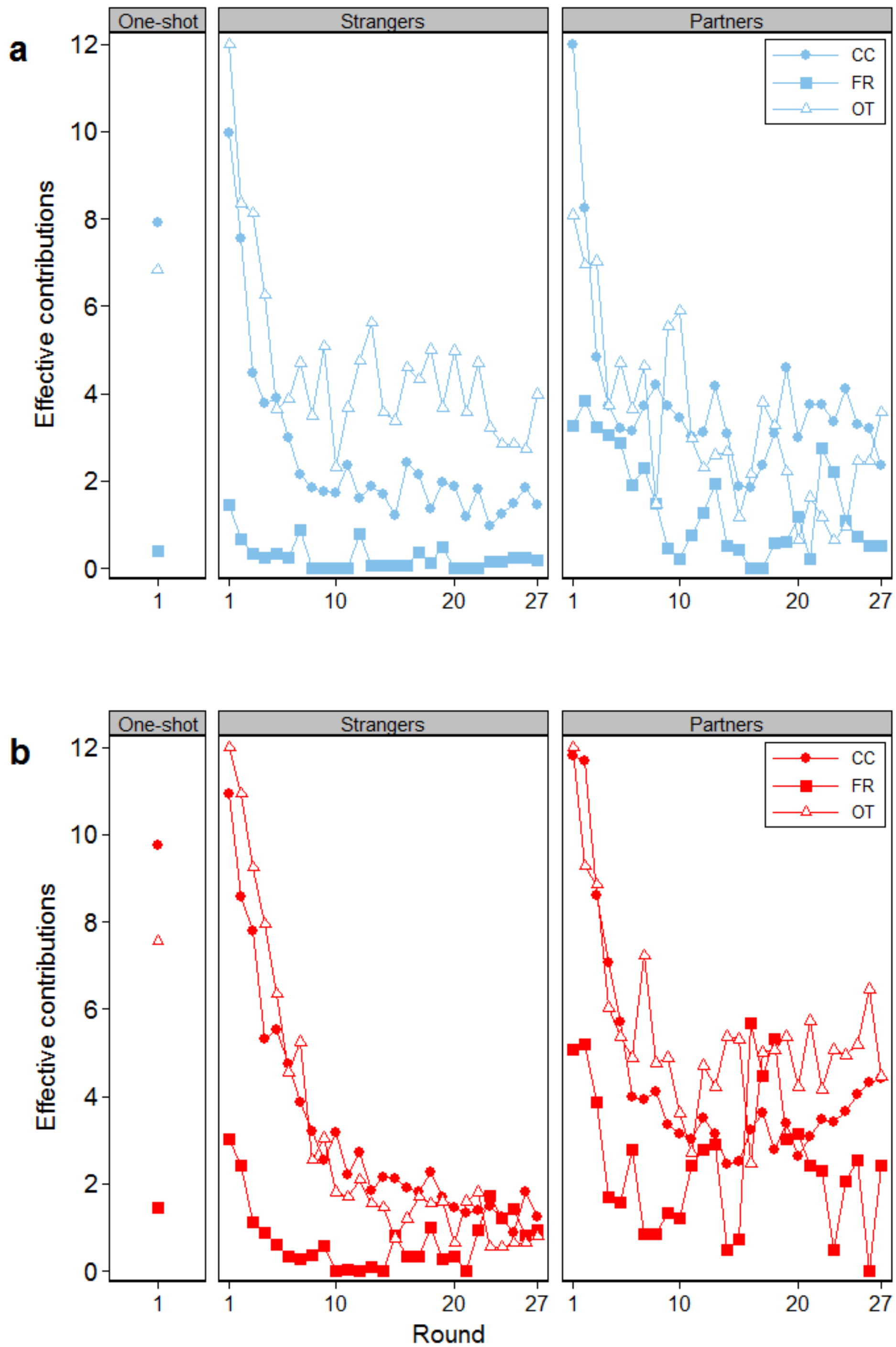
Supplementary Table 14 (Robustness check for Figure 3b)

	(1) Strangers Maintenance	(2) Strangers Provision	(3) Partners Maintenance	(4) Partners Provision
CC				
$\bar{C}_{-ij,t-1}$	0.334**	0.659***	0.897***	0.974***
	(0.142)	(0.051)	(0.071)	(0.039)
Round	-0.051	-0.204***	-0.045	-0.052***
	(0.056)	(0.022)	(0.038)	(0.019)
Constant	5.409***	3.093***	0.911	0.318
	(1.099)	(0.427)	(0.815)	(0.397)
STR				
Round	-0.651***	-0.993***	-0.911***	-0.664***
	(0.063)	(0.155)	(0.155)	(0.146)
Constant	-1.027	-3.118*	-4.015**	-3.888*
	(0.779)	(1.778)	(2.034)	(2.294)
Estimated mixing proportions				
CC	0.184***	0.456***	0.300***	0.549***
	(0.036)	(0.047)	(0.057)	(0.057)
STR	0.460***	0.327***	0.451***	0.401***
	(0.045)	(0.044)	(0.061)	(0.056)
FR	0.356***	0.217***	0.249***	0.050**
	(0.043)	(0.037)	(0.048)	(0.024)
N	3328	3328	2080	2080
Log L	-3109.1	-4270.3	-2624.6	-3892.7
AIC	6236.2	8558.7	5267.1	7803.4

Supplementary Table 14 | Maximum likelihood estimation of two-limit Tobit finite mixture models. Details on the estimation procedure can be found in section 1.2. Dependent variable: effective contributions. $\bar{C}_{-ij,t-1}$ is the average contribution of the other three group members from the previous round. CC = *conditional cooperators*, STR = *strategic free riders*, and FR = *free riders*. The bottom part of the table shows the estimated mixing proportions. Estimates for FR are deduced from the sum of proportions of CC and STR, the standard error for FR is obtained from the covariance matrix of the estimates of CC and STR. AIC is the Akaike's information criterion. Standard errors in parentheses. *** $P < 0.01$, ** $P < 0.05$, * $P < 0.1$.

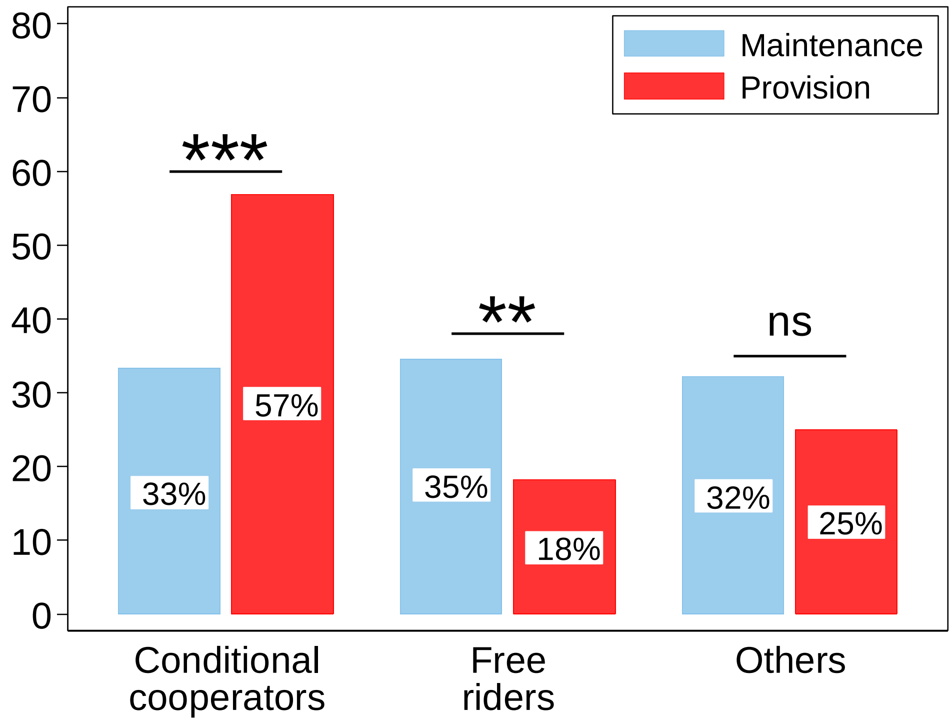
4. Supplementary Figures

Supplementary Figure 1



Supplementary Figure 1 | Effective average contributions by attitude type and type of strategic interaction. A, Maintenance. **B,** Provision. CC: Conditional Cooperators, FR: Free Riders, OT: Others.

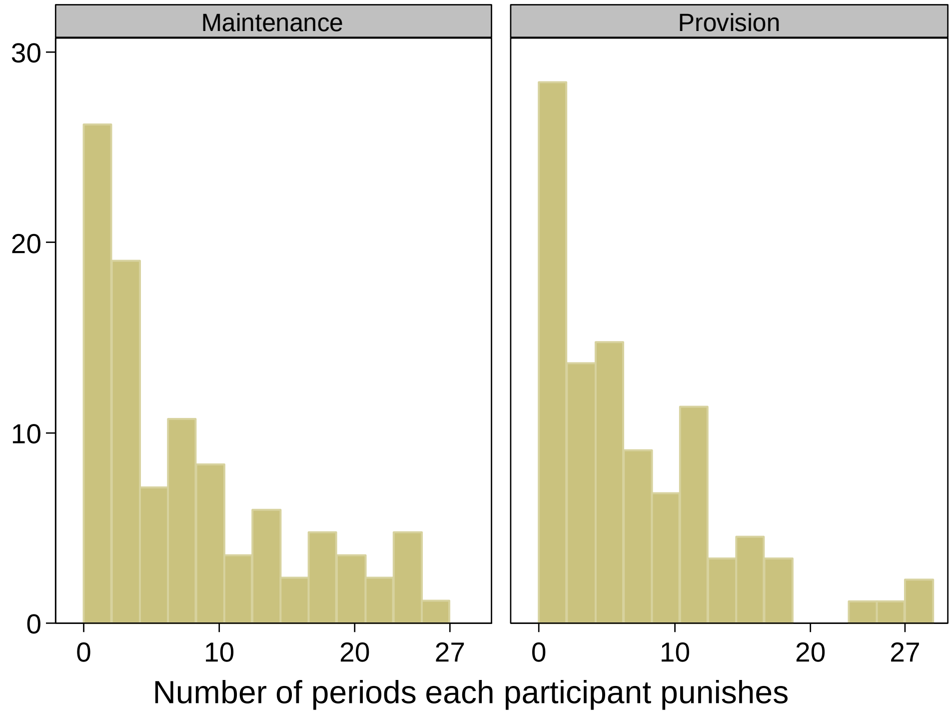
Supplementary Figure 2



Supplementary Figure 2 | Replication of results on strong reciprocity in Partners with Punishment.

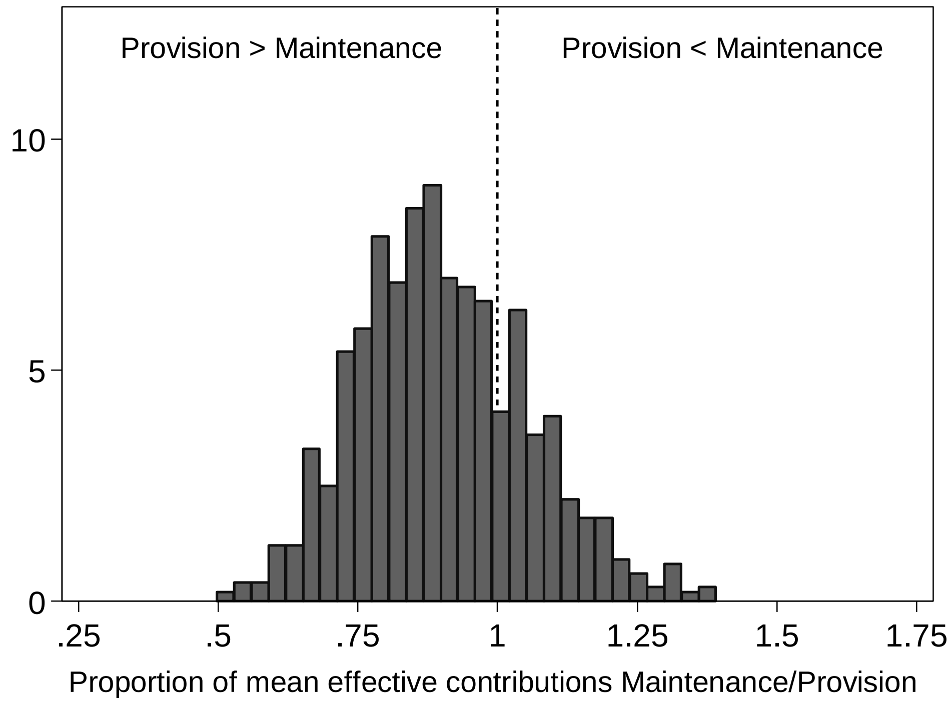
Strong reciprocity as measured by cooperation attitudes elicited prior to the repeated experiment; n_M = 84, n_P = 88. χ^2-tests, *** $P < 0.01$, ** $P < 0.05$, ns (not significant) $P > 0.10$.

Supplementary Figure 3



Supplementary Figure 3 | Distribution of the number of periods in which a participant punished a group member in Partners with Punishment. The figure is constructed counting for each individual in how many out of the 27 periods they punish some other group member. The mean (median) number of rounds where participants punish is 7.9 (6) and 7.1 (6) in Maintenance and Provision, respectively, with no differences across treatments (Kolmogorov Smirnov test, P = 0.870).

Supplementary Figure 4



Supplementary Figure 4 | Simulated effective contribution ratios. Distribution of 1000 simulated effective contribution ratios between Maintenance and Provision ($\bar{c}^M/\bar{c}^P$) using a sample of n = 100 per treatment and simulated experiment.