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Supporting Information

Voluntary restrictions on self-reliance increase cooperation and mitigate wealth inequality

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The Supporting Information is divided into three parts.

In the first part (*Theoretical Background & Experimental Setup*), we provide a more extensive discussion on the experimental task including screenshots of the experimental instructions and computer interface, as well as statistical modeling strategy.

In the second part (*Extended Results*), we provide the full regression models underlying the results reported in the main manuscript, separately for Study 1 and Study 2.

In the third part (*Additional and Exploratory Results*), we report additional exploratory analyses that are not reported in the main manuscript and were not the main focus of the study but may still provide additional insights for future explorations, like dynamics over rounds, the role of personality measures, or potential gender effects.

I Theoretical Background & Experimental Setup

The private-public goods game confronts a group of people with a shared problem that can be solved individually or collectively, creating a conflict between cooperation and self-reliance. Each group member has resources at their disposal that they can invest toward creating a public good. The public good, if created, protects each individual group member from losing their remaining endowment. Because the public good is non-excludable, it confronts the group with the classic problem of cooperation: Everybody can benefit from its creation but each individual group member has an incentive to free-ride on the cooperation of others. Further, since they are confronted with a step-level public good, cooperation can also fail due to under-provision. Step-level public goods games can be used to model cooperation dilemmas such as reducing global greenhouse gas emission below a critical threshold to avoid the detrimental consequences of climate change (1, 2), building a dam to prevent flooding, fund-raising campaigns with a set goal that needs to be reached (3), or a group of students that have to meet a minimum level of effort to successfully pass a student project.

As opposed to a standard cooperation dilemma, group members can, however, also invest resources toward creating a private good in the private-public goods game. The private good, if created, only protects the respective group member from losing her remaining endowment. Because the private good is excludable, it can remedy the problems with public goods provision: free-riding and under-provision. To use the above example, if a student has the ability (and given the opportunity) to finish the student project on her own, she might opt to do so to evade the possibility of exploitation or group failure. Private good provision is ubiquitous in modern societies and often combined or in conflict with public goods provision. For example, public transport systems can be seen as a public good that grants mobility to many people,[1] while people can also travel by car as an individual way of transportation, if they can afford it. Public healthcare systems often exist next to private health-care plans, retirement planning is often a mixture of public goods and private provision, and precautions to climate change or pandemics like COVID-19 can take place on the global, national, or even individual level.

[1] Although it is an 'impure' public good since it does not perfectly satisfy the assumption of non-excludability.

From a theoretical perspective, the ability to substitute cooperation with 'self-reliance' creates a so far largely ignored social dilemma: the dilemma of self-reliance (4). Especially when some group members prefer to solve the problem individually while others prefer a collective solution, costly coordination failures can emerge. Further, resources spent on private goods have a 'social opportunity cost:' Since they are used to solve the problem on the individual level, they are not available anymore to support a collective solution and to benefit other group members. Especially when the access to private good provision is restricted (because some group members do not have the resources to solve the problem on their own), such 'opting out' of public goods provision can impose a negative externality on those that depend on public goods. Private goods as an alternative to cooperation also change the interdependence structure of groups (5-10). Cooperation is often conceived and modeled as creating a social surplus, through the benefits of division of labor, specialization, or simply synergies from working together. Yet, when private goods provision becomes more affordable (which ironically is often achieved through higher division of labor and efficient trade in modern societies) immediate social interdependence decreases.

Whether to let individuals solve a problem individually, based on their capabilities and resources, or enforce public goods solutions is often is a central dividing line between political parties and ideologies and societies markedly differ in their policies to which degree they restrict self-reliance (for example regarding gun control as a private alternative to security, imposing public healthcare plans, or subsidizing public transport). We were therefore interested to which degree groups would voluntarily create higher social interdependence by restricting access to individual solutions amidst a shared problem. Further, by manipulating the cost of self-reliance we could investigate how this willingness to curtail individual independence changes with increased ability of self-reliance in a controlled laboratory experiment.

Private-public goods dilemmas outside of the laboratory are often very complex. Private good provision is sometimes used to substitute public goods (as in our model) or can complement public goods provision (like in the case of top-up systems in healthcare; 11, 12). Our experiments allow us to abstract away from these complexities, manipulate the interdependence structure of groups through varying the costs of private goods provision, and observe participants' choices when confronted with a clear trade-off between solving a shared problem either collectively or individually.

Game-theoretical description

The private-public goods game deviates from commonly employed step-level public goods game in two ways: First, not reaching the public threshold leads to losing all remaining resource points (RP) rather than gaining a fixed price (see also 1, 2, 13-15). Second, group members have an additional strategy to avoid losing RP that only applies to them (the individual solution).

In the one-shot private-public goods game there are *n* players who are endowed with e_k RP. Each player *k* simultaneously decides how much of the RP she spends on the public solution $s_{k,p}$, or on the individual solution $s_{k,i}$. A strategy of player *k* is a pair $(s_{k,p}, s_{k,i})$, with $s_{k,i}, s_{k,p} \geq 0$ and $s_{k,i} + s_{k,p} \leq e_k$. Pairs satisfying these constraints constitute the strategy set S_k of player *k*. Let c_p be the cost of the public solution and c_i the cost of the individual solution. Then, a public solution is realized if $\sum_k s_{k,p} \geq c_p$, whereas player *k* reaches her individual solution if $s_{k,i} \geq c_i$. If player *k* reaches her individual solution or a public solution is reached, the payoff of player *k* is $\pi_k = e_k - s_{k,p} - s_{k,i}$. If neither solution is reached, then the payoff of player *k* is 0, instead. Resources invested toward the individual or public solution, while not reaching the respective target, are considered wasted. Meeting both targets does not have any benefits for the player. It follows that any strategy $(s_{k,p} > 0, s_{k,i} > 0)$ is dominated by $\left(s_{k,p} \geq 0, s_{k,i} = 0\right)$ or $\left(s_{k,p} = 0, s_{k,i} \geq 0\right)$. In other words, an equilibrium strategy for a rational player would never assign resources toward both the individual and public solution.

In our experiments, we set $n = 5$, $c_p = 200$, while c_i was taking a value from the set {80, 60, 40}. In Study 1, each participant had the same amount of RP in each round ($e = 100$). In Study 2, three participants were given a low endowment, while two participants were given a high endowment ($\mathrm{e} = [80, 80, 80, 130, 130]$). Note that groups in both studies had the same amount of RP available ($\sum_k e_k = 500$). Hence, we manipulated resource distribution while keeping group wealth constant across studies. Regardless of the RP distribution, with $c_i > 40$, players choosing their individual solutions is Pareto-dominated by all of the possible public/collective solutions. Further, an equilibrium in which all group members choose the individual solution is payoff-dominated by the equilibrium in which all group members invest 40 RP to the public solution for $c_i > 40$.

Equilibria take the shape $(\bar{s}_{k,p}, 0)_{k\in 1,\ldots,n}$ with $\bar{s}_{k,p} \leq c_i$ (individual rationality) and $\sum_k \bar{s}_{k,p} = c_p$ (collective solution reached without waste). Including the single symmetric solution, the number of pure-strategy equilibria (regardless of the resource distribution) with a public solution is very large under $c_i = 80$ (25,784,901) due to the many combinations of contributions that satisfy $\sum_k s_{k,p} = c_p$. The number of possible equilibria with a public solution decreases substantially under $c_i = 60$ (3,981,076) and reduces to 1 under $c_i = 40$ (the single symmetric equilibrium). In addition, there may be a large number of mixed-strategy equilibria (16). The number of pure-strategy equilibria reduces when lowering the cost for the individual solution because rational agents will not invest more resources toward the public solution than the individual solution cost. $(s_{k,p} > c_i, s_{k,i} = 0)$ is dominated by $(s_{k,p} = 0, s_{k,i} = c_i)$. In other words, increasing the ability of self-reliance lowers the tolerance for free-riding since agents have a more viable private alternative. In all pure-strategy equilibria with a public solution, except for the single symmetric solution, some agents invest more RP into creating the public solution than others. Hence, they all involve free-riding. Note that reaching the individual solution differs from free-riding. When meeting the individual threshold, an agent does not benefit from the creation of a public solution anymore since the individual solution is a perfect substitute for the public solution. An agent deciding to vote for abolishing the individual solution option can be considered rational if the agent believes that others will contribute enough RP such that the own investment toward a public solution is lower or equal to the individual solution cost ($s_{k,p} \leq c_i$). This also holds under $c_i = 40$.

Experimental Implementation

Participants were randomly assigned to groups of five and remained in this group throughout the whole experiment. At the beginning of the experiment, we measured social preferences using the social value orientation (SVO) slider task (17). In this task, participants have to decide how to distribute points between themselves and another unknown person. For example, the participant has to choose one out of nine possible allocations ranging from allocating 100 points to oneself and 50 points to the other person (maximal 'pro-self' option) to allocating 50 points to oneself and 100 points to the other person (maximal 'pro-social' option). The decision pattern of participants allows to calculate a single measure of social preferences: the SVO angle. The higher the SVO angle, the more a person was willing to sacrifice points in order to benefit another person (i.e., higher degree of social preferences). The total points kept for oneself and received from another randomly selected participant were converted to money at a rate of 100 points = 6 euro cents and added to the final payoff for the study. Each participant was matched with one receiver and was the receiver for another, different participant.

After the SVO task, participants entered the private-public goods game. Figure S1 gives an overview of the game structure. Participants first received extensive instructions on the computer screen (Figure S2) followed by comprehension questions (Figure S3) to make sure that every participant had sufficient understanding of the game. Two experimenters were always present in each experimental session to answer individual questions of participants. In the instructions it was explained to participants that they receive RP every round (called 'monetary units (MU)' in the experiment) but that there is the possibility that they will lose these RP. To prevent this from happening, they could invest RP into an 'individual pool' (referred to as 'private pool' in the experiment) or a 'public pool.' If they either met their 'individual target' (referred to as 'private target' in the experiment) or the group-wide 'public target', they could keep any RP that they did not invest. In the voting treatments, participants received additional instructions that explained to them that there is the possibility to remove the individual pool.

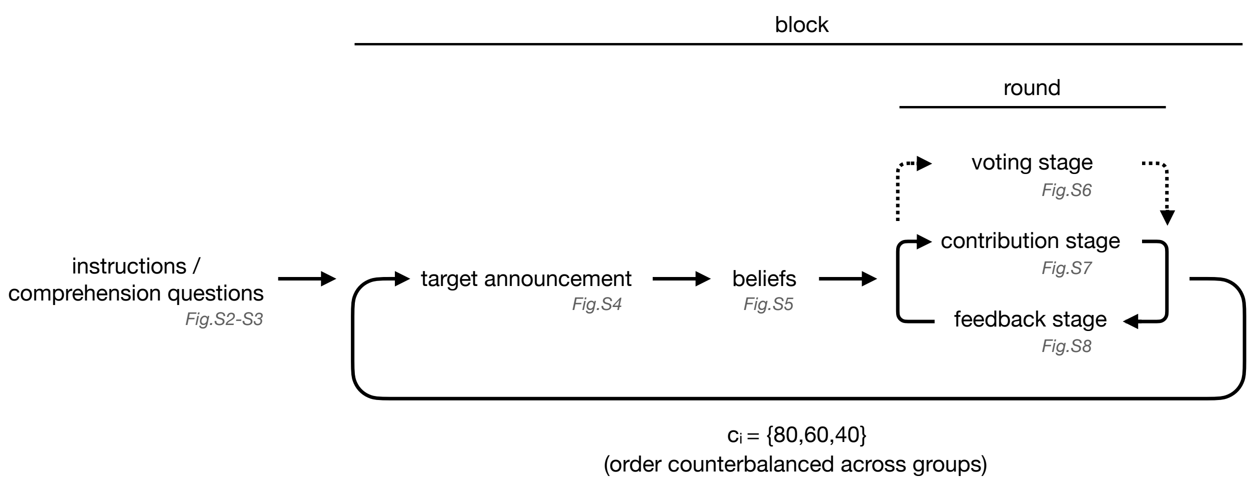

Figure S1. Timeline of the main experiment. After receiving instructions and answering comprehension questions, the public and individual target was announced. Then beliefs were elicited. Each round was comprised of a contribution stage in which each group member simultaneously decided how to invest their RP and a feedback stage showing the outcome of the round. In the voting treatments, the first and every third consecutive round also comprised a voting stage in which group members could vote on removing the possibility to solve the shared problem also individually for the following three rounds.

After answering all comprehension questions correctly, participants saw a ‘target announcement’ screen (Figure S4). On this screen, they were reminded about the endowment of each group member, the target for the public pool and the target for their individual pool. Then, we elicited beliefs of participants. Specifically, we asked them what they think the other group members would on average contribute to the shared public pool, their respective individual pool, and how much RP they would keep (Figure S5). In the voting treatments, we further asked about their beliefs assuming that a majority voted in favor of removing the individual pool and hence RP could only be invested into the public pool. Then the first round started. Each round was split into a contribution stage and a feedback stage. In the contribution stage, each group member simultaneously and independently decided how to distribute their RP across public and individual pool and how many RP to keep for themselves (Figure S7). After every group member made their decision, they entered the feedback stage and saw the outcome of the round. In this stage, they saw (i) how many RP each individual group member invested into the public and individual pool, (ii) how many RP were invested in total into the public pool and their individual pool, (iii) whether the group-wide public target was reached and which individual group members met their individual target, and (iv) earnings of individual group members for that round (Figure S8). This information was shown sequentially. Upon pressing a button, more information was added to the screen to avoid presenting too much information at once. After all information was revealed, the group member could enter the next round. Groups assigned to the voting treatment had an additional voting stage that was displayed at the beginning of round 1, 4, 7, 10, 13, and 16 (Figure S6). In this stage, group members were asked whether they vote in favor or against removing the individual pool for the next three rounds. After every group member casted their vote, the outcome was shown. If a majority ($n \geq 3$) voted in favor of removing the individual pool, group members could only invest RP into the public pool for the next three rounds (Figure S7).

Each group completed three blocks of the private-public goods game. Across blocks, the public target (c_p) was always 200 RP. The individual target (c_i) changed between 40, 60, or 80, manipulating the cost of solving the (shared) problem individually. The order of blocks was counterbalanced across groups and treatments. This also ensured that we had an equal number of block-orders in each treatment of the studies. Each block consisted of 18 rounds in total.

After finishing the private-public goods game, we measured individualism using the horizontal individualism scale (18). The horizontal individualism scale consists of four items ('I'd rather depend on myself than others', 'I rely on myself most of the time; I rarely rely on others', 'I often do my 'own thing'', 'My personal identity, independent of others, is very important to me') that are answered on a 9-point Likert scale with two anchors on each side ('never / definitely no', 'always / definitely yes'). Then, participants performed a gambling task based on the Preference Survey Module (19) to measure individual-level risk-aversion. In this task, participants were confronted with a choice between a sure outcome and receiving 300 points with $p = 0.5$ and 0 points with $1-p = 0.5$. Across gambles, the sure outcome was varied between 0 and 310 points to see when a participant would prefer the sure outcome and at which point the participant would switch to the gamble. One gamble was randomly selected by the computer and the outcome was added to the final payoff at a conversion rate of 100 points = 50 cents. Finally, participants answered demographics questions, were debriefed, and received their total payoff.

Experimental manipulations

In Study 1, each group member had 100 RP in each round. Groups were randomly assigned to two treatments. Half of the groups ($n = 20$) were assigned to the 'baseline treatment' in which they played the standard version of the private-public goods game. The other half of the groups ($n = 20$) were assigned to the 'voting treatment'. In this treatment, groups, in every third consecutive round, had the possibility to abolish the individual pool and restrict the ability to solve the problem individually for the following three rounds, as described above.

In Study 2, we manipulated the RP distribution across group members (additional between-subjects factor). Two group members were endowed with 130 RP ('richer' group members) and three group members were endowed with 80 RP ('poorer' group members). Group members remained in their role ('rich' vs. 'poor') across the whole experiment to avoid reciprocity or perspective taking. Groups were again randomly assigned to a 'baseline treatment' ($n = 20$) and a 'voting treatment' ($n = 20$).

Across both studies, three rounds from each block were randomly selected by the computer. The RP that the participant earned in these rounds were summed up and added to the final payoff at a conversion rate of 100 RP = 50 euro cents.

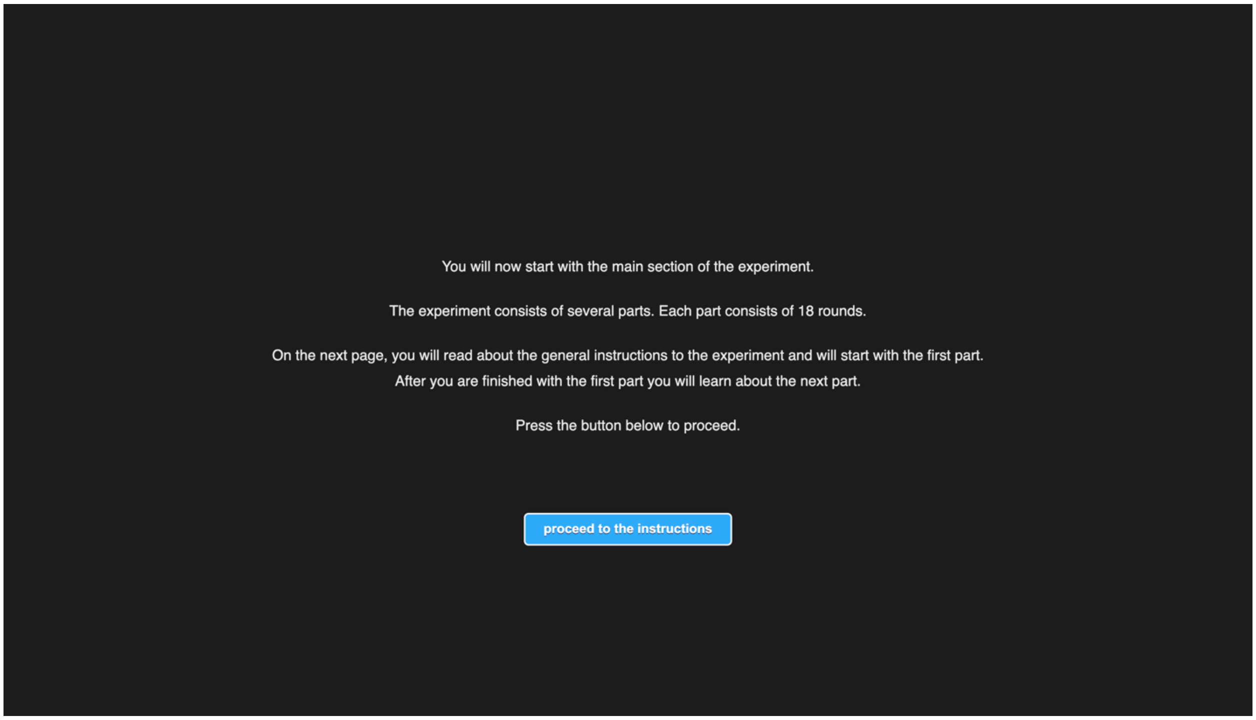

Figure S2. Instructions (page 1).

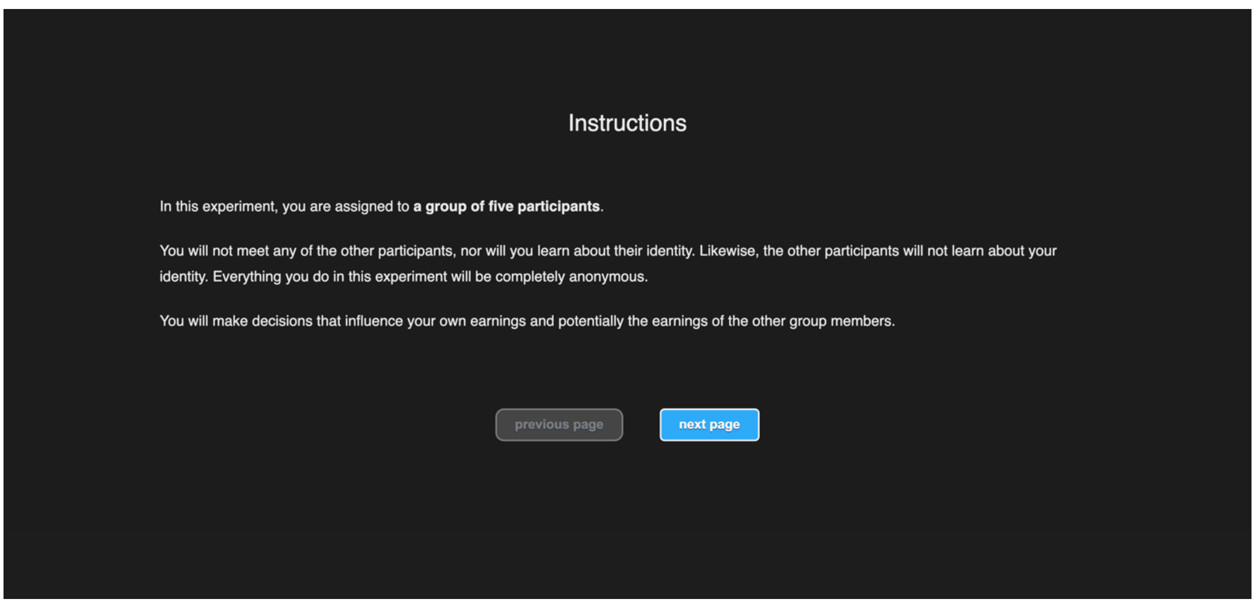

Figure S2 (continued). Instructions (page 2).

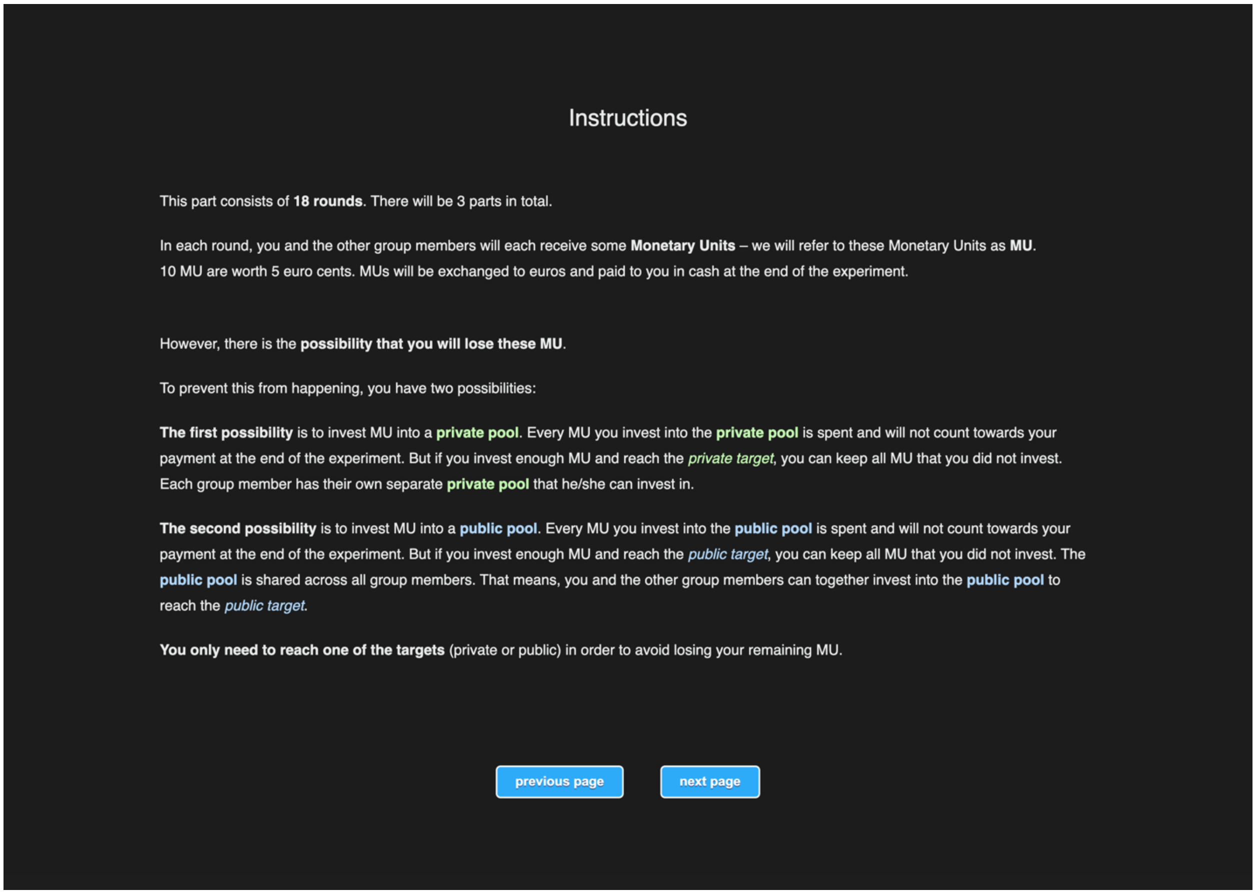

Figure S2 (continued). Instructions (page 3).

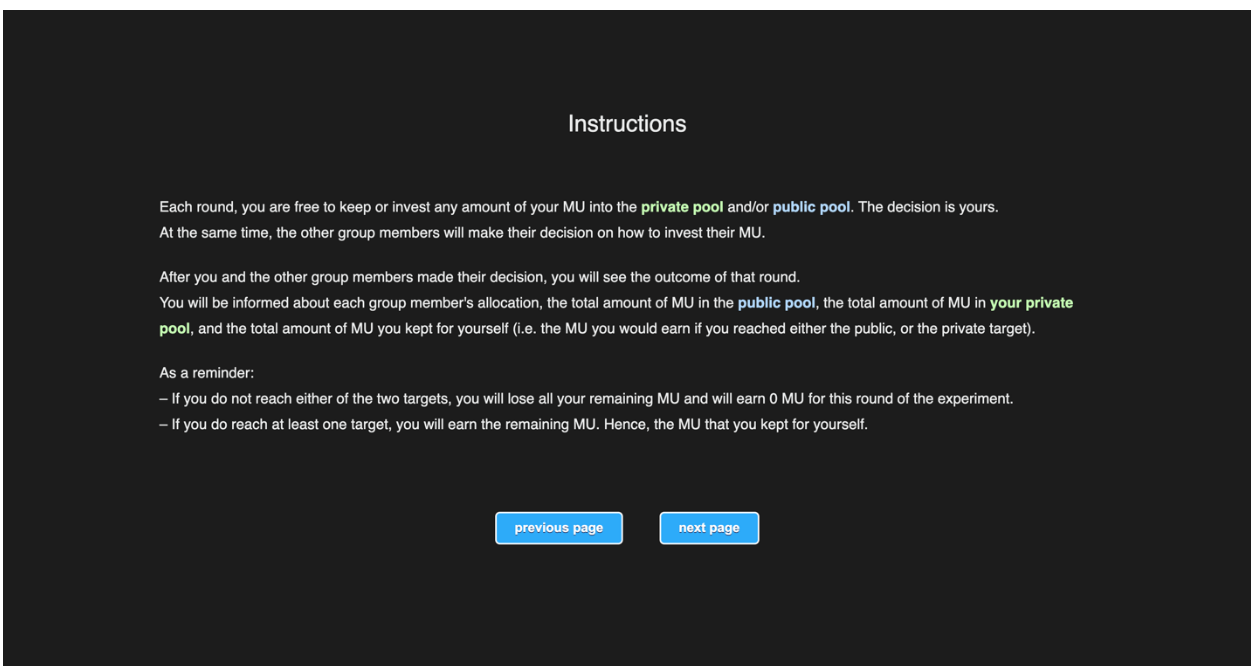

Figure S2 (continued). Instructions (page 4).

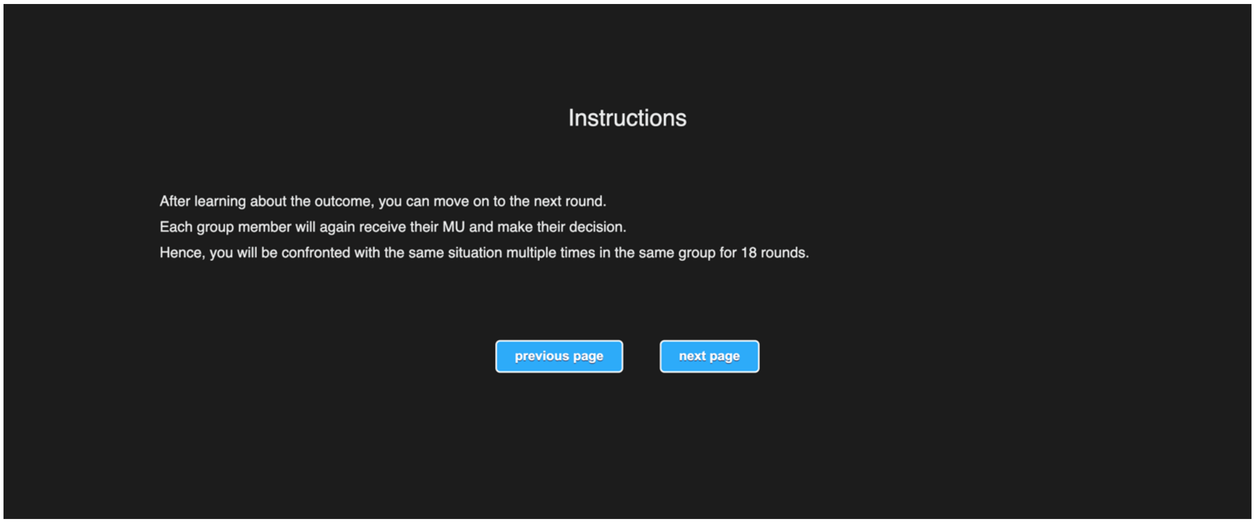

Figure S2 (continued). Instructions (page 5).

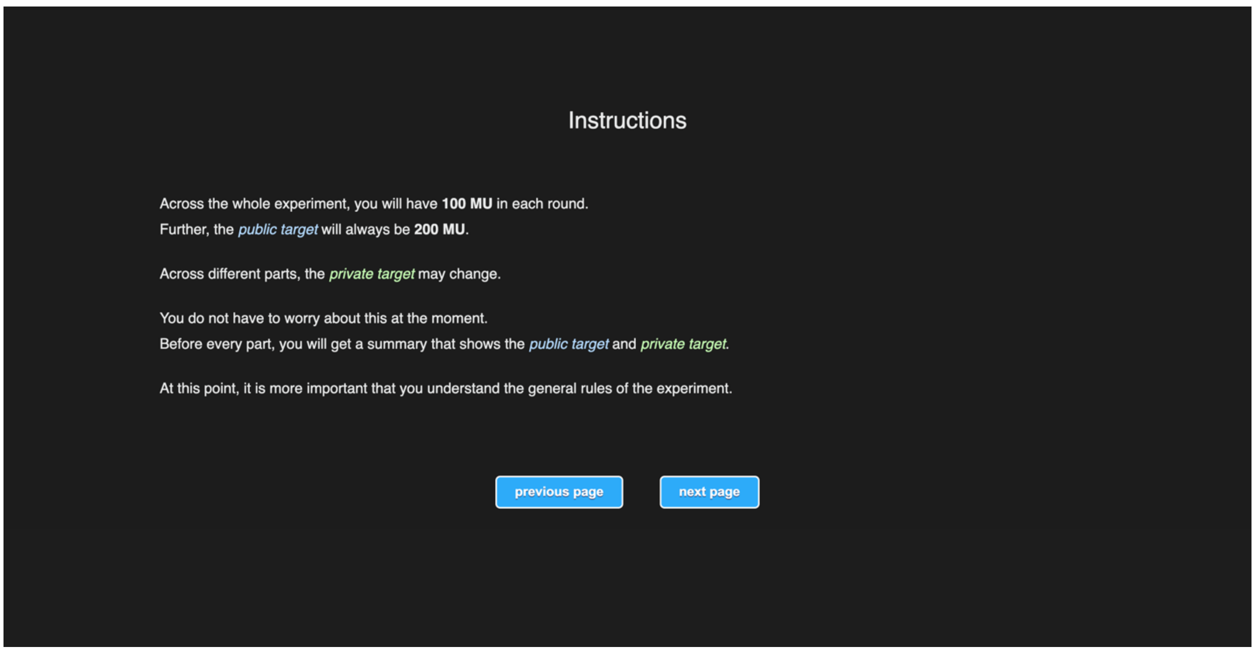

Figure S2 (continued). Instructions (page 6 – Study 1).

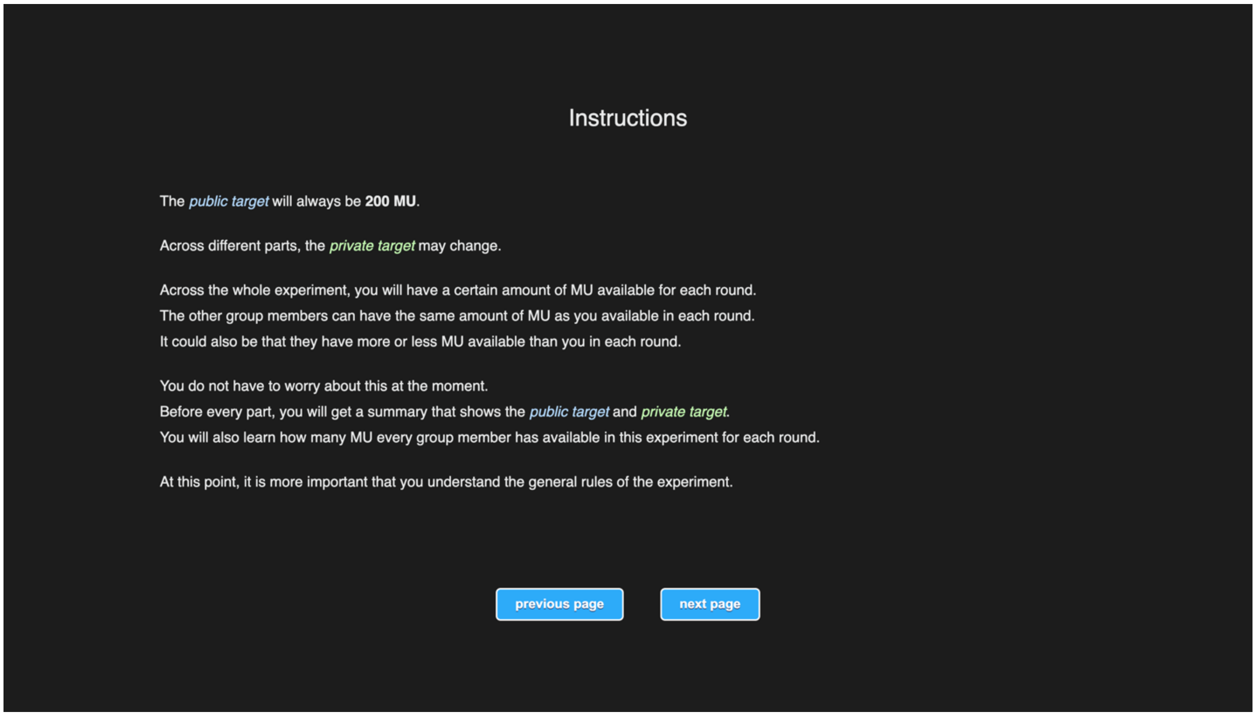

Figure S2 (continued). Instructions (page 6 – Study 2).

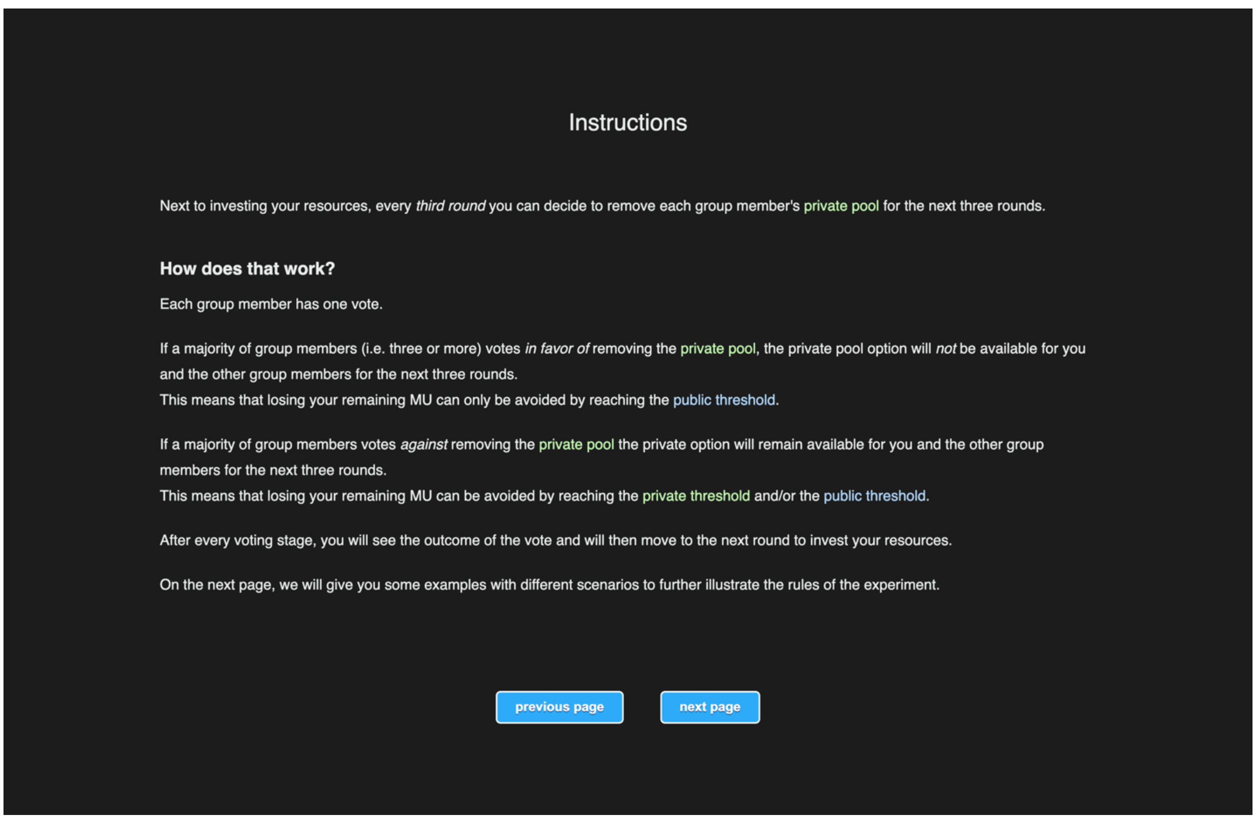

Figure S2 (continued). Instructions (voting treatments).

Instructions

The following examples will illustrate the rules of this experiment. These examples are for illustrative purposes only. They do not necessarily have to make sense, but are aimed at illustrating the rules of the task.

Example 1

The majority voted *against* removing the private pool.
The *public target* is 200 MU.
The *private target* is 60 MU.

Group member 1 decides to invest **60 MU** into **his/her private pool** and **0 MU** to the **public pool**.
Group member 2 decides to invest **60 MU** into **his/her private pool** and **20 MU** to the **public pool**.
Group member 3 decides to invest **0 MU** into **his/her private pool** and **60 MU** to the **public pool**.
Group member 4 decides to invest **0 MU** into **his/her private pool** and **20 MU** to the **public pool**.
Group member 5 decides to invest **0 MU** into **his/her private pool** and **0 MU** to the **public pool**.

Hence, together, group members 1, 2, 3, 4 and 5 invested **100 MU** into the **public pool** in total.

In this example, group members 3, 4 and 5 lose all their remaining MU, as they, neither, reached their *private target*, nor the *public target*.
Group member 1 can keep his/her remaining MU, because he/she reached *his/her private target*.
Group member 2 can keep his/her remaining MU, because he/she reached *his/her private target*.

Example 2

The majority voted *in favor of* removing the private pool.
The *public target* is 200 MU.

Group member 1 decides to invest **90 MU** to the **public pool**.
Group member 2 decides to invest **70 MU** to the **public pool**.
Group member 3 decides to invest **20 MU** to the **public pool**.
Group member 4 decides to invest **10 MU** to the **public pool**.
Group member 5 decides to invest **10 MU** to the **public pool**.

Hence, together, group members 1, 2, 3, 4 and 5 invested **200 MU** into the **public pool** in total.

In this example, all group members can keep their remaining MU, because they reached *the public target*.

Example 3

The majority voted *against* removing the private pool.
The *public target* is 200 MU.
The *private target* is 70 MU.

Group member 1 decides to invest **0 MU** into **his/her private pool** and **60 MU** to the **public pool**.
Group member 2 decides to invest **0 MU** into **his/her private pool** and **80 MU** to the **public pool**.
Group member 3 decides to invest **0 MU** into **his/her private pool** and **30 MU** to the **public pool**.
Group member 4 decides to invest **70 MU** into **his/her private pool** and **0 MU** to the **public pool**.
Group member 5 decides to invest **70 MU** into **his/her private pool** and **0 MU** to the **public pool**.

Hence, together, group members 1, 2, 3, 4 and 5 invested **170 MU** into the **public pool** in total.

In this example, group members 1, 2, and 3 lose all their remaining MU, as they, neither, reached their *private target*, nor the *public target*.
Group member 4 and 5 can keep their remaining MU, because he/she reached *his/her private target*.

Example 4

The majority voted *in favor of* removing the private pool.
The *public target* is 200 MU.

Group member 1 decides to invest **80 MU** to the **public pool**.
Group member 2 decides to invest **60 MU** to the **public pool**.
Group member 3 decides to invest **10 MU** to the **public pool**.
Group member 4 decides to invest **0 MU** to the **public pool**.
Group member 5 decides to invest **0 MU** to the **public pool**.

Hence, together, group members 1, 2, 3, 4 and 5 invested **150 MU** into the **public pool** in total.

In this example, all group members lose all their remaining MU, because they did not reached *the public target*.

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Figure S2 (continued). Instructions (examples).

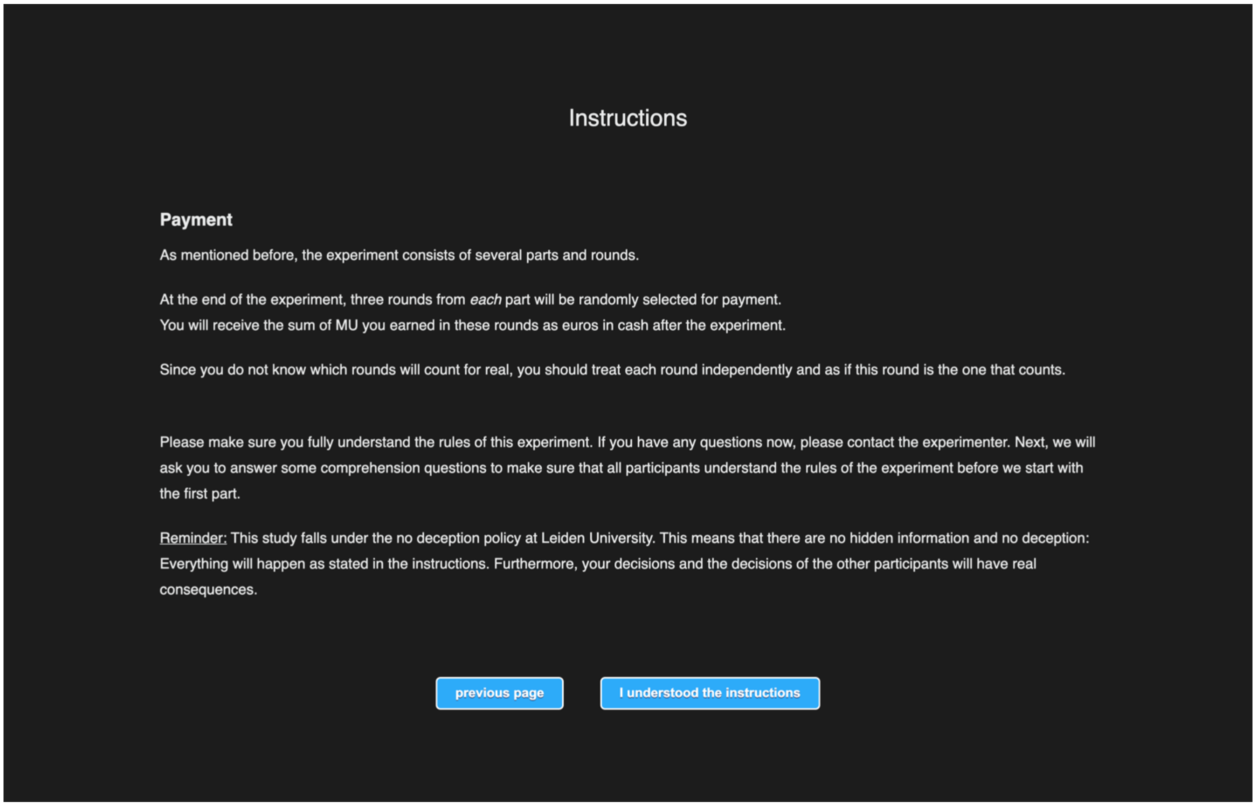


Figure S2 (continued). Instructions (payments).

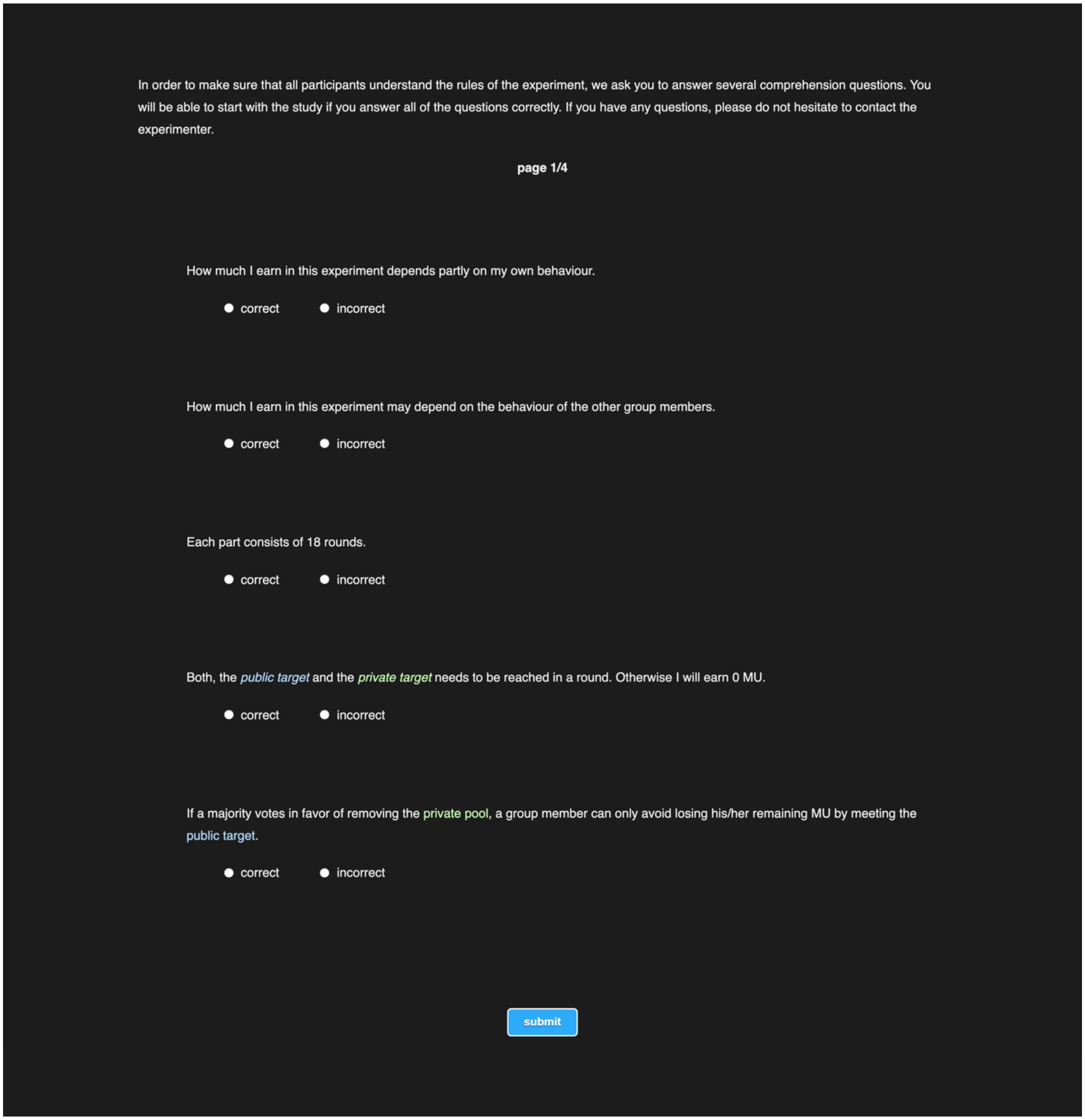
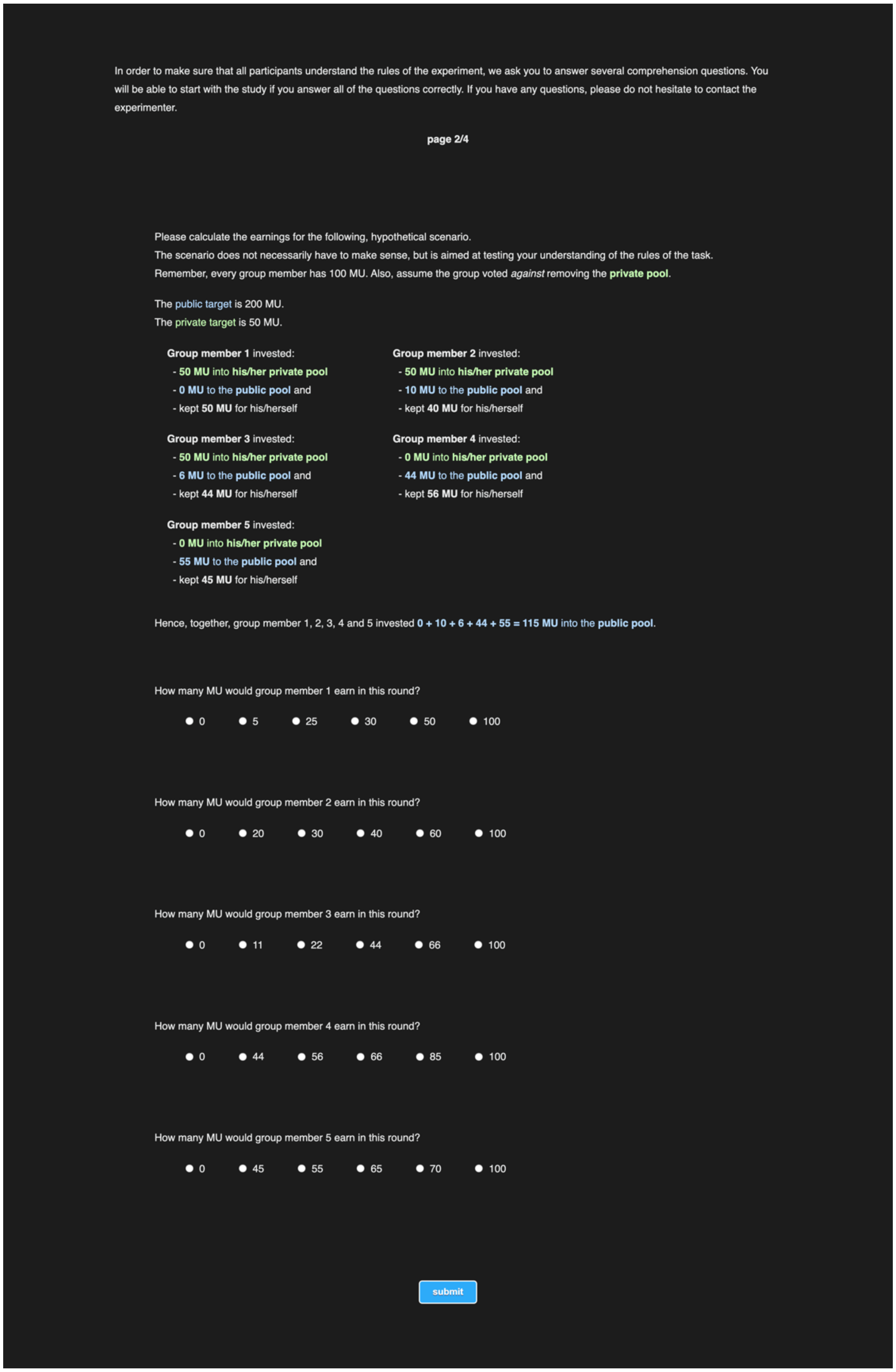


Figure S3. Comprehension questions.



In order to make sure that all participants understand the rules of the experiment, we ask you to answer several comprehension questions. You will be able to start with the study if you answer all of the questions correctly. If you have any questions, please do not hesitate to contact the experimenter.

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Please calculate the earnings for the following, hypothetical scenario.
The scenario does not necessarily have to make sense, but is aimed at testing your understanding of the rules of the task.
Remember, every group member has 100 MU. Also, assume the group voted *against* removing the **private pool**.

The public target is 200 MU.
The private target is 50 MU.

Group member 1 invested:
- **50 MU** into **his/her private pool**
- **0 MU** to the **public pool** and
- kept **50 MU** for his/herself

Group member 2 invested:
- **50 MU** into **his/her private pool**
- **10 MU** to the **public pool** and
- kept **40 MU** for his/herself

Group member 3 invested:
- **50 MU** into **his/her private pool**
- **6 MU** to the **public pool** and
- kept **44 MU** for his/herself

Group member 4 invested:
- **0 MU** into **his/her private pool**
- **44 MU** to the **public pool** and
- kept **56 MU** for his/herself

Group member 5 invested:
- **0 MU** into **his/her private pool**
- **55 MU** to the **public pool** and
- kept **45 MU** for his/herself

Hence, together, group member 1, 2, 3, 4 and 5 invested **0 + 10 + 6 + 44 + 55 = 115 MU** into the **public pool**.

How many MU would group member 1 earn in this round?

● 0 ● 5 ● 25 ● 30 ● 50 ● 100

How many MU would group member 2 earn in this round?

● 0 ● 20 ● 30 ● 40 ● 60 ● 100

How many MU would group member 3 earn in this round?

● 0 ● 11 ● 22 ● 44 ● 66 ● 100

How many MU would group member 4 earn in this round?

● 0 ● 44 ● 56 ● 66 ● 85 ● 100

How many MU would group member 5 earn in this round?

● 0 ● 45 ● 55 ● 65 ● 70 ● 100

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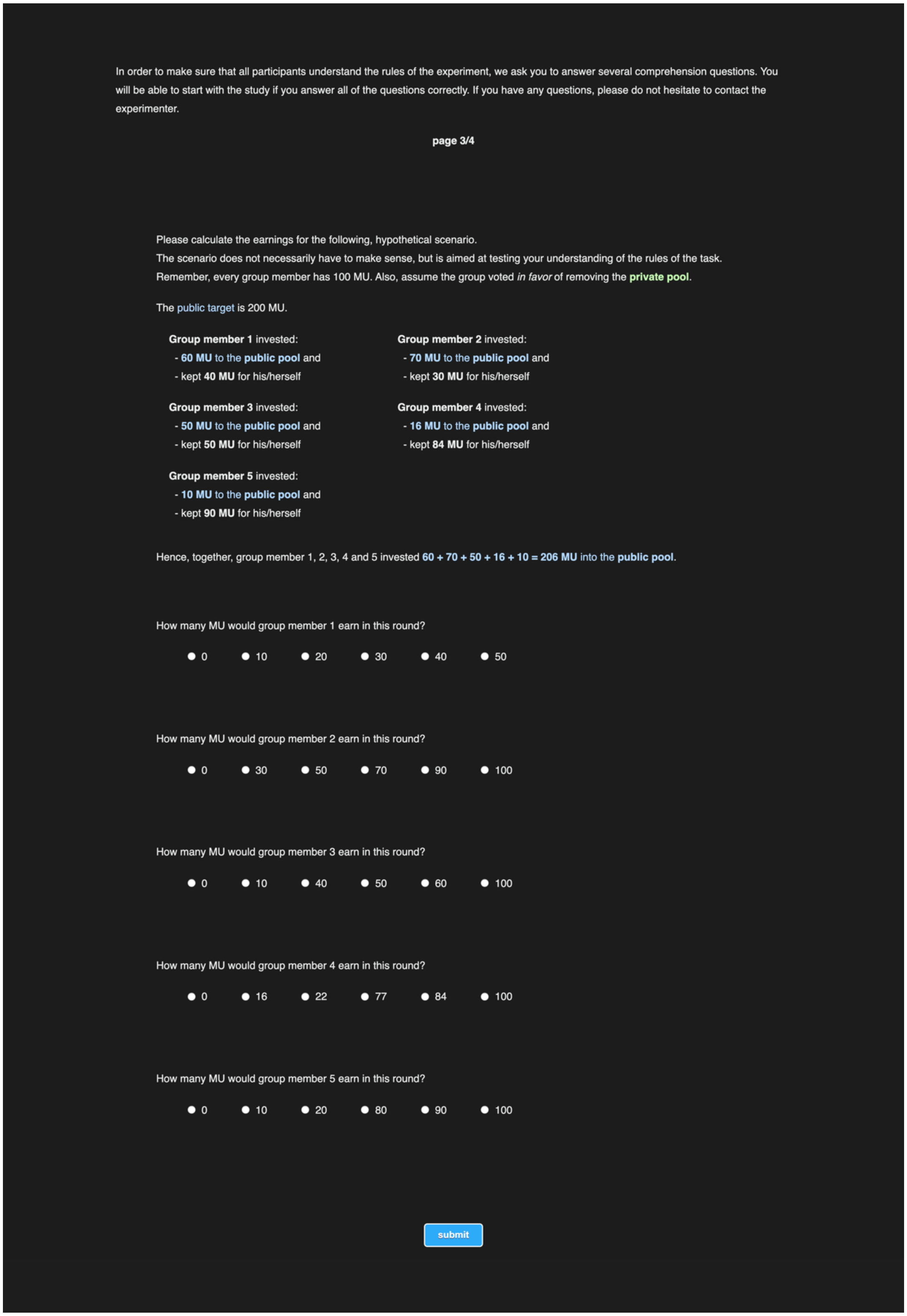
Figure S3 (continued). Comprehension questions.



In order to make sure that all participants understand the rules of the experiment, we ask you to answer several comprehension questions. You will be able to start with the study if you answer all of the questions correctly. If you have any questions, please do not hesitate to contact the experimenter.

page 3/4

Please calculate the earnings for the following, hypothetical scenario.
The scenario does not necessarily have to make sense, but is aimed at testing your understanding of the rules of the task.
Remember, every group member has 100 MU. Also, assume the group voted *in favor* of removing the **private pool**.

The public target is 200 MU.

Group member 1 invested:
- **60 MU** to the **public pool** and
- kept **40 MU** for his/herself

Group member 2 invested:
- **70 MU** to the **public pool** and
- kept **30 MU** for his/herself

Group member 3 invested:
- **50 MU** to the **public pool** and
- kept **50 MU** for his/herself

Group member 4 invested:
- **16 MU** to the **public pool** and
- kept **84 MU** for his/herself

Group member 5 invested:
- **10 MU** to the **public pool** and
- kept **90 MU** for his/herself

Hence, together, group member 1, 2, 3, 4 and 5 invested **60 + 70 + 50 + 16 + 10 = 206 MU** into the **public pool**.

How many MU would group member 1 earn in this round?

0 10 20 30 40 50

How many MU would group member 2 earn in this round?

0 30 50 70 90 100

How many MU would group member 3 earn in this round?

0 10 40 50 60 100

How many MU would group member 4 earn in this round?

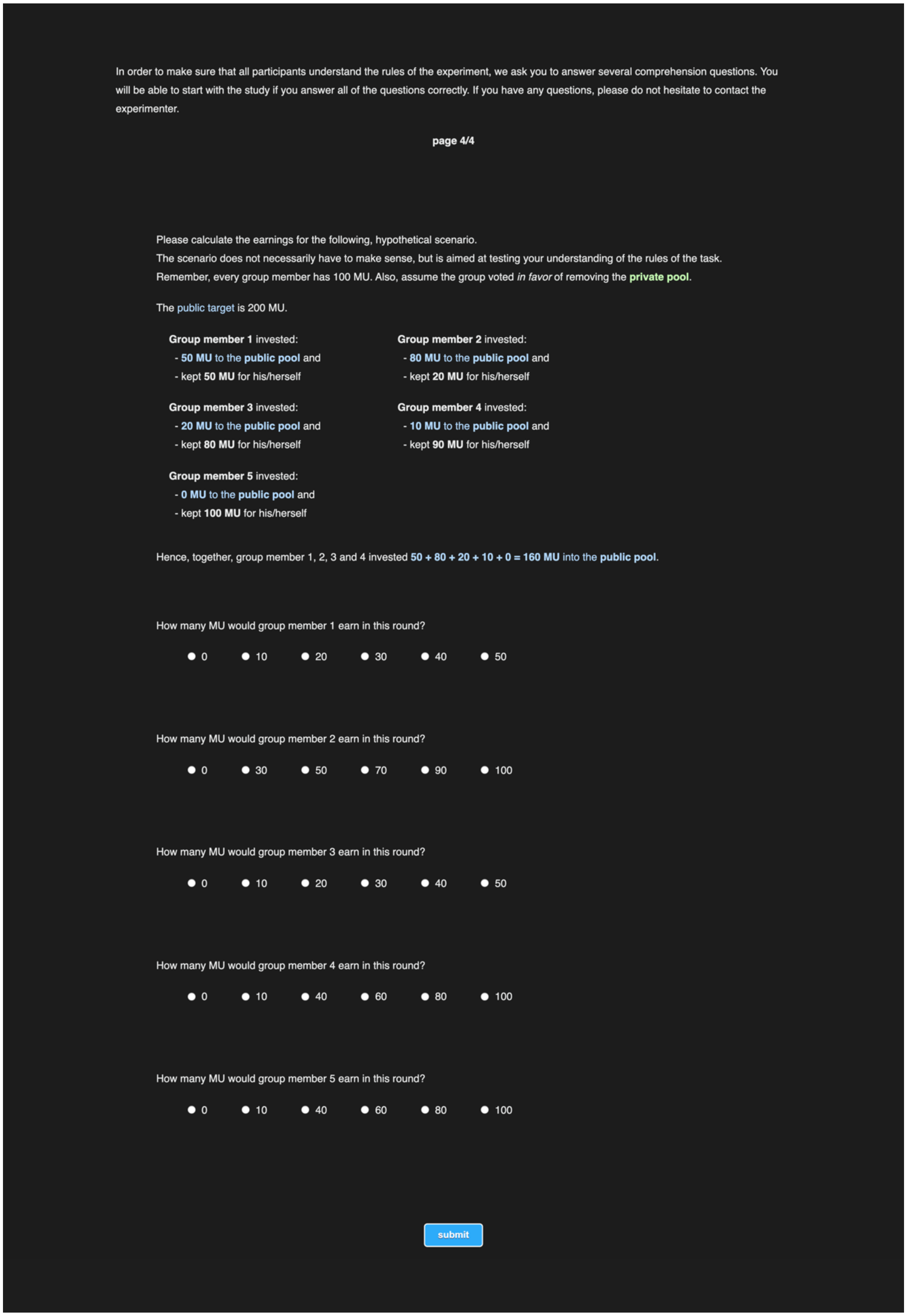
0 16 22 77 84 100

How many MU would group member 5 earn in this round?

0 10 20 80 90 100

submit

Figure S3 (continued). Comprehension questions.


In order to make sure that all participants understand the rules of the experiment, we ask you to answer several comprehension questions. You will be able to start with the study if you answer all of the questions correctly. If you have any questions, please do not hesitate to contact the experimenter.

page 4/4

Please calculate the earnings for the following, hypothetical scenario.
The scenario does not necessarily have to make sense, but is aimed at testing your understanding of the rules of the task.
Remember, every group member has 100 MU. Also, assume the group voted *in favor* of removing the **private pool**.

The public target is 200 MU.

Group member 1 invested:
- **50 MU** to the **public pool** and
- kept **50 MU** for his/herself

Group member 2 invested:
- **80 MU** to the **public pool** and
- kept **20 MU** for his/herself

Group member 3 invested:
- **20 MU** to the **public pool** and
- kept **80 MU** for his/herself

Group member 4 invested:
- **10 MU** to the **public pool** and
- kept **90 MU** for his/herself

Group member 5 invested:
- **0 MU** to the **public pool** and
- kept **100 MU** for his/herself

Hence, together, group member 1, 2, 3 and 4 invested **50 + 80 + 20 + 10 + 0 = 160 MU** into the **public pool**.

How many MU would group member 1 earn in this round?

0 10 20 30 40 50

How many MU would group member 2 earn in this round?

0 30 50 70 90 100

How many MU would group member 3 earn in this round?

0 10 20 30 40 50

How many MU would group member 4 earn in this round?

0 10 40 60 80 100

How many MU would group member 5 earn in this round?

0 10 40 60 80 100

submit

Figure S3 (continued). Comprehension questions.

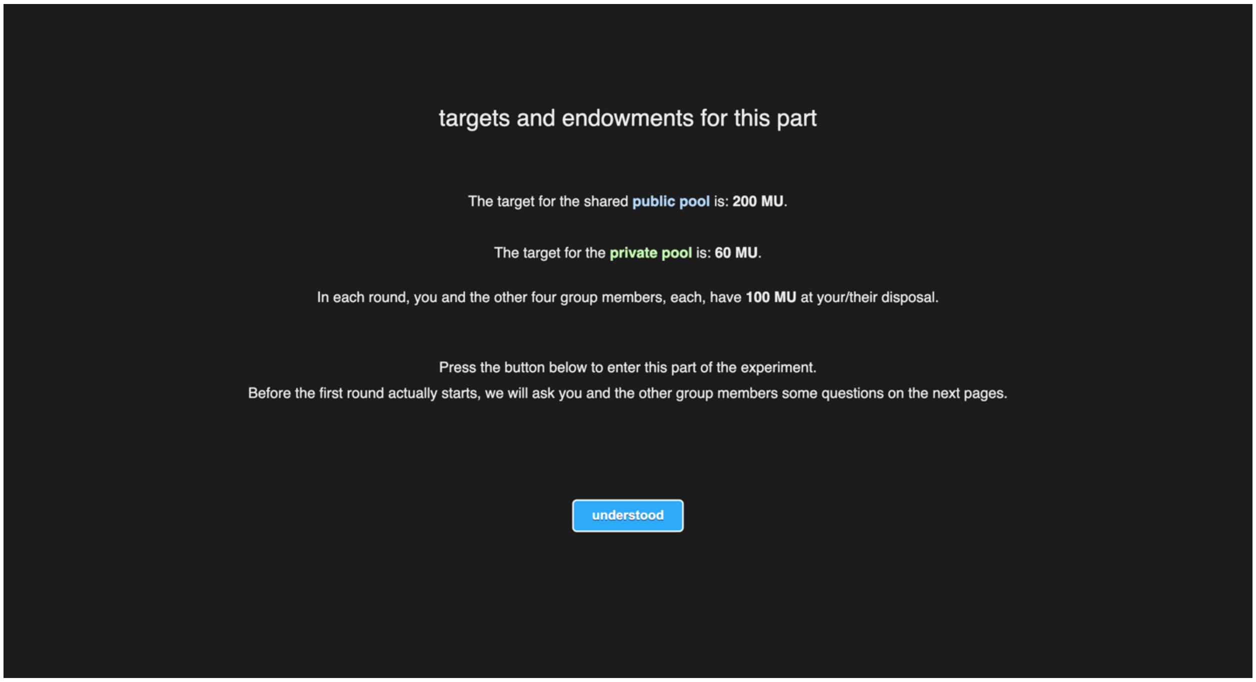


Figure S4. Target announcement.

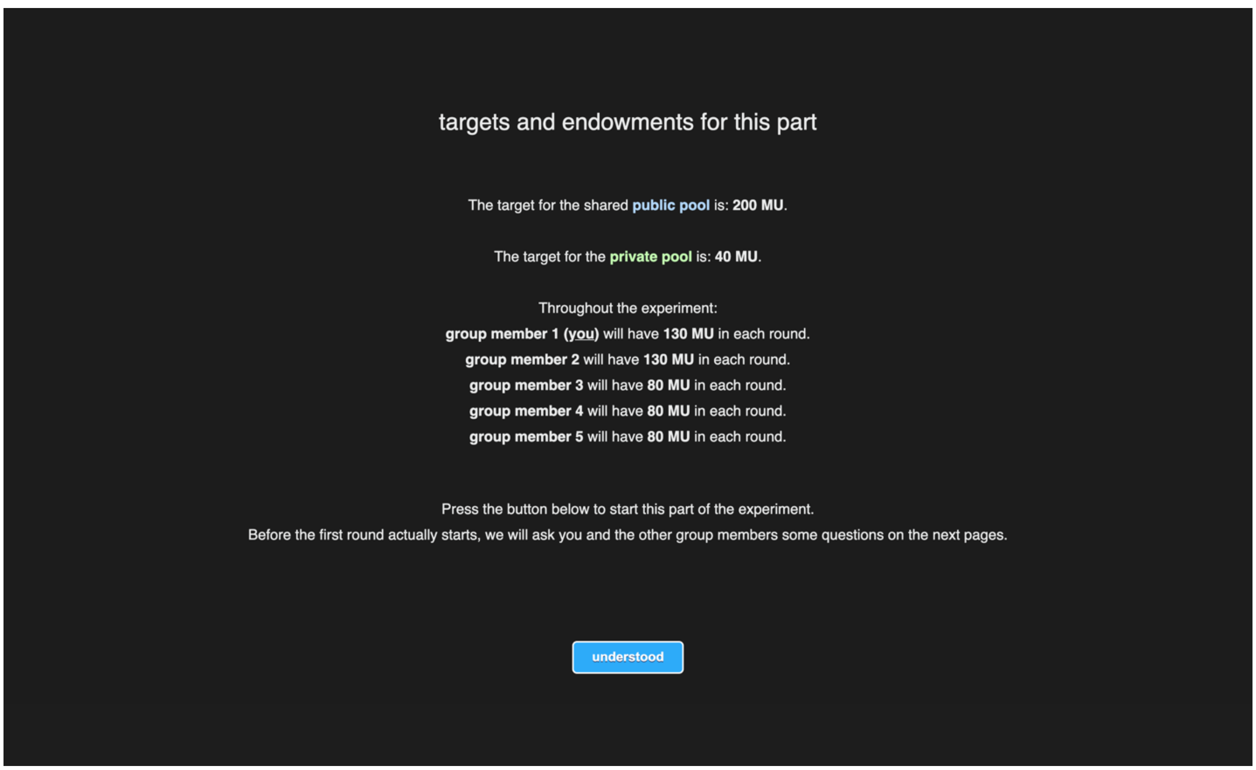


Figure S4 (continued). Target announcement in Study 2.

Figure S5. Belief elicitation (voting treatment).

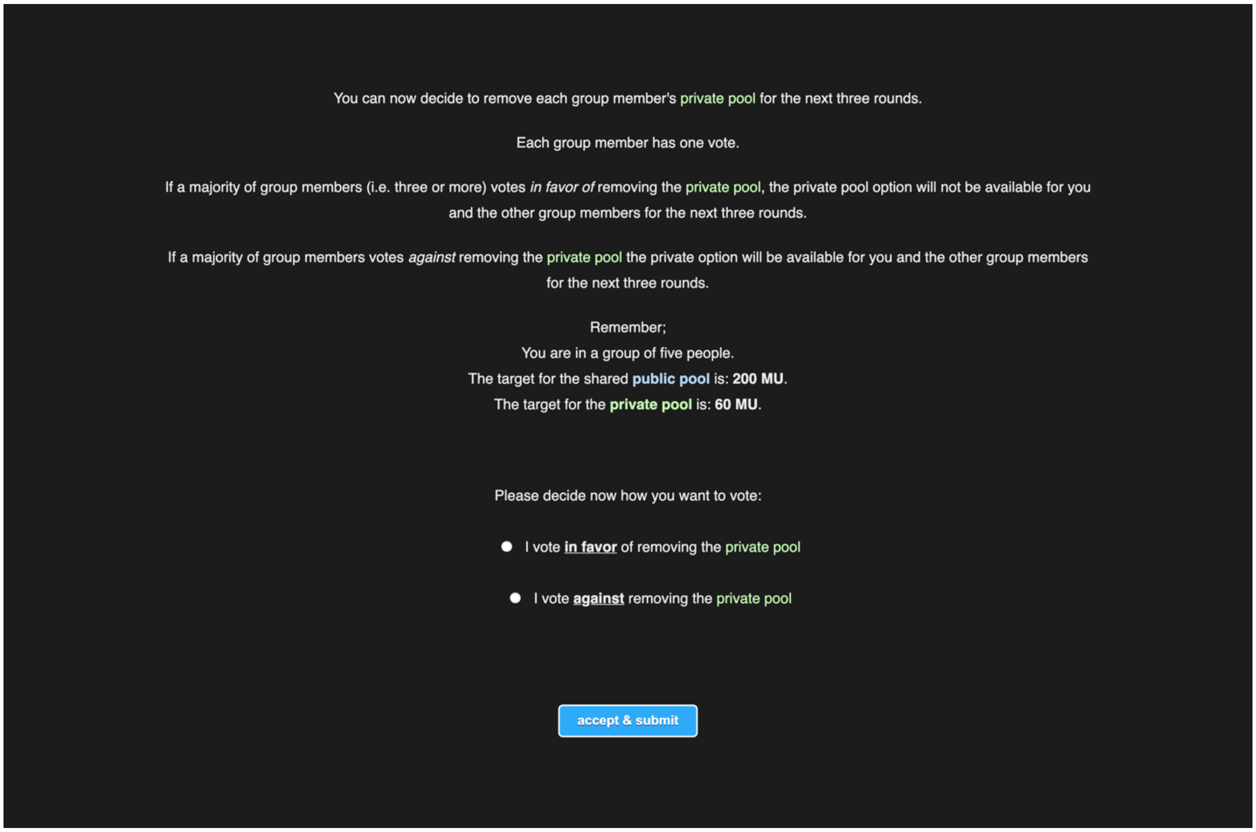


Figure S6. Voting stage.

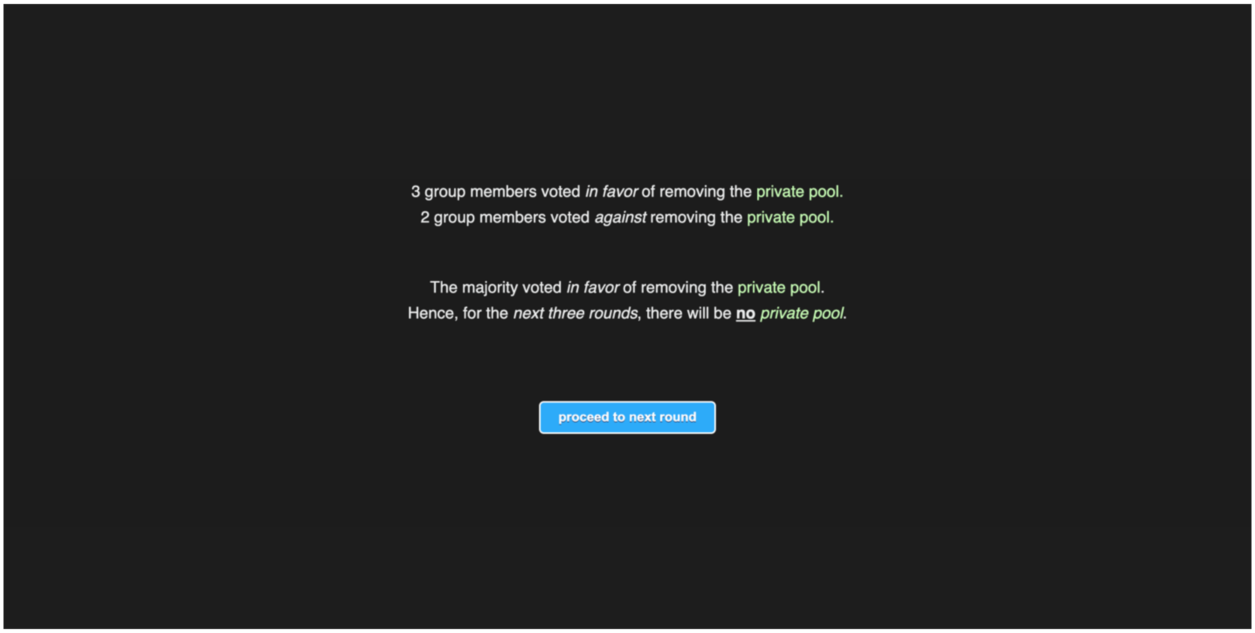


Figure S6 (continued). Voting stage (possible outcome).

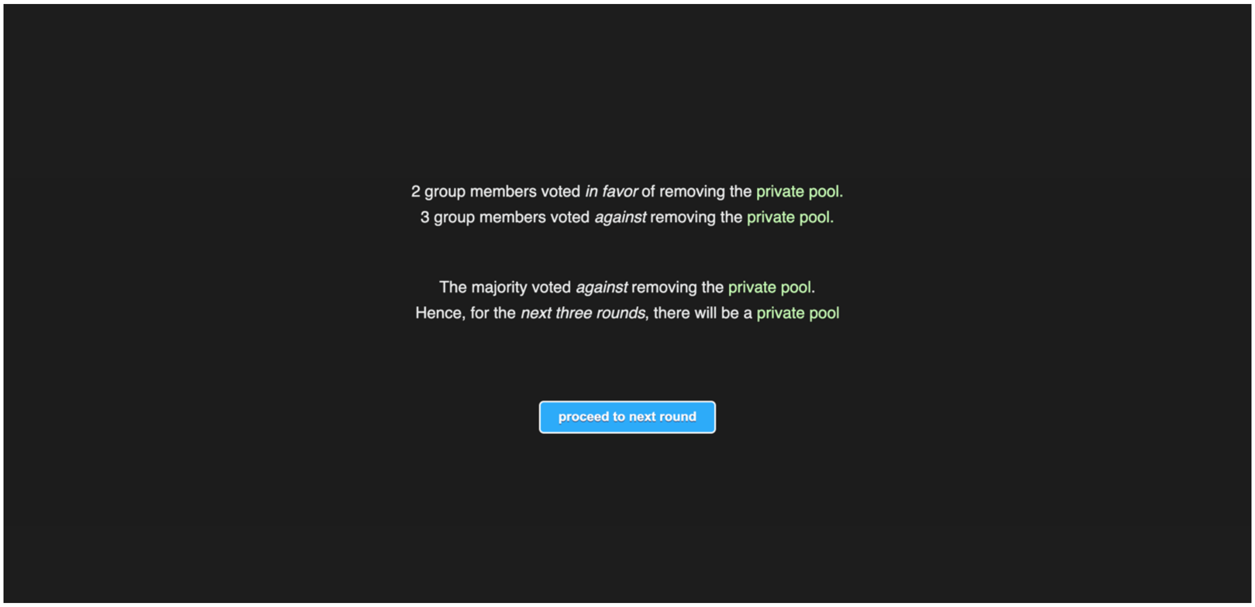


Figure S6 (continued). Voting stage (possible outcome).

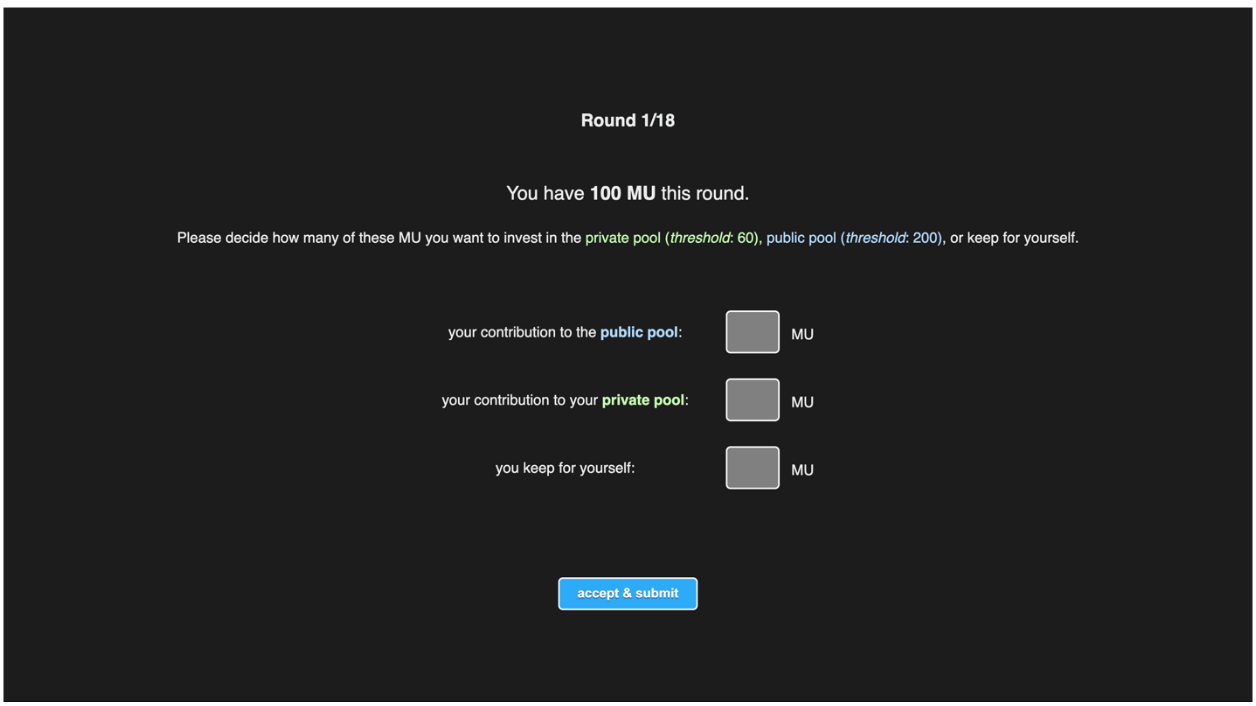


Figure S7. Contribution stage.

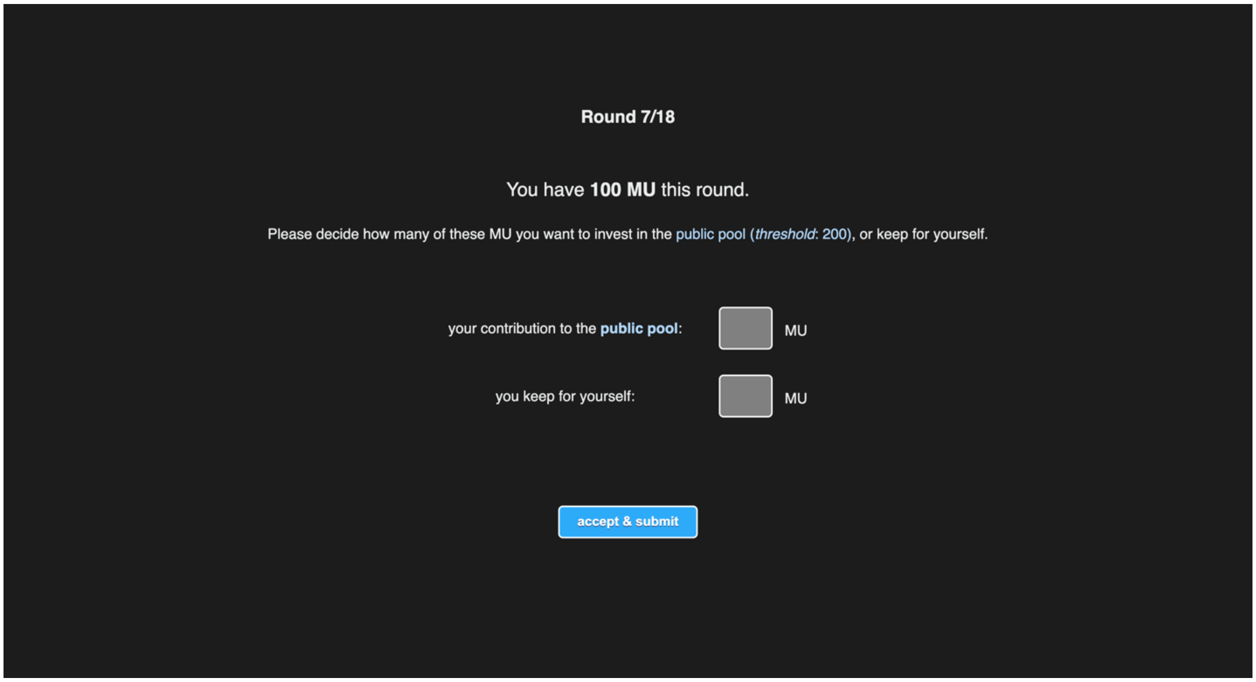


Figure S7 (continued). Contribution stage (after successfully removing the individual solution).

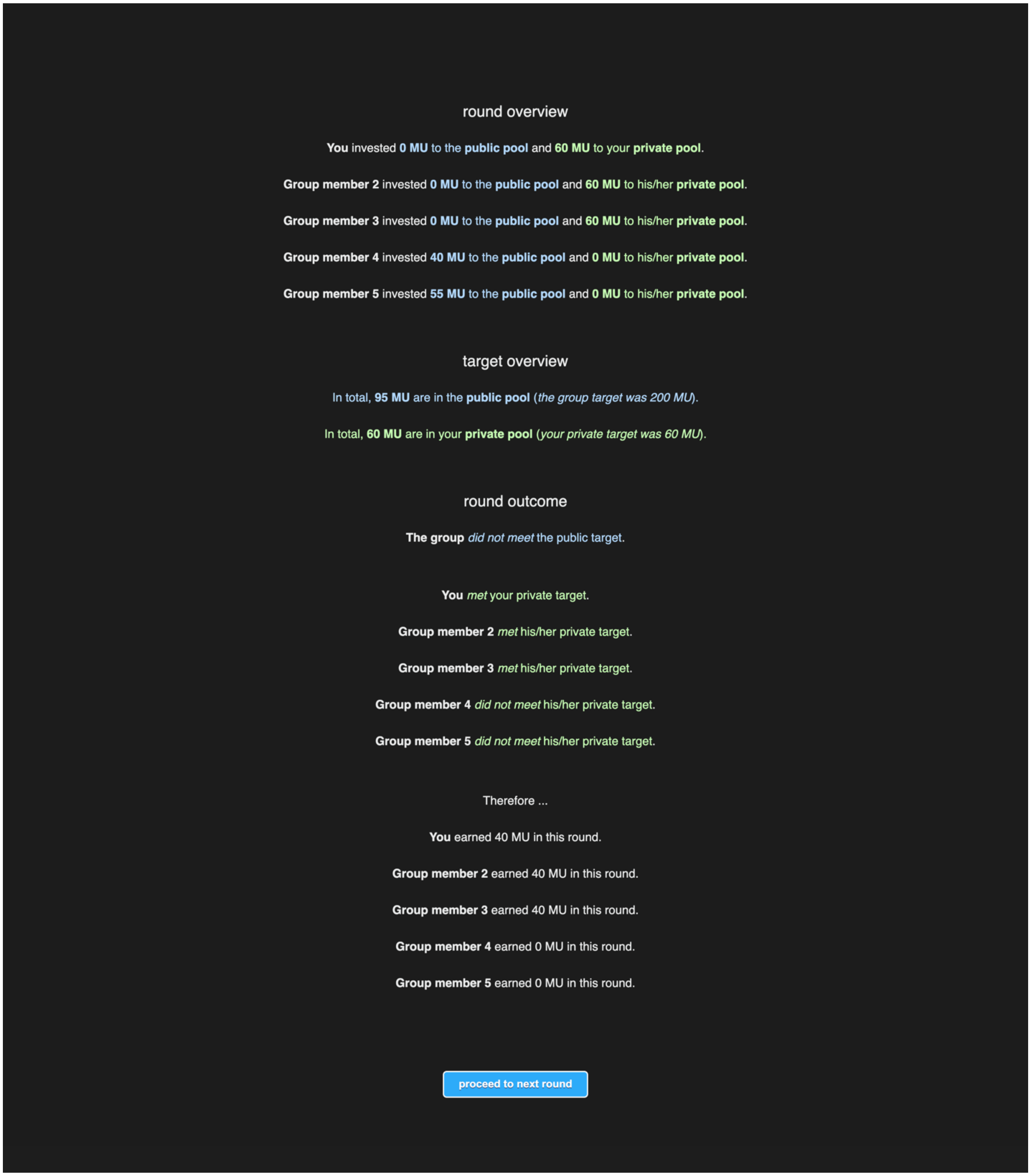


Figure S8. Feedback stage (numbers are just for illustration and do not reflect actual behavior).

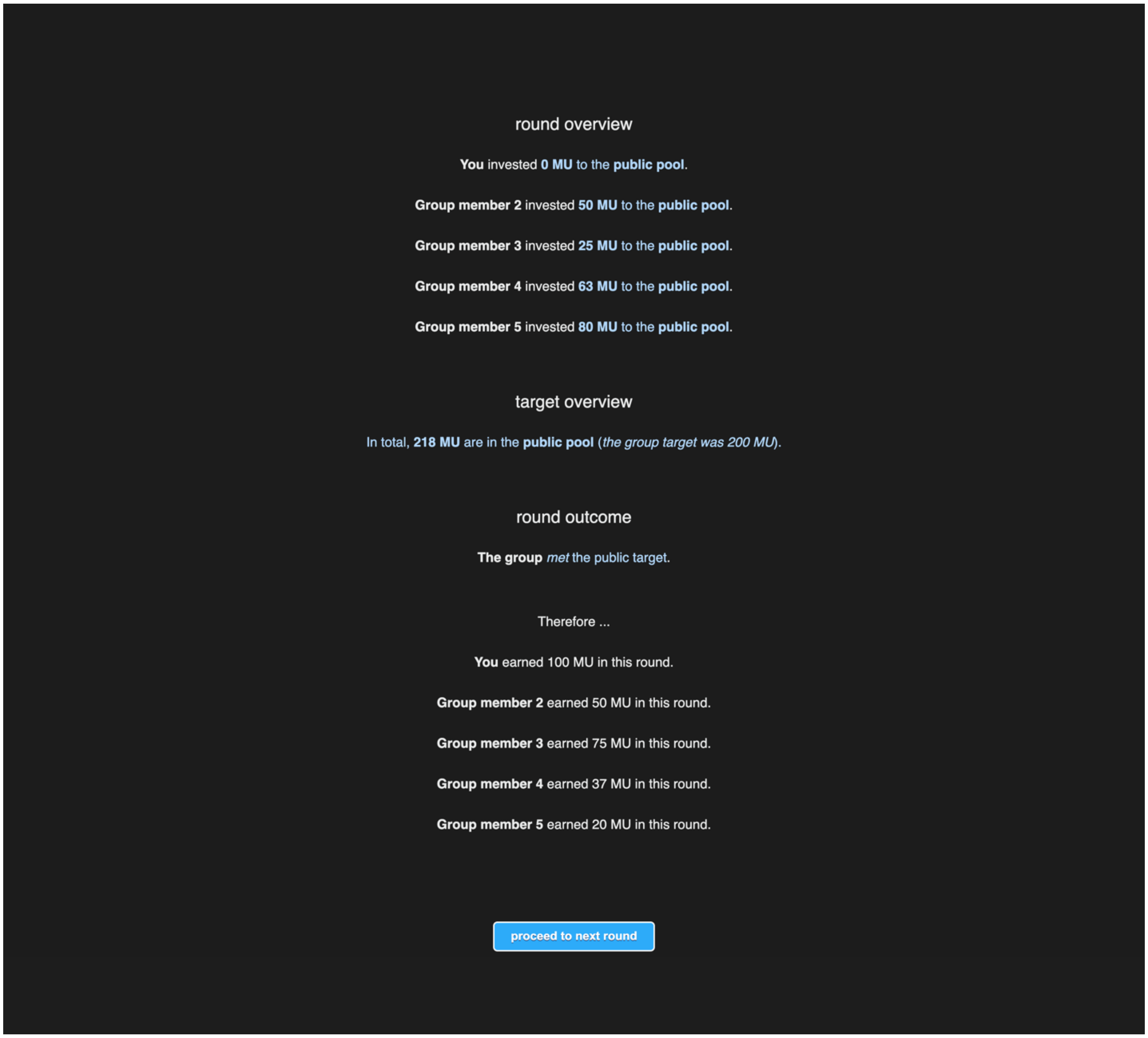


Figure S8 (continued). Feedback stage for a round in which the individual solution was abolished (numbers are just for illustration and do not reflect actual behavior).

Statistical Analyses

The data was hierarchically structured. Each data point (i.e., an investment decision) was nested in participants and groups. To account for the resulting violation of independence of individual data points, we either aggregated data on the group level to obtain independent observations (i.e., one average per group) and used non-parametric tests (as reported in the main manuscript) or fitted multilevel regression models using the 'lme4' package in R (and applying the Satterthwaite's degrees of freedom method to derive *p*-values; 20). Results based on multilevel regressions are reported below in more detail.

In each regression, we estimated two hierarchically clustered random intercepts to model decisions (level 1) nested in subjects (level 2) within groups (level 3), as shown in equation 1. When the dependent variable was binary (e.g., public threshold reached or vote-outcome) we used a generalized model with a logit link function (i.e., logistic regression).

$$
\begin{aligned}
&y_{ijk} = \beta_{0jk} + \beta_1 X_{1ijk} + e_{ijk},\ e_{ijk} \sim N\left(0, \sigma_e^2\right) && \text{(level-1)} \\
&\beta_{0jk} = \beta_{0k} + e_{0jk},\ e_{0jk} \sim N\left(0, \sigma_{e_{0jk}}^2\right) && \text{(level-2)} \qquad (1) \\
&\beta_{0k} = \beta_0 + e_{0k},\ e_{0k} \sim N\left(0, \sigma_{e_{0k}}^2\right) && \text{(level-3)} \\
&\text{where } k = \text{group}, \quad j = \text{subject}, \quad i = \text{response}
\end{aligned}
$$

The analysis of hierarchically structured data can also be performed on intermediate levels by, for example, aggregating the data across rounds or across blocks in our case, removing variation on one level and simplifying the regression equation. Doing so did not change the results substantially compared to models on the un-aggregated data and fitting the full model as specified in equation 1. We therefore report these full models for consistency, except for variables that only had one value per round (like within-group inequality in earnings or whether the public threshold was reached). In this case, we only estimated one random intercept per group since there was no subject-variation and only one observation per round.

Since each group performed three different c_i blocks in a counterbalanced order (using the same counterbalance scheme across treatments), we controlled for order by including dummy variables in the regression models. We also controlled for block-number (i.e., the block number of the respective c_i cost-level). Controlling for block-number can be interpreted as controlling for experience with the game. These control variables are omitted in the regression tables below to increase readability.

II Extended Results (Study 1)

Below, we report the regression models underlying the results and dependent variables reported in the main manuscript for Study 1.

Public investments and public solutions

Contributions to the public solution decreased when reducing the cost of the individual solution, both in the baseline and in the voting treatment (Table S1, first & second column). However, cooperation was significantly higher under medium and low interdependence in the voting treatment (Table S1, voting treatment × c_i coefficients, third column).

Similarly, the likelihood to create a public good decreased when lowering the cost of the individual solution (Table S2), both in the baseline and in the voting treatment (Table S2, first & second column). The likelihood to solve the problem collective was, however, significantly higher when groups had the ability to restrict access to individual solutions (Table S2, voting treatment × c_i coefficients, third column).

Private investments and individual solutions

Analogously, contributions toward an individual solution increased when individual solutions became cheaper (Table S3, first & second column). Yet, under medium and low interdependence, private investments significantly decreased in groups with voting power (Table S3, voting treatment × c_i coefficients, third column). Consequently, the likelihood to create individual solutions for the shared problem decreased significantly when groups had the ability to restrict access to them (Table S4, voting treatment × c_i coefficients, third column).

Table S1. Cooperation.

Multilevel regression modeling public contributions as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept (c_i = 80)	42.78 (2.16)***	38.21 (2.94)***	40.57 (2.03)***
c_i = 60	-8.50 (0.54)***	-1.71 (0.45)***	-8.50 (0.50)***
c_i = 40	-34.02 (0.54)***	-17.58 (0.46)***	-33.97 (0.50)***
round	-0.41 (0.04)***	0.09 (0.04)*	-0.16 (0.03)***
voting treatment			-0.15 (1.67)
voting treatment × c_i = 60			6.79 (0.71)***
voting treatment × c_i = 40			16.34 (0.71)***
$\sigma_{\text{level 1}}$	16.09	13.64	14.97
$\sigma_{\text{level 2}}$	6.77	3.48	5.38
$\sigma_{\text{level 3}}$	2.67	5.52	4.42

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S2. Public goods creation.

Multilevel logistic regression modeling the likelihood to meet the public threshold as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept (c_i = 80)	0.93 (0.78)	1.04 (0.82)	0.56 (0.66)
c_i = 60	-1.45 (0.20)***	-0.56 (0.20)**	-1.45 (0.20)***
c_i = 40	-7.12 (0.68)***	-2.41 (0.22)***	-7.16 (0.68)***
round	0.002 (0.02)	0.04 (0.02)*	0.02 (0.01)*
voting treatment			0.74 (0.55)
voting treatment × c_i = 60			0.90 (0.28)**
voting treatment × c_i = 40			4.76 (0.71)***
$\sigma_{\text{level 3}}$	1.38	1.54	1.57

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S3. Self-reliance.

Multilevel regression modeling private contributions as a function of the individual solution cost (c_i) and treatment.

coefficient	baseline treatment est. (std. error)	voting treatment est. (std. error)	combined model est. (std. error)
Intercept (c_i = 80)	8.09 (3.74)*	5.90 (3.28)	8.73 (2.78)**
c_i = 60	14.15 (0.63)***	1.91 (0.53)***	14.15 (0.59)***
c_i = 40	31.76 (0.63)***	16.84 (0.53)***	31.87 (0.59)***
round	0.13 (0.05)**	-0.22 (0.04)***	-0.04 (0.03)
voting treatment			-3.48 (2.28)
voting treatment × c_i = 60			-12.24 (0.83)***
voting treatment × c_i = 40			-15.15 (0.83)***
$\sigma_{\text{level 1}}$	18.96	15.97	17.60
$\sigma_{\text{level 2}}$	4.12	0.00	2.67
$\sigma_{\text{level 3}}$	7.02	6.38	6.86

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S4. Private goods creation.

Multilevel logistic regression modeling the likelihood to meet the individual threshold as a function of the individual solution cost (c_i) and treatment.

coefficient	baseline treatment est. (std. error)	voting treatment est. (std. error)	combined model est. (std. error)
Intercept (c_i = 80)	-3.71 (0.56)***	-3.70 (0.96)***	-2.98 (0.64)***
c_i = 60	2.34 (0.12)***	1.03 (0.16)***	2.25 (0.12)***
c_i = 40	7.40 (0.21)***	4.10 (0.16)***	7.13 (0.20)***
round	0.04 (0.01)***	-0.04 (0.01)***	-0.002 (0.01)
voting treatment			-1.25 (0.54)*[a]
voting treatment × c_i = 60			-1.24 (0.20)***
voting treatment × c_i = 40			-3.03 (0.25)***
$\sigma_{\text{level 2}}$	0.77	0.00	0.46
$\sigma_{\text{level 3}}$	0.99	1.89	1.58

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; a = $p > 0.05$ after Bonferroni correction, see robustness check below for details

Resource waste

Groups most efficiently solve the shared problem by investing 200 RP towards a public solution or by each investing 40 RP each towards an individual solution under $c_i = 40$. Any additional RP can be considered wasteful and taken as an indicator for miscoordination. Resource waste was particularly high under $c_i = 60$ ($i = 0.5$, 'medium' interdependence) and decreased under $c_i = 40$ ($i = 0$, 'low' interdependence), leading to an inverted u-shape relationship of interdependence level and waste in the baseline treatment (Table S5, first column). With the ability to vote on removing individual solutions, the number of wasted RP equalized across interdependence levels. There was not significant difference anymore across the c_i levels (Table S5, second column). In general, resource waste significantly decreased in the voting treatment (Table S5, voting treatment coefficient, third column) which was particularly the case under medium interdependence (Table S5, voting treatment × $c_i = 60$ coefficient, third column).

Table S5. Resource waste.

Multilevel regression modeling resource waste as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept ($c_i = 80$)	54.36 (11.90)***	20.55 (5.69)**	46.52 (7.39)***
$c_i = 60$	28.25 (2.87)***	0.99 (2.34)	28.25 (2.64)***
$c_i = 40$	-11.33 (2.87)***	-3.69 (2.35)	-10.49 (2.65)***
round	-1.40 (0.23)***	-0.62 (0.18)***	-1.01 (0.15)***
voting treatment			-18.13 (6.13)**
voting treatment × $c_i = 60$			-27.26 (3.74)***
voting treatment × $c_i = 40$			5.97 (3.74)
$\sigma_{\text{level 1}}$	38.45	31.44	35.46
$\sigma_{\text{level 2}}$	22.37	9.24	17.49

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Earnings

Participants earned the most when cooperation had no benefit over self-reliance and the problem was easily solved by meeting the individual target (c_i = 40 / i = 0, Table S6, first column). They earned the least under medium interdependence (c_i = 60 / i = 0.5, Table S6, first column). According to the model, participants earned 7.44 RP (7.89 RP) more under c_i = 80 (c_i = 60) in the voting treatment compared to the baseline treatment (voting treatment coefficient, Table S6, third column). When self-reliance was rather cheap (c_i = 40), average earnings between voting and baseline treatment did not significantly differ (post-hoc test, voting + voting treatment × c_i = 40 ≠ 0, estimate = -2.03, std. error = 3.14, p = 0.52).

Table S6. Earnings.

Multilevel regression modeling earnings as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept (c_i = 80)	31.18 (4.96)***	40.13 (4.96)***	31.94 (3.83)***
c_i = 60	-3.31 (0.64)***	-2.85 (0.66)***	-3.31 (0.65)***
c_i = 40	14.52 (0.64)***	4.98 (0.66)***	14.48 (0.65)***
round	0.50 (0.05)***	0.23 (0.05)***	0.36 (0.04)***
voting treatment			7.44 (3.14)*[a]
voting treatment × c_i = 60			0.45 (0.92)
voting treatment × c_i = 40			-9.46 (0.92)***
$\sigma_{level\ 1}$	19.15	19.72	19.45
$\sigma_{level\ 2}$	3.95	1.04	2.88
$\sigma_{level\ 3}$	9.60	9.73	9.61

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; a = $p > 0.05$ after Bonferroni correction, see robustness check below for details

Within-group inequality

The ability to constrain the ability of self-reliance not only decreased resource waste and increased earnings but also influenced within-group inequality. For each round and each group, we calculated the Gini coefficient as a measure of inequality using the Gini function of the DescTools package in R. As can be seen in Table S7 (first column), inequality increased with c_i = 60 (compared to c_i = 80) and decreased with c_i = 40 in the baseline treatment similar to the pattern we saw with resource waste. The ability of groups to restrict individual solutions significantly decreased inequality by -0.17 points (for c_i = 80) and -0.22 (for c_i = 60), while it did not significantly reduce the already low degree of inequality when groups faced a situation in which the reliance on cooperation was low because the individual solution was cheap (c_i = 40, post-hoc test, voting + voting treatment × c_i 40 ≠ 0, estimate = -0.05, std. error = 0.03, p = 0.12).

Table S7. Inequality.

Multilevel regression modeling within-group inequality (measured by the Gini coefficient) as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept (c_i = 80)	0.37 (0.06)***	0.10 (0.03)**	0.32 (0.04)***
c_i = 60	0.05 (0.02)**	0.004 (0.01)	0.05 (0.01)***
c_i = 40	-0.12 (0.02)***	0.01 (0.01)	-0.12 (0.01)***
round	-0.01 (0.001)***	-0.003 (0.0006)***	-0.01 (0.0008)***
voting treatment			-0.17 (0.03)***
voting treatment × c_i = 60			-0.05 (0.02)*[a]
voting treatment × c_i = 40			0.12 (0.02)***
$\sigma_{\text{level 1}}$	0.25	0.10	0.19
$\sigma_{\text{level 2}}$	0.10	0.05	0.08

Note. * p < 0.05, ** p < 0.01, *** p < 0.001; a = p > 0.05 after Bonferroni correction, see robustness check for details

Voting and voting outcome

The support for voting in favor of removing the individual solution increased with higher social interdependence (multilevel logistic regression, coefficient i = 2.65, std. error = 0.18, p < 0.001). When using c_i as a categorical predictor, it can be seen that the support for restricting individual solutions only decreased by 2.5 percentage points when moving from high to medium interdependence (Table S8, c_i = 60 coefficient) but decreased by 52 points when moving to i = 0 (Table S8, c_i = 40 coefficient).

Consequently, the likelihood to successfully remove the individual solution and restrict the ability of self-reliance was the highest under c_i = 80 & c_i = 40 (Table S9).

Table S8. Voting.

Multilevel logistic regression modeling the likelihood to vote in favor of removing the individual solution as a function of the individual solution cost (c_i).

coefficient	**voting treatment** est. (std. error)
Intercept (c_i = 80)	1.78 (0.57)**
c_i = 60	-0.19 (0.18)
c_i = 40	-2.46 (0.18)***
voting round	0.09 (0.04)*
$\sigma_{\text{level 2}}$	1.29
$\sigma_{\text{level 3}}$	0.84

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table S9. Voting outcome.

Multilevel logistic regression modeling the likelihood to remove the individual solution (i.e., reaching a majority) as a function of the individual solution cost (c_i).

coefficient	**voting treatment** est. (std. error)
Intercept (c_i = 80)	3.00 (0.84)***
c_i = 60	-0.80 (0.56)
c_i = 40	-3.60 (0.53)***
voting round	0.15 (0.10)
$\sigma_{\text{level 2}}$	1.00

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

III Extended Results (Study 2)

In Study 2, we further manipulated the RP available to each group member within groups, adding an additional between-subjects factor. Below, we report the regression models underlying the results and dependent variables reported in the main manuscript for Study 2.

Public investments and public solutions

Figure S9 shows the average cooperation and public goods creation (i.e., solving the problem cooperatively by meeting the public threshold) depending on treatment and RP endowment. Especially under medium ($c_i = 60$ / $i = 0.5$) and low ($c_i = 80$ / $i = 0$) interdependence, cooperation was higher in the voting treatment (Figure S9A), which mainly was driven by 'richer' group members increasing their public pool contributions (Figure S9C).

Table S10 shows the regression results for public investments. The first and second column shows the simple model estimating average contributions regardless of RP endowment which allows to draw comparisons to Study 1. The third and fourth column shows the regression results when differentiating between 'poorer' ($e = 80$, coded as baseline) and 'richer' group members ($e = 130$). The last column shows the full model that allows to draw conclusions about group member type ($e = 80$, coded as baseline / $e = 130$) in interaction with treatment (baseline vs. voting).

As in Study 1, cooperation rates significantly decreased when individual solution costs reduced (Table S10, column 1 & 2). In the baseline treatment, 'richer' group members contributed around 9 RP more to a public solution compared to 'poorer' group members when social interdependence was high ($c_i = 80$ / $i = 1$, Table S10, column 3, $e = 130$ coefficient). In relative terms, however, this means that 'poorer' group members contributed around 53% of their endowment, while 'richer' group members only contributed around 40% of their endowment. This gap further increased under $c_i = 40$ (Table S10, column 3, $e = 130 \times c_i = 40$ coefficient). In the voting treatment, especially 'richer' group members increased their contributions compared to 'poorer' group members (Table S10, column 4, $e = 130$ coefficient), and compared to 'richer' group members in the baseline treatment (Table S10, column 5, voting treatment $\times$ $e = 130$ coefficient), while 'poorer' group members could reduce their contributions to the public solutions especially under $c_i = 80$ compared to ‘poorer’ group members in the baseline treatment (Table S10, column 5, voting treatment coefficient).

Consequently, and similar to Study 1, the likelihood of creating a public good and solving the problem cooperatively decreased with c_i = 60 and c_i = 40 in the baseline treatment (Table S11, first column, c_i = 60 & c_i = 40 coefficient), while it only decreased for c_i = 40 in the voting treatment (Table S11, second column, c_i = 60 & c_i = 40 coefficient). Overall, when groups had the ability to restrict individual solutions, they had a significant higher likelihood to solve the problem cooperatively under c_i = 60 & c_i = 40 (Table S11, third column, voting treatment × c_i = 60 & voting treatment × c_i = 40 coefficient). When social interdependence was already high (c_i = 80 / i =1), restricting access to individual solutions did not further increase public goods creation (Table S11, third column, voting treatment coefficient).

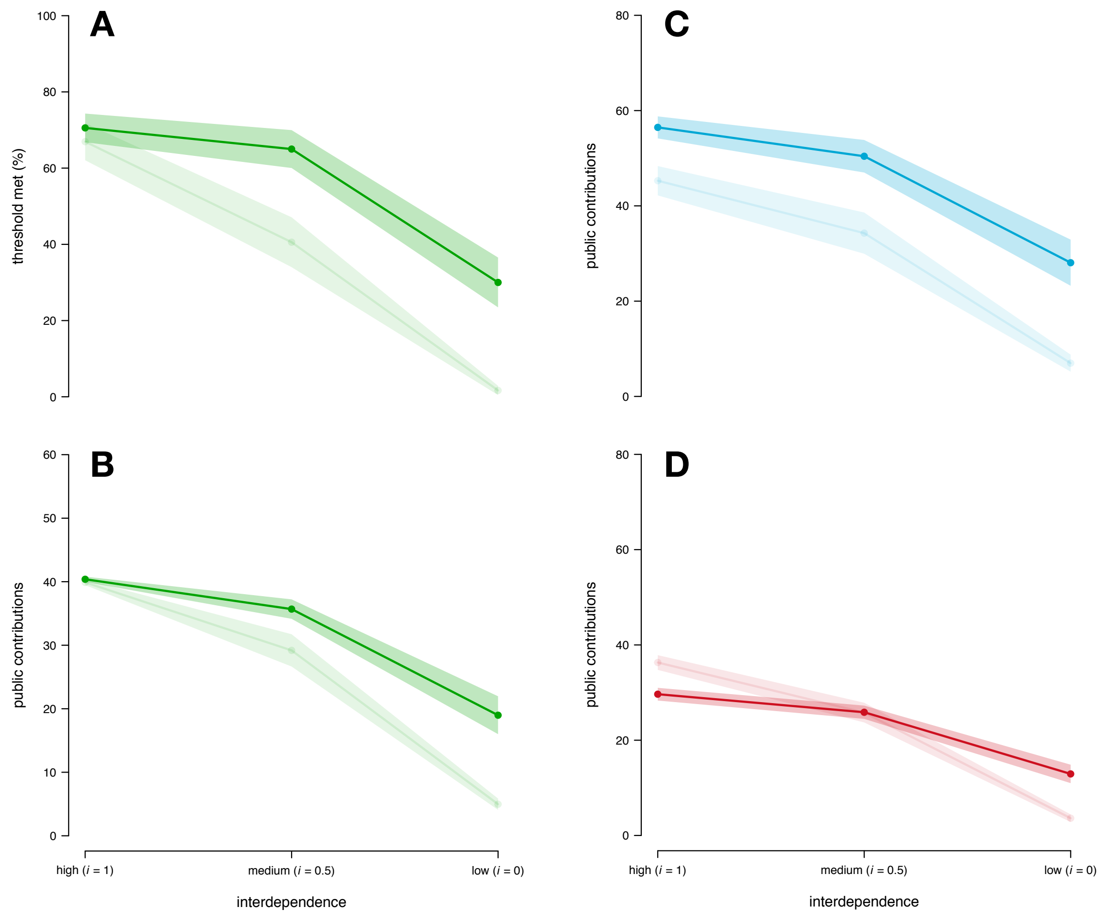


Figure S9. Public contributions and public goods creation in Study 2. (**A**) Average percentage of public threshold met and (**B**) average RP contributed towards a public solution across interdependence levels. (**C**) Average RP contributed towards a public solution by 'richer' group members (e = 130) and (**D**) average RP contributed towards a public solution by 'poorer' group members (e = 80). Solid colors: voting treatment, light colors: baseline treatment. The band around the averages indicate the standard error of the mean.

Table S10. Cooperation.

Multilevel regression modeling public contributions as a function of the individual solution cost (c_i), treatment, and starting endowment.

coefficient	**baseline'** est. (se)	**voting'** est. (se)	**baseline''** est. (se)	**voting''** est. (se)	**full** est. (se)
Intercept (c_i = 80)	46.26*** (2.56)	39.94*** (3.38)	42.67*** (2.70)	29.22*** (3.08)	39.27*** (2.29)
round	-0.30*** (0.04)	-0.13** (0.04)	-0.30*** (0.04)	-0.13** (0.04)	-0.21*** (0.03)
c_i = 60	-10.71*** (0.56)	-4.70*** (0.51)	-10.52*** (0.72)	-3.79*** (0.65)	-10.52*** (0.69)
c_i = 40	-34.97*** (0.56)	-21.30*** (0.51)	-32.72*** (0.72)	-16.63*** (0.65)	-32.65*** (0.69)
e = 130			8.97*** (2.09)	26.82*** (1.97)	8.97*** (2.03)
e = 130 × c_i = 60			-0.49 (1.14)	-2.27* (1.03)	-0.49 (1.09)
e = 130 × c_i = 40			-5.62*** (1.14)	-11.67*** (1.03)	-5.62*** (1.09)
voting treatment					-6.65** (2.11)
voting treatment × c_i = 60					6.73*** (0.97)
voting treatment × c_i = 40					15.95*** (0.97)
voting treatment × e = 130					17.85*** (2.88)
voting treatment × e = 130 × c_i = 60					-1.79 (1.54)
voting treatment × e = 130 × c_i = 40					-6.06*** (1.54)
$\sigma_{\text{level 1}}$	16.82	15.34	16.78	15.14	15.99
$\sigma_{\text{level 2}}$	10.13	14.77	9.45	8.99	9.22
$\sigma_{\text{level 3}}$	1.81	0.00	2.43	4.15	3.35

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; se = standard error

Table S11. Public goods creation.

Multilevel logistic regression modeling the likelihood to meet the public threshold as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept (c_i = 80)	1.58 (0.61)**	0.30 (0.37)	0.82 (0.41)*
c_i = 60	-1.35 (0.18)***	-0.26 (0.17)	-1.33 (0.18)***
c_i = 40	-5.82 (0.54)***	-1.91 (0.18)***	-5.62 (0.50)***
round	0.02 (0.02)	0.02 (0.01)	0.02 (0.01)*
voting treatment			0.09 (0.34)
voting treatment × c_i = 60			1.06 (0.24)***
voting treatment × c_i = 40			3.68 (0.53)***
$\sigma_{\text{level 3}}$	1.01	0.55	0.90

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Private investments and individual solutions

Figure S10 shows the frequency of solving the problem individually and average individual pool investments between treatments. Conversely to the cooperation patterns, private investments decreased in the voting treatment (Figure S10B). Especially 'richer' group members spent less resources on solving the problem on their own in the voting treatment (Figure S10C) but also 'poorer' group members assigned less resources towards an individual solution (partly, of course, because groups decided to abolish individual solutions entirely and made it impossible for group members to solve the problem individually).

Table S12 and S13 shows the fitted models for private contributions and the likelihood to solve the problem individually, respectively, across c_i cost levels and treatment. Contributions towards an individual solution significantly decreased under c_i = 60 & c_i = 80 in the voting treatment compared to the baseline treatment (Table S12, fifth column, voting treatment × c_i = 60 coefficient & voting treatment × c_i = 40) and further decreased for 'richer' group members (Table S12, fifth column, voting treatment × e = 130 coefficient). Likewise, the likelihood to solve the problem individually was significantly lower in the voting treatment (Table S12, fifth column, voting treatment coefficient), irrespective of the cost of the individual solution or RP endowment. Interestingly, the likelihood to solve the shared problem individually significantly increased over rounds in the baseline treatment (Table S12, first column, round coefficient), which was not the case in the voting treatment (Table S12, second column, round coefficient).

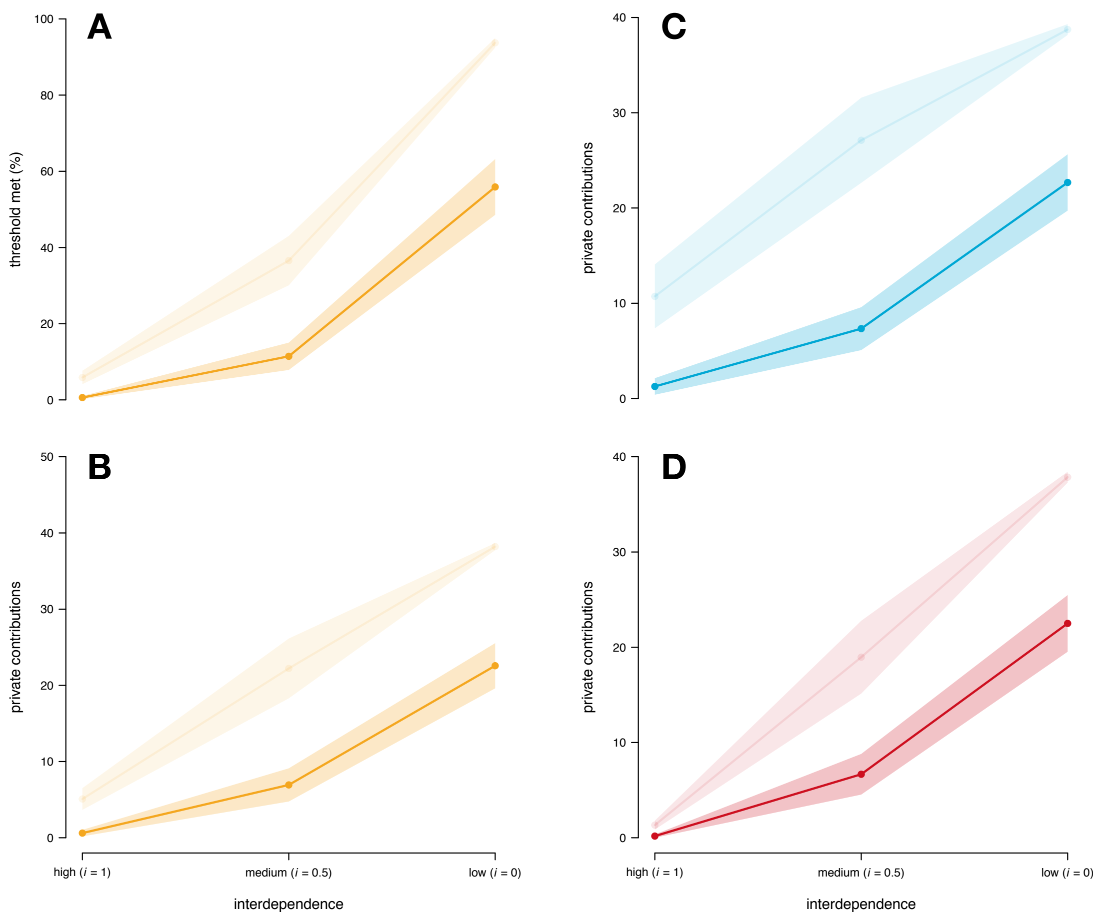


Figure S10. Private contributions and private goods creation in Study 2. (**A**) Average percentage of individual threshold (c_i) met and (**B**) average RP contributed towards an individual solution across interdependence levels. (**C**) Average RP contributed towards an individual solution by 'richer' group members (e = 130) and (**D**) average RP contributed towards an individual solution by 'poorer' group members (e = 80). Solid colors: voting treatment, light colors: baseline treatment. The band around the averages indicate the standard error of the mean.

Table S12. Self-reliance.

Multilevel regression modeling private contributions as a function of the individual solution cost (c_i), treatment, and starting endowment.

coefficient	**baseline'** est. (se)	**voting'** est. (se)	**baseline''** est. (se)	**voting''** est. (se)	**full** est. (se)
Intercept (c_i = 80)	1.83 (4.11)	4.62 (3.31)	-1.93 (4.15)	4.19 (3.33)	1.70 (2.85)
round	0.11* (0.05)	-0.02 (0.04)	0.11* (0.05)	-0.02 (0.04)	0.04 (0.03)
c_i = 60	17.13*** (0.62)	6.32*** (0.50)	17.63*** (0.80)	6.49*** (0.65)	17.63*** (0.73)
c_i = 40	32.94*** (0.63)	21.65*** (0.50)	36.35*** (0.80)	22.02*** (0.65)	36.28*** (0.73)
e = 130			9.39*** (1.40)	1.09 (0.73)	9.39*** (1.08)
e = 130 × c_i = 60			-1.24 (1.27)	-0.42 (1.03)	-1.24 (1.16)
e = 130 × c_i = 40			-8.52*** (1.27)	-0.91 (1.03)	-8.52*** (1.16)
voting treatment					-1.15 (2.39)
voting treatment × c_i = 60					-11.14*** (1.03)
voting treatment × c_i = 40					-14.20*** (1.03)
voting treatment × e = 130					-8.31*** (1.53)
voting treatment × e = 130 × c_i = 60					0.82 (1.64)
voting treatment × e = 130 × c_i = 40					7.61*** (1.64)
$\sigma_{\text{level 1}}$	18.71	15.10	18.63	15.10	17.00
$\sigma_{\text{level 2}}$	6.21	0.00	5.27	0.00	3.49
$\sigma_{\text{level 3}}$	7.53	6.47	7.68	6.47	6.91

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; se = standard error

Table S13. Private goods creation.

Multilevel logistic regression modeling the likelihood to meet the individual threshold as a function of the individual solution cost (c_i), treatment, and starting endowment.

coefficient	**baseline'** est. (se)	**voting'** est. (se)	**baseline''** est. (se)	**voting''** est. (se)	**full** est. (se)
Intercept (c_i = 80)	-5.00*** (0.67)	-5.60*** (0.96)	-6.96*** (0.76)	-7.51*** (1.35)	-5.90*** (0.70)
round	0.03*** (0.01)	0.01 (0.01)	0.03*** (0.01)	0.01 (0.01)	0.02** (0.01)
c_i = 60	3.25*** (0.16)	3.37*** (0.32)	4.87*** (0.37)	5.22*** (1.00)	4.62*** (0.34)
c_i = 40	7.72*** (0.22)	6.50*** (0.33)	9.42*** (0.41)	8.39*** (1.00)	9.01*** (0.38)
e = 130			3.22*** (0.44)	2.76** (1.04)	3.03*** (0.38)
e = 130 × c_i = 60			-2.39*** (0.40)	-2.61* (1.06)	-2.23*** (0.37)
e = 130 × c_i = 40			-2.72*** (0.48)	-2.69* (1.05)	-2.57*** (0.44)
voting treatment					-2.54*[a] (1.16)
voting treatment × c_i = 60					0.53 (1.06)
voting treatment × c_i = 40					-0.63 (1.07)
voting treatment × e = 130					-0.24 (1.12)
voting treatment × e = 130 × c_i = 60					-0.39 (1.12)
voting treatment × e = 130 × c_i = 40					-0.16 (1.15)
$\sigma_{\text{level 2}}$	1.21	0.00	1.04	0.00	0.62
$\sigma_{\text{level 3}}$	1.14	1.80	1.19	1.80	1.53

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; se = standard error; a = $p > 0.05$ after Bonferroni correction, see robustness check below for details

Resource waste

Table S14 shows the regression results for resource waste of groups (i.e., total investments as deviation from the most efficient expenditure of 200 RP). As in Study 1, resource waste followed an inverted u-shape relationship, increasing under $c_i = 60$ and decreasing again under $c_i = 40$ (Table S14, first and second column). In the voting treatment, resource waste declined by around 20 RP according to the model under $c_i = 80$ and further decreased by 24 RP points under $c_i = 60$, while it only decreased by 8 RP points under $c_i = 40$ (Table S14, third column, voting treatment coefficients).

Table S14. Resource waste.

Multilevel regression modeling resource waste as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept ($c_i = 80$)	40.42 (10.85)**	22.83 (5.29)***	41.59 (6.75)***
$c_i = 60$	32.11 (2.64)***	8.13 (2.01)***	32.11 (2.35)***
$c_i = 40$	-10.15 (2.65)***	1.78 (2.02)	-10.11 (2.35)***
round	-0.98 (0.21)***	-0.72 (0.16)***	-0.85 (0.13)***
voting treatment			-19.94 (5.60)***
voting treatment × $c_i = 60$			-23.98 (3.32)***
voting treatment × $c_i = 40$			11.84 (3.32)***
$\sigma_{\text{level 1}}$	35.45	26.96	31.49
$\sigma_{\text{level 2}}$	20.36	8.93	16.07

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Earnings

Figure S11 shows average individual earnings per interdependence level and starting endowment. While the earnings gap increased in the baseline treatment across interdependence levels (Figure S11A, resonating with previous findings, see 21), it remained closer together in the voting treatment (Figure S11B).

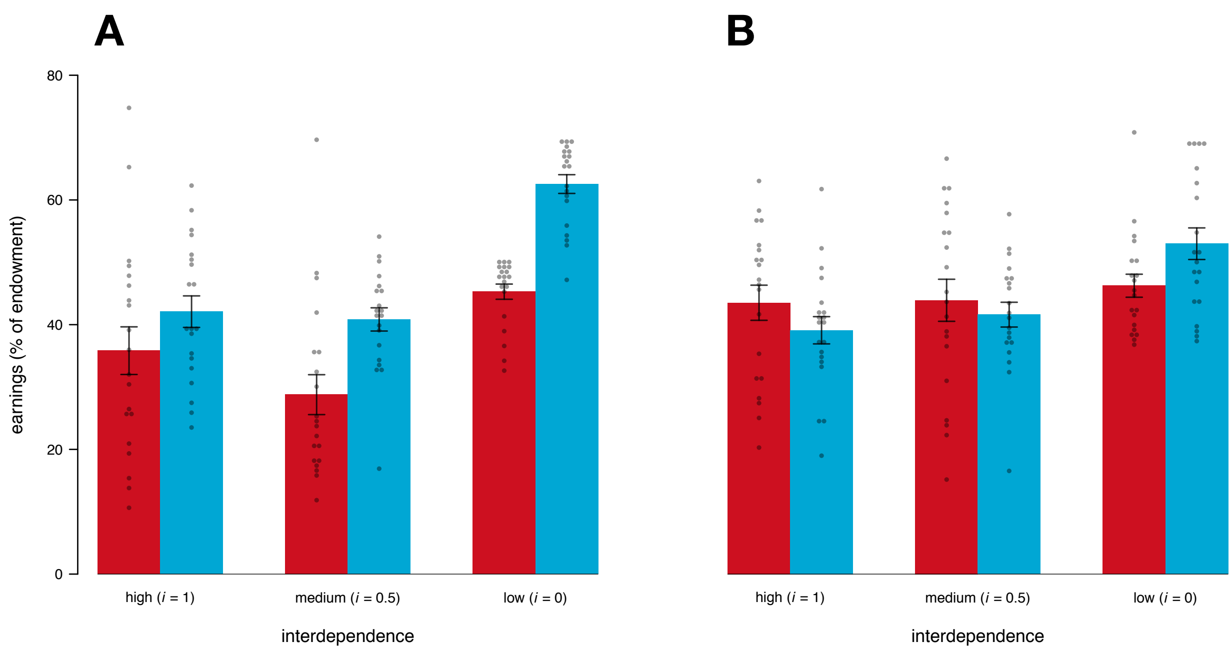


Figure S11. Earnings. Earnings as a percentage of the starting endowment of 'poorer' (e = 80, red, left bars) and 'richer' group members (e = 130, blue, right bars) in (**A**) the baseline treatment and (**B**) the voting treatment. Error bars indicate the standard error of the mean. Individual points show averages per group.

Overall, individual earnings, unsurprisingly, followed the reverse pattern of resource waste in the baseline treatment (Table S15, first column). Yet, in the voting treatment, earnings did not significantly decrease anymore under medium interdependence (c_i = 60, compared to high interdependence, Table S15, first column, c_i = 60 coefficient). In the baseline treatment, 'richer' group members earned 26-45 RP (depending on the interdependence level) more than 'poorer' group members (Table S15, column 3). Being able to vote on restricting individual solutions, earnings of 'poorer' group members significantly increased compared to the baseline treatment (Table S15, column 5, voting treatment coefficient), especially under c_i = 80 & c_i = 60 (i.e., high and medium interdependence). In contrast, 'richer' group members earned significantly less in the voting treatment (around 10 RP according to the model estimate). Hence, in the voting treatment, the wealth gap between 'poorer' and 'richer' group members narrowed compared to the baseline treatment. Especially 'poorer' group members benefitted from the group's ability to restrict individual solutions.

Table S15. Earnings.

Multilevel regression modeling earnings as a function of the individual solution cost (c_i), treatment, and starting endowment.

coefficient	**baseline'** est. (se)	**voting'** est. (se)	**baseline''** est. (se)	**voting''** est. (se)	**full** est. (se)
Intercept (c_i = 80)	34.95*** (4.37)	34.53*** (3.20)	24.53*** (3.58)	28.12*** (2.76)	23.25*** (2.49)
round	0.51*** (0.06)	0.42*** (0.07)	0.51*** (0.06)	0.42*** (0.07)	0.46*** (0.04)
c_i = 60	-4.04*** (0.73)	1.49 (0.84)	-5.64*** (0.93)	0.32 (1.08)	-5.64*** (1.01)
c_i = 40	15.72*** (0.73)	8.87*** (0.85)	8.11*** (0.93)	2.52* (1.08)	8.01*** (1.01)
e = 130			26.05*** (1.69)	16.02*** (1.76)	26.05*** (1.73)
e = 130 × c_i = 60			4.02** (1.47)	2.94 (1.71)	4.02*[a] (1.59)
e = 130 × c_i = 40			19.03*** (1.47)	15.86*** (1.71)	19.03*** (1.59)
voting treatment					6.15** (2.21)
voting treatment × c_i = 60					5.96*** (1.42)
voting treatment × c_i = 40					-5.38*** (1.42)
voting treatment × e = 130					-10.03*** (2.44)
voting treatment × e = 130 × c_i = 60					-1.08 (2.25)
voting treatment × e = 130 × c_i = 40					-3.16 (2.25)
$\sigma_{\text{level 1}}$	21.96	25.29	21.58	25.06	23.39
$\sigma_{\text{level 3}}$	18.97	13.30	6.54	6.31	6.42
$\sigma_{\text{level 3}}$	0.00	0.00	6.07	3.85	4.98

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; se = standard error; a = $p > 0.05$ after Bonferroni correction, see robustness check below for details

Within-group inequality

As shown in Table S16, within group inequality (measured by the Gini coefficient) was particularly high under c_i = 60 (Table S16, column 1, c_i = 60 coefficient). In the voting treatment, inequality reduced by 0.18 points in general and further reduced by 0.09 points under medium interdependence (c_i = 60) . Under c_i = 40, inequality only reduced by 0.11 points (yet, still significantly; post-hoc test, voting + voting treatment × c_i = 40 ≠ 0, estimate = -0.11, std. error = 0.03, $p < 0.001$).

Table S16. Inequality.

Multilevel regression modeling within-group inequality (measured by the Gini coefficient) as a function of the individual solution cost (c_i) and treatment.

coefficient	**baseline treatment** est. (std. error)	**voting treatment** est. (std. error)	**combined model** est. (std. error)
Intercept (c_i = 80)	0.34 (0.06)***	0.18 (0.03)***	0.35 (0.03)***
c_i = 60	0.11 (0.02)***	0.03 (0.01)**	0.11 (0.01)***
c_i = 40	0.01 (0.02)	0.08 (0.01)***	0.01 (0.01)
round	-0.01 (0.001)***	-0.002 (0.0007)**	-0.004 (0.0008)***
voting treatment			-0.18 (0.03)***
voting treatment × c_i = 60			-0.09 (0.02)***
voting treatment × c_i = 40			0.07 (0.02)***
$\sigma_{level\ 1}$	0.24	0.13	0.19
$\sigma_{level\ 2}$	0.10	0.05	0.08

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Voting and voting outcome

Table S17 shows model results on the individual likelihood to vote in favor of removing individual solutions. Similar to the first study, individual support for restricting the access to individual solutions decreased with reducing its cost (Table S17, first column, $c_i = 60$ & $c_i = 40$ coefficient). When separating the voting decision by type ('richer' vs. 'poorer' group members, Table S17, second column), it can be seen that this general pattern was true for both types. However, 'richer' group members were significantly less in favor of removing the ability to also solve the problem individually in general (Table S17, second column, $e = 130$ coefficient). Under $c_i = 40$, the support for removing individual solutions further decreased for 'richer' group members (Table S17, second column, $e = 130 \times c_i = 40$ coefficient). Consequently, the likelihood to successfully remove the individual solution was the highest under $c_i = 80$ and significantly decreased under $c_i = 60$ and $c_i = 40$ (Table S18).

Table S17. Voting.

Multilevel logistic regression modeling the likelihood to vote in favor of removing the individual solution as a function of the individual solution cost (c_i) and starting endowment.

coefficient	**voting treatment'** est. (std. error)	**voting treatment''** est. (std. error)
Intercept ($c_i = 80$)	2.22 (0.50)***	2.94 (0.52)***
$c_i = 60$	-1.18 (0.19)***	-0.88 (0.29)**
$c_i = 40$	-2.79 (0.20)***	-2.41 (0.27)***
voting round	0.04 (0.04)	0.04 (0.04)
$e = 130$		-2.09 (0.40)***
$e = 130 \times c_i = 60$		-0.47 (0.37)
$e = 130 \times c_i = 40$		-0.76 (0.39)*[a]
$\sigma_{\text{level 2}}$	1.90	1.22
$\sigma_{\text{level 3}}$	0.0000007	0.58

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, a = $p > 0.05$ after Bonferroni correction, see robustness check below for details

Table S18. Voting outcome.

Multilevel logistic regression modeling the likelihood to remove the individual solution (i.e. reaching a majority) as a function of the individual solution cost (c_i).

coefficient	**voting treatment** est. (std. error)
Intercept (c_i = 80)	4.06 (1.02)***
c_i = 60	-2.26 (0.78)**
c_i = 40	-5.03 (0.80)***
voting round	0.02 (0.10)
$\sigma_{\text{level 2}}$	0.98

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Exploiting differences in social interdependence

In the main manuscript, we reported that ‘richer’ group members in the baseline treatment increased their frequency to solve the problem individually, the less resources ‘poorer’ dedicated towards a public solution in the previous round. Table S19 shows the underlying regression models separated by c_i level. Across all levels, self-reliance of ‘richer’ group members was predicted by contribution levels of ‘poorer’ group members in the previous round (Table S19, public contributions of e = 80 (t-1) coefficient, contributions were reverse coded for these regressions meaning that lower levels of cooperation were related to a higher likelihood of self-reliance). In turn, ‘poorer’ group members increased their cooperation, the more group members with a high endowment (e = 80) opted for self-reliance in the previous round under c_i = 80 (Table S20, first column, # of e = 130 members that met c_i (t-1) coefficient). In other words, since ‘poorer’ group members could not afford to solve the problem individually (or only by investing all of their resources), they instead had to increase their public contributions.

Table S19. Reverting to individual solutions.

Multilevel logistic regression modeling the likelihood of group members with e = 130 to meet the individual target based on the public contributions of group members with e = 80 in the previous round (t-1) (controlling for public contributions and whether the subject met her individual target in in t-1).

coefficient	$c_i = 80$ est. (std. error)	$c_i = 60$ est. (std. error)	$c_i = 40$ est. (std. error)
Intercept	-2.06 (1.18)	-2.31 (1.01)*	-2.04 (1.54)
Public contributions of e = 80 (t-1)	0.06 (0.02)*	0.08 (0.01)***	0.05 (0.02)*
Public contributions of e = 130 (t-1)	-0.05 (0.02)**	-0.05 (0.01)***	-0.04 (0.01)***
Subject met c_i (t-1)	0.51 (0.51)	0.87 (0.38)*	2.62 (0.49)***
round	-0.02 (0.03)	0.01 (0.03)	0.05 (0.05)
$\sigma_{\text{level 2}}$	1.25	1.27	0.00
$\sigma_{\text{level 3}}$	1.01	1.24	0.00

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; public contributions of e = 80 (t-1) is reverse coded to ease interpretation

Table S20. Reaction to self-reliance.

Multilevel regression modeling cooperation of group members with e = 80 based on the number of group members with e = 130 that solved the problem individually in the previous round (t-1) (controlling for own public contributions in t-1).

coefficient	$c_i = 80$ est. (std. error)	$c_i = 60$ est. (std. error)	$c_i = 40$ est. (std. error)
Intercept	28.66 (2.64)***	13.38 (2.58)***	8.29 (2.21)***
# of e = 130 members that met c_i (t-1)	4.36 (0.77)***	-2.73 (0.75)***	-2.80 (0.99)**
Public contributions of e = 80 (t-1)	0.22 (0.05)***	0.64 (0.04)***	0.41 (0.05)***
round	-0.10 (0.06)	-0.12 (0.09)	-0.05 (0.06)
$\sigma_{\text{level 1}}$	9.52	13.52	9.79
$\sigma_{\text{level 2}}$	6.66	7.99	4.02
$\sigma_{\text{level 3}}$	2.42	0.00	0.00

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

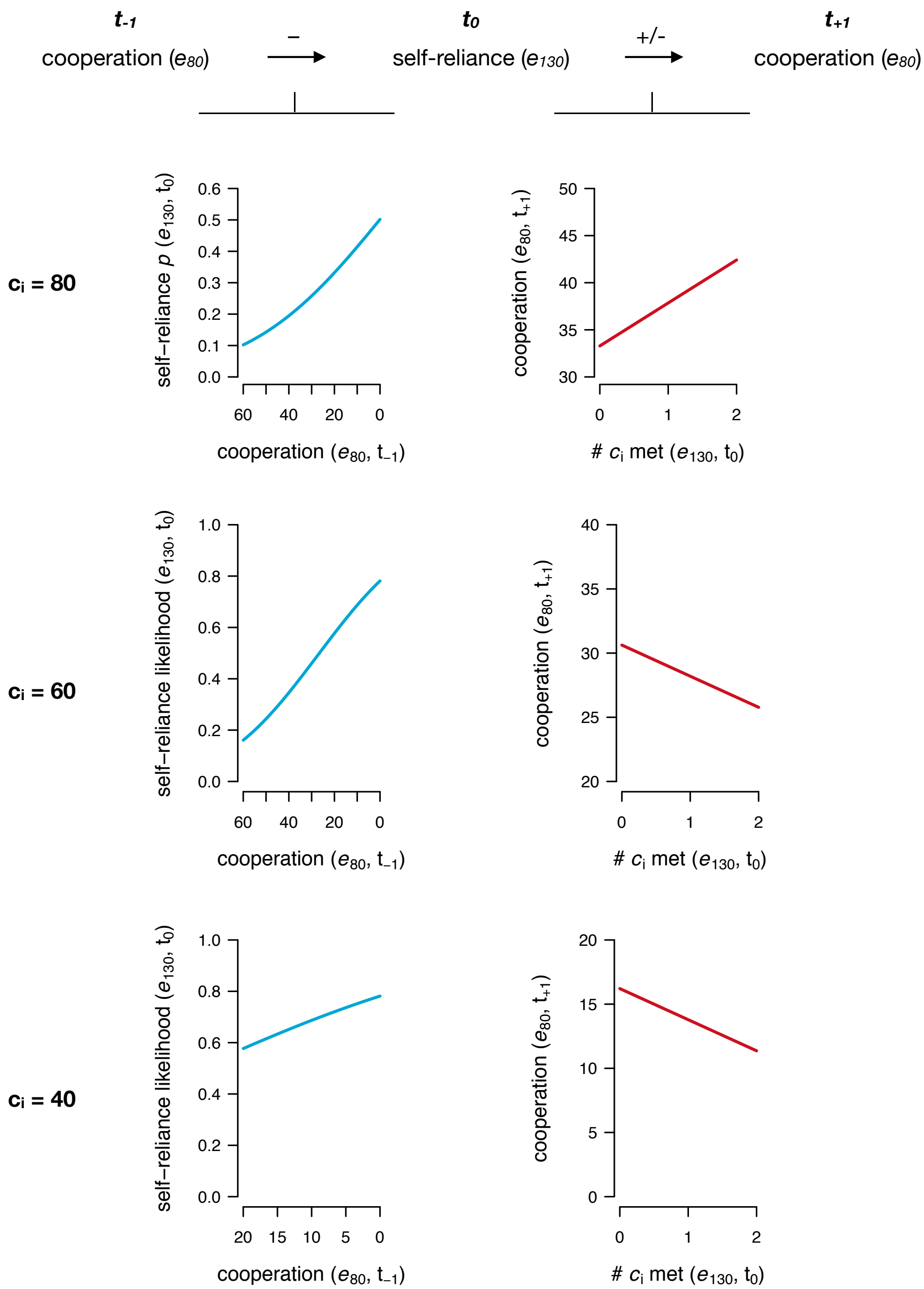


Figure S12. Dynamics of inequality in social interdependence. Model fits showing how lower rates of cooperation by 'poorer' group members in the previous round (e = 130, left column, x-axis) was related to a higher likelihood of 'richer' group members to solve the problem individually (e = 80, left column, y-axis). In turn, the more group members with e = 130 opted for self-reliance in the previous round (right column, x-axis) the more (less) RP group members with e = 80 dedicated to a public solution under c_i = 80 (c_i = 60 / c_i = 40) (right-column, y-axis).

This relationship reversed under c_i = 60 and c_i = 40. The more group members with a high endowment (e = 80) opted for self-reliance in the previous round, the less 'poor' group members contributed to a public solution in the present round. Instead, they were significantly more likely to meet their own individual threshold (multilevel regression, c_i = 60: # of e = 130 members that met c_i (t-1) coefficient = 1.38, p < 0.001; c_i = 40: # of e = 130 members that met c_i (t-1) coefficient = 1.43, $p < 0.001$). In other words, while self-reliance of 'richer' group members forced 'poorer' group members to increase their public contributions when they highly depended on a public solution, self-reliance of 'richer' group members under c_i = 60 and c_i = 40 led to a crowding out of cooperation, because 'poorer' group members adapted to the self-reliance of 'richer' group members. This pattern is further illustrated in Figure S12.

Multiple comparisons robustness check

In both studies, we analyzed multiple dependent variables and, especially in Study 2, the models had many predictors due to the dummy coded cost level c_i in combination with the within-group manipulation of endowment (and resulting interaction terms). Analyses were aimed at providing a full picture of the dynamics of the game in each study, looking at cooperation rates (and public goods creation), self-reliance (and private goods creation), resource waste, earnings, inequality, and voting / voting outcome, even though some of the DVs are necessarily interrelated (e.g., earnings and resource waste are correlated by design, as well as cooperation rates and public goods creation). Yet, with many predictors, the rate of type I errors necessarily increases due to the many comparisons that are performed in each analysis.

We therefore probed the robustness of the results when controlling for multiple comparisons. To this end, for each of the main analyses (i.e. cooperation, self-reliance, resource waste, earnings, inequality, and voting), we divided the two-sided p-threshold of $p < 0.05$ (used to determine significance in each regression model above) by the number of relevant predictors in each conceptual analyses in the most complex models (i.e., the models reported in the last column in the tables above). To illustrate, for the analysis on resource waste in Study 1 (Table S14, last column) we had five coefficients relevant to our broader conclusions (not counting the intercept, the round coefficient or control-variables like order-dummies). Hence, for this analysis, we divided the p-value by five, leading to a new critical threshold of $p = 0.01$ in this case. This is equivalent to a Bonferroni correction. For conceptual analyses for which we had two separate DVs and regression models (like cooperation and public goods creation or voting and voting outcome) we counted the number of coefficients across regression models. For example, in Study 2, we had 16 relevant coefficients across both cooperation models in total (Table S10 / S11). The corrected *p*-value is, hence, 0.05 / 16 = 0.003125.

Note that this correction is rather conservative (increasing Type II error rates), because Bonferroni correction is considered a conservative correction in the first place and we also corrected for main effects or interaction effects that were not critical for the conclusions of the study, but were part of the regression models for completeness sake. Yet, these corrections still allow us to get an impression how robust results are when correcting for multiple comparisons.

After applying this correction, three effects that were not the main scope of the analyses were not statistically significant anymore. Specifically, the treatment × $c_i = 60$ interaction in the inequality model (Study 1, Table S7, last column), the $e = 130 \times c_i = 60$ interaction in the earnings model (Study 2, Table S15, last column), and the $e = 130 \times c_i = 40$ interaction in the voting model (Study 2, Table S17, last column) did not survive correction. Yet, none of these effects were further interpreted or part of the conclusions of the study.

Further, three effects that were, at least partly, relevant for the conclusion of the study also were not significant anymore after applying this correction. Specifically, the voting treatment coefficient when estimating private goods creation across both studies (indicating that groups in the voting treatment created fewer private goods compared to the baseline treatment in the original analyses; Table S4 / Table S13, last column). Yet, the voting treatment × $c_i = 40$ and voting treatment × $c_i = 60$ interactions in Study 1 remained robust and when estimating individual pool contributions, the voting interactions also remained significant across both studies (Table S3 / S12). Hence, we believe that the voting coefficient in the private goods creation models may not have survived this correction due to lower power, since private goods creation is a binary variable (requiring a logistic regression model) that necessarily provides less information compared to the continuous variable in the self-reliance models (i.e. RP dedicated to the individual pool).

Further, in Study 1, the voting treatment coefficient when estimating earnings (Table S6, last column) was not significant anymore after correction. However, the voting treatment coefficients remained a robust predictor of earnings in Study 2 (Table S15, last column) and this effect was pre-registered. All other effects remained statistically significant.

Sensitivity analysis

Sample size for both studies was determined based on feasibility concerns rather than a priori power calculations. To test achieved power, we conducted a sensitivity power analysis to determine the minimum effect size that can be detected with a power of .80 in the multilevel regression models reported above. For this, we simulated data using the 'simr' package in R across four comparison types: a model testing (i) a within-subject effect (e.g. difference in cooperation across the c_i level within one treatment), (ii) a between-subject effect (e.g. difference in cooperation rates between baseline and voting treatment), (iii) a between-group effect on the aggregate group level (e.g. resource waste between baseline and voting treatment), (iv) an effect on a binary dependent variable on the aggregate group level (e.g. voting outcome between baseline and voting treatment). For each simulation, we selected the model with the highest average variance based on our model fits and used these variance estimates for the simulations to get a conservative estimate.

For a within-subject effect (i.e. effect across two within-subject blocks), the smallest detectable effect with a power of .80 was 1.8 points according to the simulations (2,000 simulations, $k = 20$ groups, $j = 100$ subjects, $i = 2\times18$ responses, $\sigma_{\text{level 1}} = 19.15$, $\sigma_{\text{level 2}} = 3.95$, $\sigma_{\text{level 3}} = 9.60$; variance terms are based on the earnings models reported in Table S6). To put these numbers into perspective, earnings, cooperation, and self-reliance can theoretically vary between 0 and 100 in the game. Actual average earnings varied between 38 and 55 points between blocks in Study 1 and 35 and 54 points in Study 2, average cooperation rates varied between 5 and 39 points in Study 1 and 5 and 40 points in Study 2, and average contributions to the individual pool varied between 3 and 39 points in Study 1 and 1 and 38 points in Study 2.

For a between-subject effect, the smallest effect detectable with a power of .80 was 9 points according to the simulations (2,000 simulations, $k = 40$ groups, $j = 200$ subjects, $i = 18$ responses, $\sigma_{\text{level 1}} = 19.45$, $\sigma_{\text{level 2}} = 2.88$, $\sigma_{\text{level 3}} = 9.61$; variance terms based on the earnings models reported in Table S6). To put these numbers into perspective, the smallest (largest) observed difference between treatments was 2 points (15 points) in Study 1 and 2 points (15 points) in Study 2 for earnings, 2 points (34 points) in Study 1 and 4 points (35 points) in Study 2 for cooperation, and 2 points (36 points) in Study 1 and 0 points (38 points) in Study 2 for contributions to the individual pool.

For a between-group effect on the aggregate group level, the smallest effect detectable with a power of .80 was 18 points according to the simulations (2,000 simulations, $k = 40$ groups, $j = 18$ observations per group, $\sigma_{\text{level 1}} = 35.46$, $\sigma_{\text{level 2}} = 17.49$; variance terms based on the resource waste model reported in Table S5). To put this number into perspective, resource waste can theoretically vary between 0 and 300 in the game. Actual average waste between blocks varied between 7 and 56 points in Study 1 and 5 and 57 points in Study 2. The smallest (largest) difference between treatments was 3 points (52 points) in Study 1 and 8 points (49 points) in Study 2. Finally, for an effect on a binary outcome variable, the smallest effect detectable with a power of .80 was 1.2 (odds ratio of 3.3) according to the simulations (2,000 simulations, $k = 40$ groups, $j = 6$ observations per group, $\sigma_{\text{level 2}} = 1$; variance term based on the voting model reported in Table S9).

IV Additional and Exploratory Results

Below we report additional results, supplementing the results of the main manuscript and providing further insights into the behavioral dynamics across both studies.

Outcome profiles

In Figure 3D of the main manuscript, we illustrate the solution profiles in Study 1. For this analysis, we classified the outcome of each round based on five possible scenarios: (1) a public solution was reached while no group member also reached her individual target ('successful collective action'), (2) a public solution was not reached and no group member reached her individual target ('failed collective action'), (3) a public solution was reached while some group members also reached their individual target ('wasteful over-insurance'), (4) a public solution was not reached and all group members solved the problem individually ('individualism'), (5) a public solution was not reached and only some group members successfully solved the problem individually ('partial self-reliance'). Failed collective action, wasteful over-insurance, and partial self-reliance can be seen as coordination failures. Further, partial self-reliance imposes a negative externality on some group members because the invested resources of group members that opted for self-reliance are missing for the collective solution. Consequently, the group members that opted for a cooperative solution fail to solve the problem and lose all their resources.

Figure S13A shows the solution profiles in Study 1 between treatments (as also shown in the main manuscript). Figure S13B additionally shows the solution profile in Study 2 between treatments. The general pattern was strikingly similar across studies: Especially under medium interdependence ($c_i = 60$ / $i = 0.5$), groups often found a solution in which some group members solved the shared problem individually while other group members tried to solve the problem cooperatively but failed. When groups could vote on removing the individual solution, the solution pattern of $c_i = 60$ converged to the solution pattern of high social interdependence ($c_i = 80$). In other words, the voting decisions of group members endogenously transformed the medium interdependence environment into high interdependence environment.

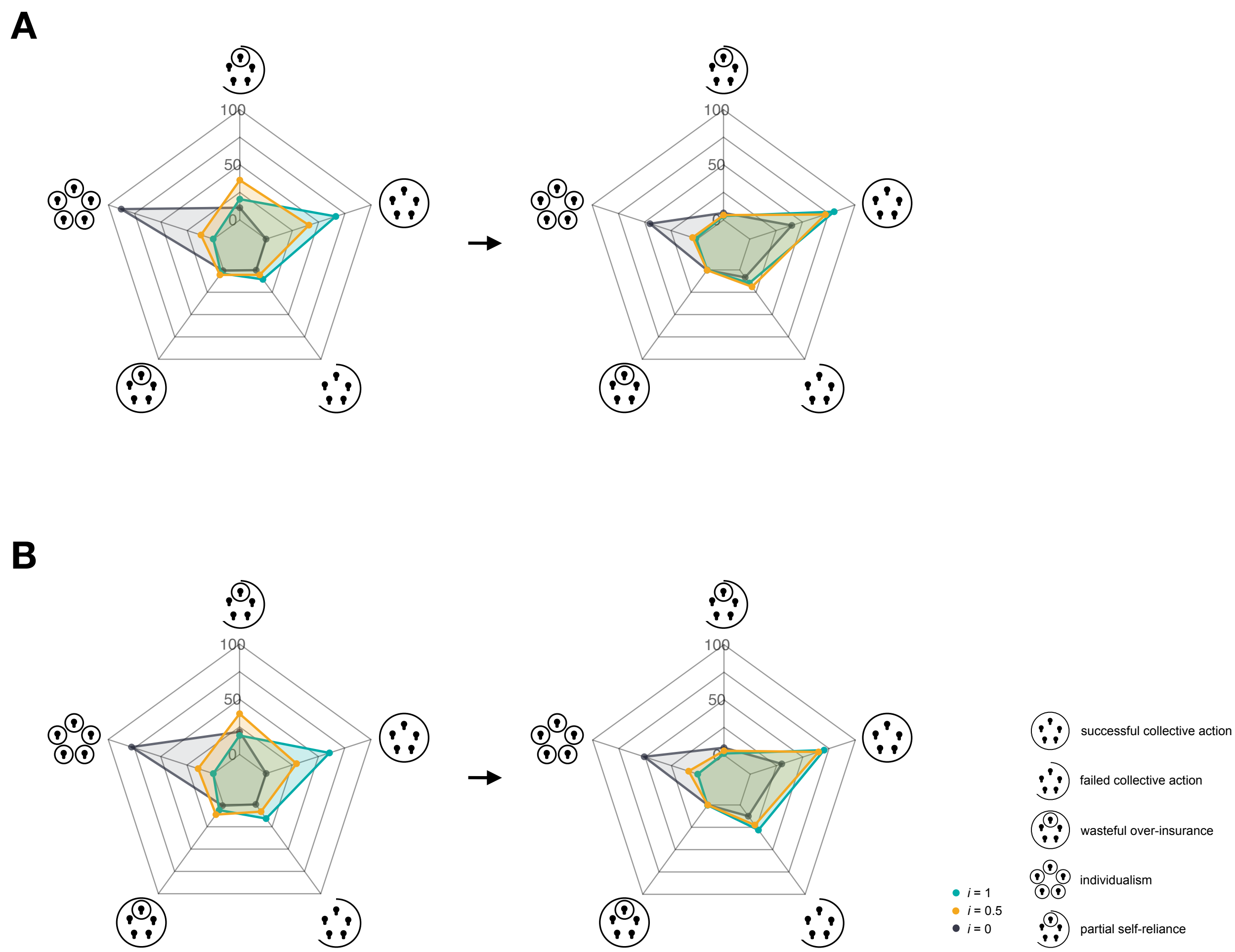


Figure S13. Solution profiles. Solution profile of groups under low (black), medium (yellow), and high (blue) social interdependence in (**A**) Study 1 (left panel: baseline treatment, right panel: voting treatment) and (**B**) Study 2 (left panel: baseline treatment, right panel: voting treatment).

Voting and subsequent cooperation

To understand how voting preferences affected subsequent decisions, we aggregated the data in the voting treatments across rounds within one voting block and regressed the average public contributions within a voting block on the vote of the group member controlling for c_i cost, vote outcome (i.e., whether the individual solution was removed in this block), and voting block number. In Study 2 we further fitted the regression separately for group members with an endowment of $e = 80$ and $e = 130$.

When the groups did not reach a majority to remove individual solutions, group members who voted in favor of removal still contributed more of their RP to the public solution compared to group members who voted against removal. This was the case in Study 1 as well as for 'poorer' ($e = 80$) and 'richer' ($e = 130$) group members in Study 2 (Table S21, vote coefficient).

When the group successfully abolished individual solution, the disparity in cooperation between those who voted against and those who voted in favor of removal disappeared (Table S21, vote × vote outcome coefficient), as also shown by post-hoc comparisons (post-hoc test, Study 1: vote + vote × vote outcome ≠ 0, estimate = -0.08, std. error = 0.54, $p = 0.88$, Study 2 – $e = 80$: vote + vote × vote outcome ≠ 0, estimate = -0.38, std. error = 1.14, $p = 0.74$, Study 2 – $e = 130$: vote + vote × vote outcome ≠ 0, estimate = 1.63, std. error = 0.95, $p = 0.09$). In other words, these results suggest that subsequent cooperation decisions reflect people's voting preferences when both solutions options are still available. Yet, when the group is forced to find a collective solution because individual solutions were abolished, it is not possible anymore to distinguish cooperation rates between those who voted in favor and those who voted against this restriction – group members cooperated similarly (and statistically indistinguishable) regardless of their previous vote.

Table S21. Voting and subsequent choice.

Multilevel regression modeling public contributions as a function of own vote and controlling for vote outcome, c_i level, and voting block.

coefficient	**Study 1** est. (std. error)	**Study 2 (*e* = 80)** est. (std. error)	**Study 2 (*e* = 130)** est. (std. error)
Intercept (c_i = 80)	7.70 (1.22)***	8.07 (2.11)***	5.64 (4.31)
vote	2.21 (0.72)**	4.19 (0.97)***	9.77 (2.30)***
vote outcome	34.52 (0.64)***	27.69 (1.32)***	49.90 (1.11)***
c_i = 60	-0.31 (0.36)	-1.04 (0.56)	-0.43 (0.84)
c_i = 40	-1.99 (0.42)***	-2.78 (0.67)***	-0.39 (1.06)
voting block	-0.23 (0.09)**	-0.66 (0.13)***	-0.03 (0.19)
vote × vote outcome	-2.29 (0.89)**	-4.57 (1.48)**	-8.13 (2.44)***
$\sigma_{level\ 1}$	6.20	7.38	8.89
$\sigma_{level\ 2}$	3.66	3.21	8.30
$\sigma_{level\ 3}$	1.16	3.10	5.44

Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$; vote outcome: dummy coded (1 = individual solutions abolished, 0 = individual solutions retained); vote: dummy coded (0 = vote against, 1 = vote in favor of removing individual solutions)

Dynamics over rounds

Figure S14 shows the relative frequency of finding a public solution across rounds depending on the social interdependence level and treatment for both studies. Whether groups solved the shared problem cooperatively did not change substantially across rounds. Only in the voting treatment of Study 1 (Figure S14A, right panel), there was statistical evidence that the likelihood to find a collective solution increased over rounds under $c_i = 80$ ($i = 1$) and $c_i = 40$ ($i = 0$) (multilevel logistic regression, round coefficient = 0.08, std. error = 0.03, p = 0.004). Yet, this result should be interpreted with caution since this effect was not consistent across studies or treatments.

Figure S15 shows the relative frequency of solving the problem individually (i.e. meeting the individual threshold) across rounds depending on the social interdependence level and treatment for both studies. There was little evidence that opting for self-reliance changed over rounds systematically across c_i level and studies. In the baseline treatment of Study 1 (Figure S15A, left panel), the likelihood to solve the problem individually increased over rounds under $c_i = 40$ and $c_i = 60$ as compared to $c_i = 80$ (multilevel logistic regression, round × $c_i = 40$ coefficient = 0.14, std.

error = 0.03, $p < 0.001$, round × $c_i = 60$ coefficient = 0.07, std. error = 0.02, $p = 0.001$), while in the voting treatment, the likelihood to solve the problem individually generally declined across rounds (multilevel logistic regression, round coefficient = -0.07, std. error = 0.03, $p = 0.01$). In Study 2, self-reliance slightly decreased under $c_i = 80$ (multilevel logistic regression, round coefficient = -0.05, std. error = 0.02, $p = 0.02$) but increased under $c_i = 60$ (post-hoc test, round + round × $c_i = 60 \neq 0$, estimate = 0.04, std. error = 0.01, $p = 0.002$) and $c_i =40$ (post-hoc test, round + round × $c_i = 40 \neq 0$, estimate = 0.09, std. error = 0.02, $p < 0.001$). Again, these results should be interpreted with caution since the pattern was not consistent across studies and/or treatments.

There was also no statistical evidence that the likelihood of self-reliance changed across rounds in the voting treatment across any interdependence level. Figure S16 further shows the average voting pattern. The voting outcome remained rather stable across voting rounds. There was no statistical evidence that the voting outcome linearly changed across rounds.

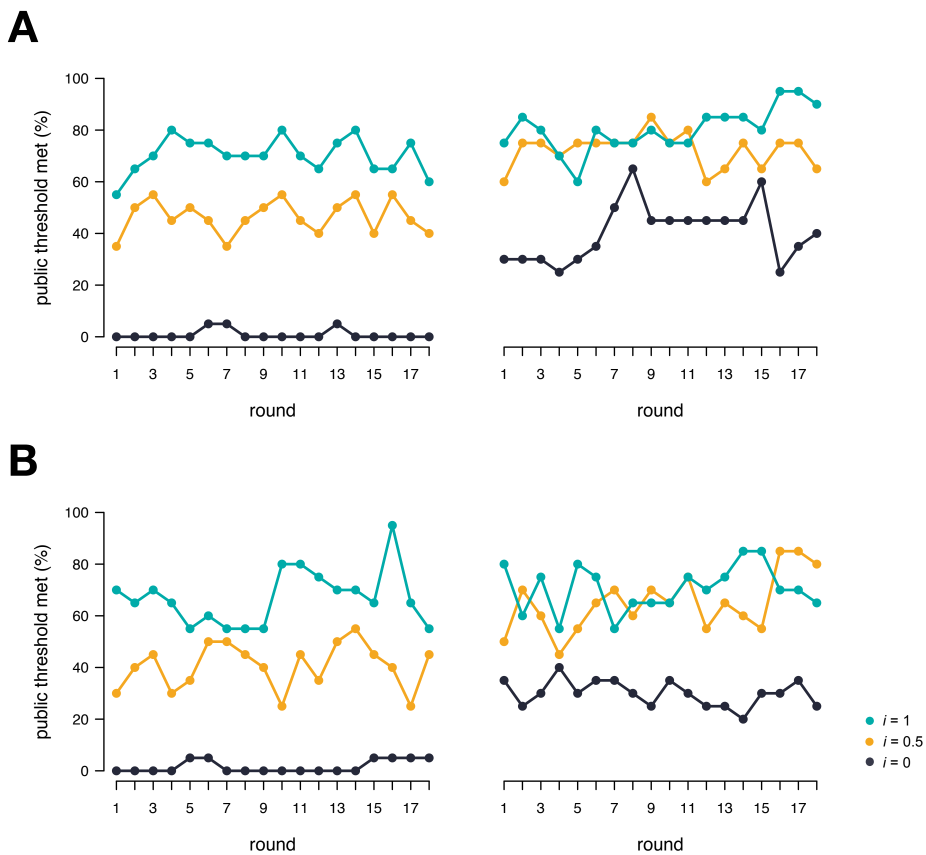


Figure S14. Public goods creation across rounds. Average percentage of meeting the public threshold and solving the shared problem collectively across rounds (**A**) in the baseline (left panel) and voting treatment (right panel) of Study 1 and (**B**) in the baseline (left panel) and voting treatment (right panel) of Study 2. Blue line: $c_i = 80$ / $i = 1$, yellow line: $c_i = 60$ / $i = 0.5$, black line: $c_i = 40$ / $i = 0$.

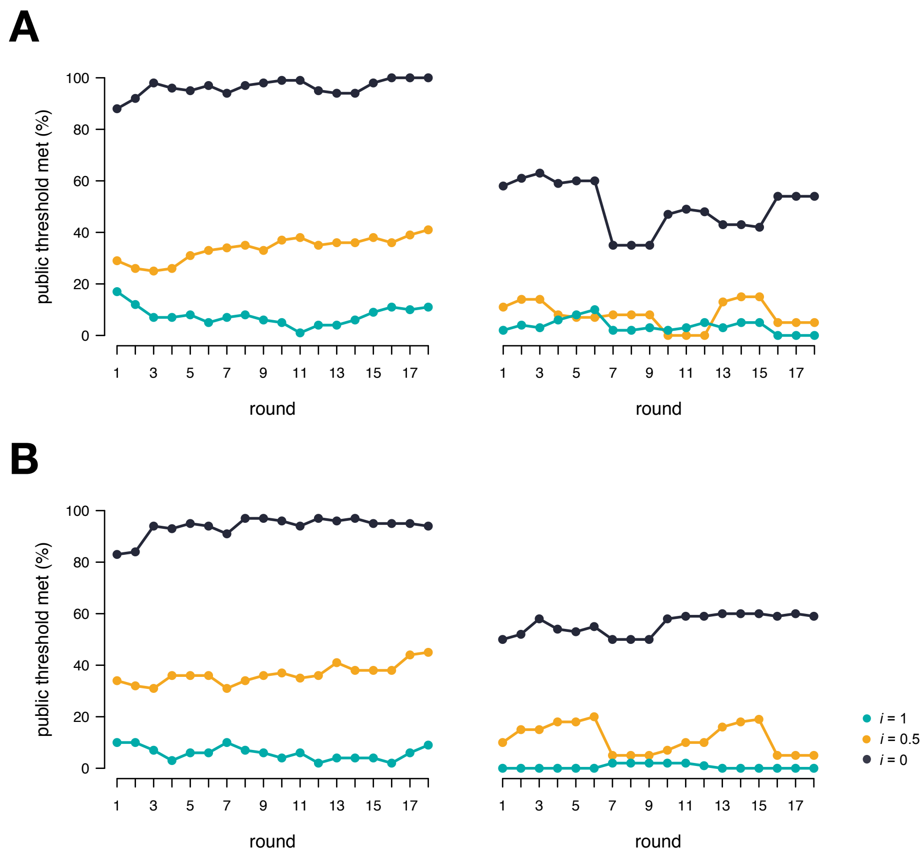


Figure S15. Private goods creation across rounds. Average percentage of meeting the individual threshold and solving the shared problem individually across rounds (**A**) in the baseline (left panel) and voting treatment (right panel) of Study 1 and (**B**) in the baseline (left panel) and voting treatment (right panel) of Study 2. Blue line: $c_i = 80$ / $i = 1$, yellow line: $c_i = 60$ / $i = 0.5$, black line: $c_i = 40$ / $i = 0$.

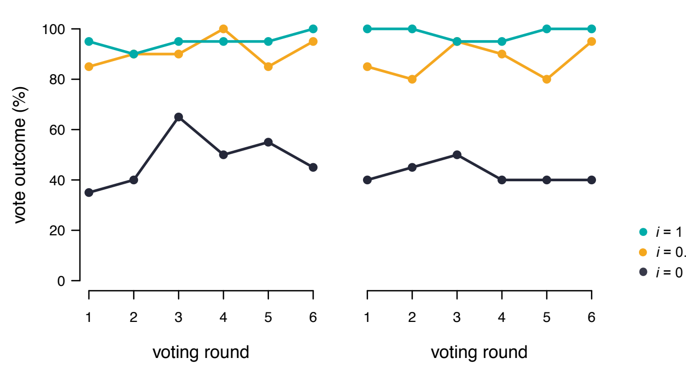


Figure S16. Voting outcomes across rounds. Average percentage of voting in favor of abolishing individual solutions across voting rounds in the first (left panel) and second study (right panel). Blue line: $c_i = 80$ / $i = 1$, yellow line: $c_i = 60$ / $i = 0.5$, black line: $c_i = 40$ / $i = 0$.

Personality measures

For each participant, we measured social value orientation (SVO; i.e., social preferences), risk preferences, and individualism (i.e., measuring the value the participant puts on self-reliance and social independence). To analyze how these economic preferences and personality measures relate to investment decisions and voting preferences (in the voting treatments), we aggregated the data to the subject level and fitted multilevel regressions with one random intercept per group and simultaneously entered the three individual-level predictors.

In Study 1, higher social value orientation was associated with higher public contributions and lower private contributions (multilevel regression, DV: public contributions, SVO coefficient = 0.17, std. error = 0.05, $p = 0.001$, DV: private contributions, SVO coefficient = -0.13, std. error = 0.04, $p < 0.001$). Descriptively, higher risk-aversion was related to lower public contributions and higher private contributions, but none of these effects were statistically significant using a 5% significance level (multilevel regression, DV: public contributions, risk-aversion coefficient = -6.29, std. error = 3.95, $p = 0.11$, DV: private contributions, risk-aversion coefficient = 4.79, std. error = 2.81, $p = 0.09$).

Interestingly, in Study 2, higher social value orientation was only associated with higher public contributions when group members had a high endowment (multilevel regression, DV: public contributions, SVO × $e = 130$ coefficient = 0.33, std. error = 0.14, $p = 0.02$), but not for group members with a low endowment (DV: public contributions, SVO coefficient = 0.01, std. error = 0.09, $p = 0.87$), suggesting that social preferences only play a role for cooperation when the group member can afford to choose between solving the problem individually or collectively. Indirectly, it also reveals that 'poorer' group members, to some degree, depend on the luck of having pro-socially inclined socially oriented 'richer' group members in their group that are willing to forgo their ability to solve the problem individually (see also 21). In contrast to Study 1, contributions to the individual solution were not significantly related to social preferences (multilevel regression, DV: private contributions, SVO coefficient = 0.03, std. error = 0.06, p = 0.57, SVO × $e = 130$ coefficient = -0.17, std. error = 0.09, $p = 0.06$). Risk-preferences and the individualism measure were also not significantly related to the contribution decisions.

Individualism, however, was related to voting decisions. In Study 1, the more the subject reported to value independence and self-reliance, the less likely she voted in favor of removing the individual solution (multilevel regression, DV: voting in favor of removing the individual solution, individualism coefficient = -0.03, std. error = 0.014, $p = 0.04$). In Study 2, this was only true for 'richer' group members (multilevel regression, DV: voting in favor of removing the individual solution, individualism coefficient × $e = 130$ = -0.06, std. error = 0.029, $p = 0.04$), suggesting that personal preferences only play a role when self-reliance is actually affordable for the decision maker, as with cooperation rates. Yet, the effects were rather small (average Pearson correlation between individualism score and average voting choice: Study 1: $r = -0.192$, Study 2: $r = -0.186$).

The zero-order associations of individualism, social preferences, cooperation, and voting decisions are illustrated in Figure S17. It is important to note that these analyses are exploratory and the results are not as strong as the group dynamics across the c_i space. Also, the results on investments towards an individual solution in relation to social preferences are not consistent across Study 1 and Study 2. They should therefore be interpreted with caution. Future work could test the role of personality and economic preferences in this game more extensively. The link between interindividual differences and decision making may also be weaker because the game was played repeatedly with full feedback. In this situation, peer influence and adapting to the incentives of the situation may have a stronger force on behavior than differences in personal preferences or attitudes.

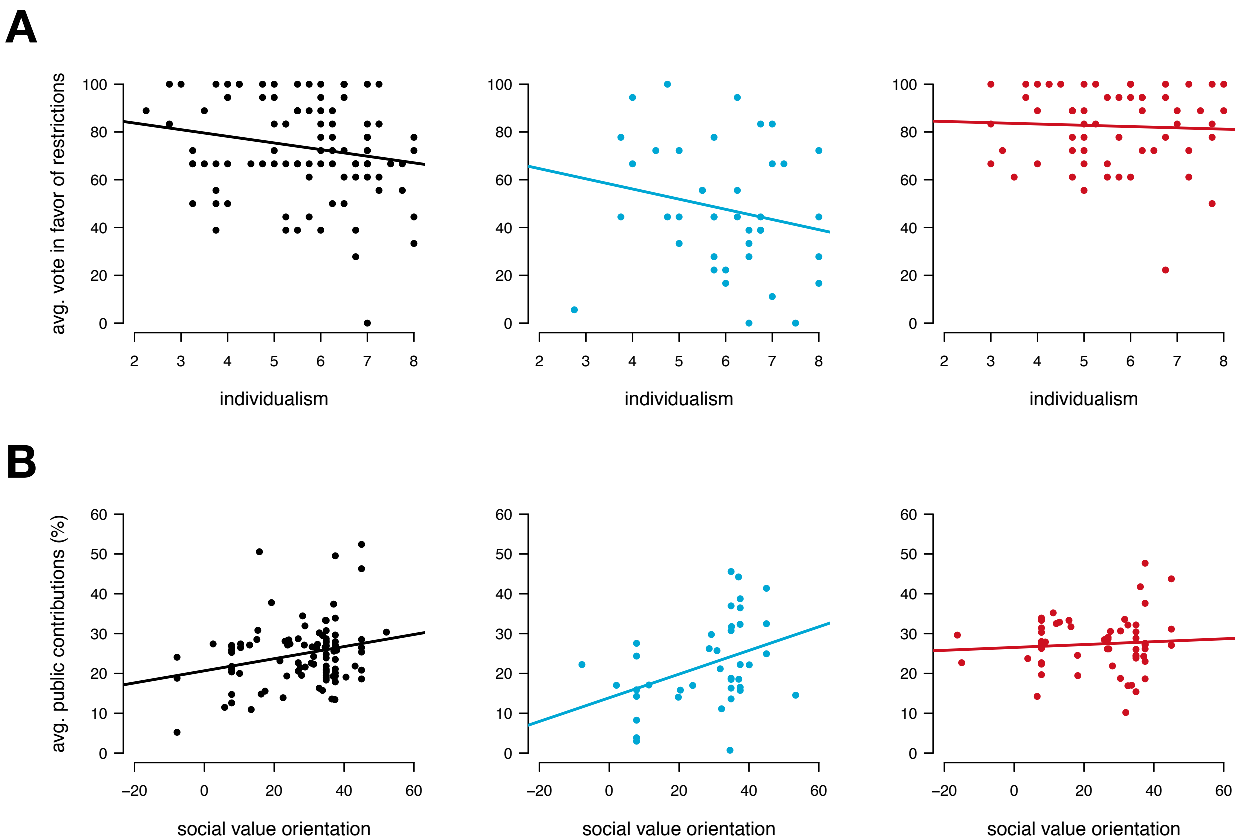


Figure S17. Personality measures and behavior. Zero order associations between (**A**) the individualism score and average support for restricting self-reliance in Study 1 (left panel) and for group members with e = 130 (middle panel, blue) and group members with e = 80 (right panel, red) in Study 2 and (**B**) associations between social value orientation (as a measure of social preferences) and average public contributions (as a percentage of endowment) in Study 1 (left panel) and for group members with e = 130 (middle panel, blue) and group members with e = 80 (right panel, red) in Study 2. Line indicates the best linear fit.

Beliefs

Before each block, we asked participants to indicate what they believe other group members, on average, would invest towards a public solution, their own individual solution, and how many RP to keep. In the voting treatments we also elicited beliefs in case the individual solution is not available and in Study 2, we elicited beliefs for group members with $e = 130$ and $e = 80$ separately. This allowed us to test to which degree group members anticipated actual behavior and what they believed the consequences of abolishing individual solutions would be.

Figure S18 shows average beliefs in the baseline treatment of Study 1. Descriptively, participants slightly underestimated the willingness to invest resources towards a public solution and overestimated investments towards self-reliance.

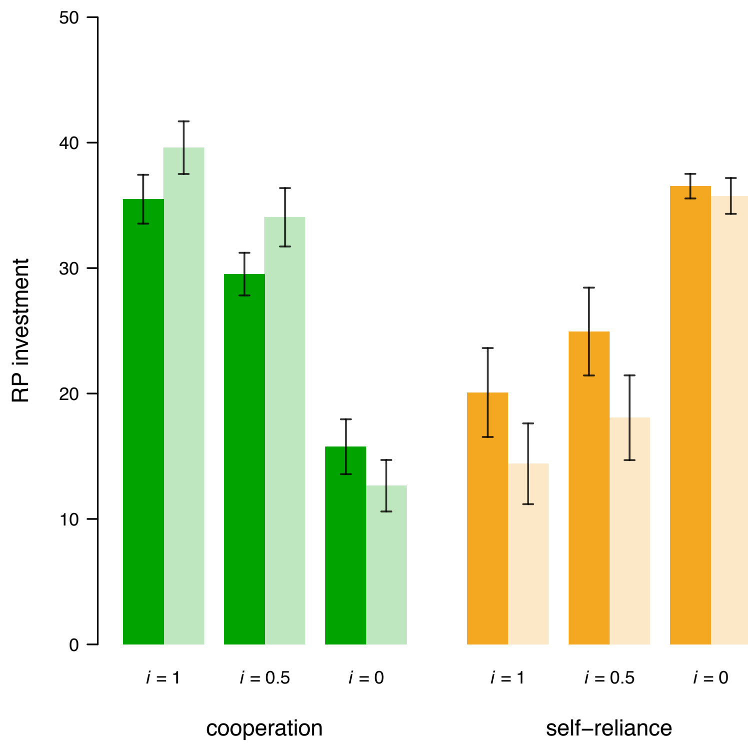


Figure S18. Beliefs and actual behavior (Study 1 – baseline treatment). Average belief of RP investment towards a public solution (green, cooperation, solid bars) and actual first-round behavior (light bars) and average belief of RP investment towards an individual solution (yellow, self-reliance, solid bars) and actual first-round behavior (light bars). Error bars indicate the standard error of the mean.

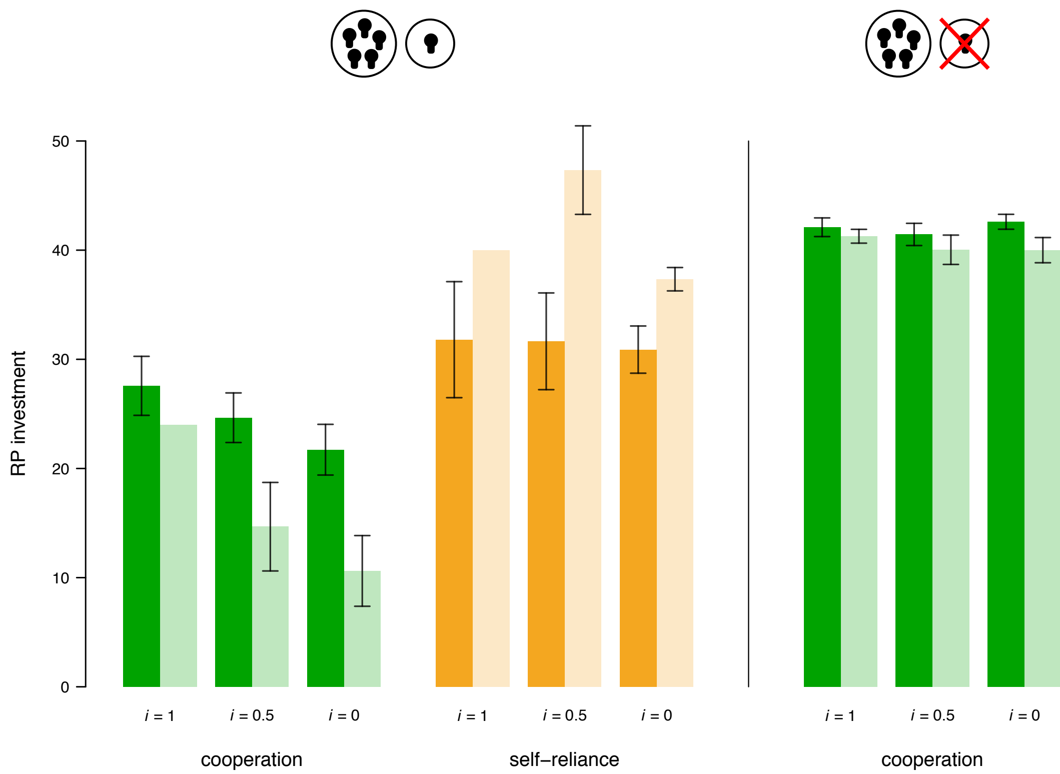


Figure S19. Beliefs and actual behavior (Study 1 – voting treatment). Average belief of RP investment towards a public solution (cooperation, solid green bars) and actual first-round behavior (light green bars) in case individual solutions were not abolished (left) vs. abolished (right) and average belief of RP investment towards an individual solution (self-reliance, solid yellow bars) and actual first-round behavior (light yellow bars). Error bars indicate the standard error of the mean.

Figure S19 shows average beliefs in the voting treatment in Study 1. As can be seen, participants anticipated lower levels of cooperation with decreased individual solution costs / social interdependence. They also correctly anticipated higher levels of cooperation when abolishing individual solutions.

In the baseline treatment of Study 2, both, richer and poorer group members expected lower levels of cooperation with decreased interdependence (Figure S20). Group members with e = 130 expected that their ‘type’ would contribute more RP than group members with e = 80. The same was true under i = 1 for poorer group members, potentially indicating self-serving beliefs.

Interestingly, ‘poorer’ group members expected higher levels of cooperation of ‘richer’ group members with lower interdependence in the voting treatment, assuming individual solutions were retained (Figure S21A). However, this was mainly driven by concomitant lower expectations of private investments of ‘richer’ group members when individual solution costs increased. Assuming that individual solutions are abolished, both ‘richer’ and ‘poorer’ group members expected that the higher share of public solution costs would be paid by ‘richer’ group members (hence, they expected the public solution to serve as a redistribution device, Figure S21B). This possibly explains why group members with e = 130 were less in favor of abolishing individual solutions compared to group members with e = 80.

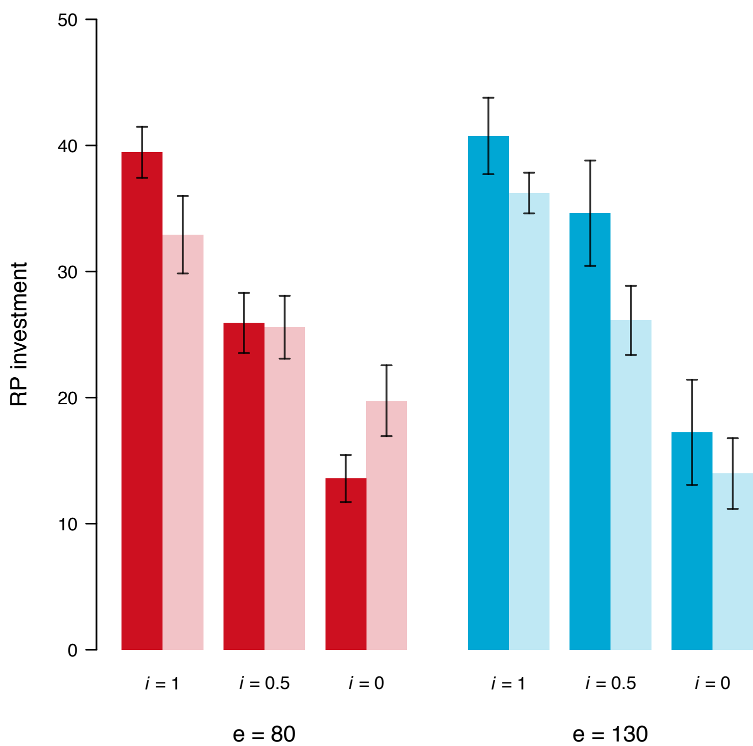


Figure S20. Beliefs (Study 2 – baseline treatment). Red bars: Average belief of ‘poorer’ group members on how many RP their fellow ‘poorer’ group member (solid bars) and ‘richer’ group members (light bars) would invest towards a public solution. Blue bars: Average belief of ‘richer’ group members on how many RP their fellow ‘richer’ group member (solid bars) and ‘poorer’ group members (light bars) would invest towards a public solution. Error bars indicate the standard error of the mean.

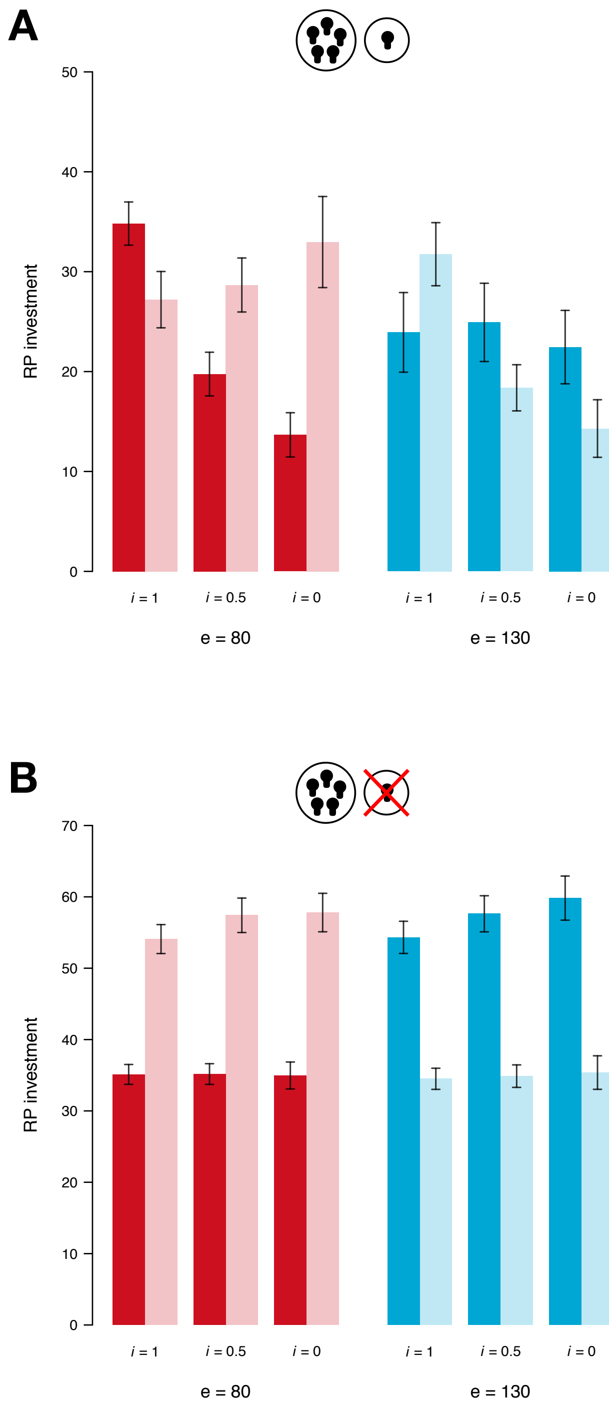


Figure S21. Beliefs (Study 2 – voting treatment). (**A**) Red bars: Average belief of 'poorer' group members on how many RP their fellow 'poorer' group member (solid bars) and 'richer' group members (light bars) would invest towards a public solution. Blue bars: Average belief of 'richer' group members on how many RP their fellow 'richer' group member (solid bars) and 'poorer' group members (light bars) would invest towards a public solution. (**B**) Average beliefs assuming individual solutions were removed. Error bars indicate the standard error of the mean.

Gender effects

Due to the composition of the subject pool, our dataset comprised more female ($n = 306$) than male ($n = 92$) participants, raising the question to which degree results can be generalized across gender. There is some evidence that gender can have an effect on cooperation in social dilemmas (e.g., (22-25). Therefore, we analyzed whether we can find evidence that male participants invested their resources differently compared to female participants and whether there is evidence for gender-specific voting preferences.

To this end, we first merged the datasets of Study 1 and Study 2 and calculated the average cooperation rates, investments in self-reliance, and voting decision per subject. The gender-specific distributions are plotted in Figure S22. Based on Mann-Whitney U-tests, we did not find statistical evidence that males cooperated more or less compared to females (Mann-Whitney U-test comparing relative cooperation rates between males and females, U = 14775, $p = 0.47$), distributed more or less towards their own individual solution (Mann-Whitney U-test comparing relative investments into the individual pool between males and females, U = 13823, $p = 0.79$), or voted differently (Mann-Whitney U-test comparing average voting in favor of removing the individual pool between males and females, U = 3709.5, $p = 0.41$). Also when looking only at the decision in the very first round (which has the advantage that behavior is not influenced by other group members yet and provides a statistically more valid test since data points can be treated as independent), we did not find evidence that male and female participants decided differently (Mann-Whitney U-tests, cooperation: U = 13882, $p = 0.84$, self-reliance investments: U = 14426, $p = 0.70$; voting: χ^2-test, $\chi^2(1) = 1.26$, $p = 0.26$).

We further repeated the multilevel regression models on cooperation (Table S1 / Table S10), self-reliance (Table S3 / Table S12) and voting choice (Table S8 / Table S17) for each study and included gender as an additional predictor. Also in these regression models, that take into account the nested structure of the data and predict individual choices, we did not find strong statistical evidence that male participants decided differently than female participants. Gender was not a significant predictor of voting choice (all p > 0.25) or cooperation rates (all $p > 0.13$), also not in interaction with endowment in Study 2. The strongest gender differences were found for self-reliance. In Study 1, female participants dedicated 1.8 RP (control treatment, std. error = 1.26, $p = 0.15$) and 1 RP (voting treatment, std. error = 0.58, $p = 0.08$) more towards an individual solution according to the model. In Study 2, female participants descriptively also dedicated more RP towards their individual solution (control treatment: female coefficient = 3.32, std. error = 1.93, p = 0.09, female × e_{130} = -3.85, std. error = 3.08, p = 0.21; voting treatment: female coefficient = 0.60, std. error = 0.87, p = 0.49, female × e_{130} = 0.20, std. error = 1.22, p = 0.86).

Yet, all these effects were not significant using a conventional p-threshold of 0.05 (two-sided and uncorrected for multiple comparisons). While we cannot perfectly rule out gender effects, given our sample characteristics, we also did not find strong evidence that male and female participants decided differently in the task.

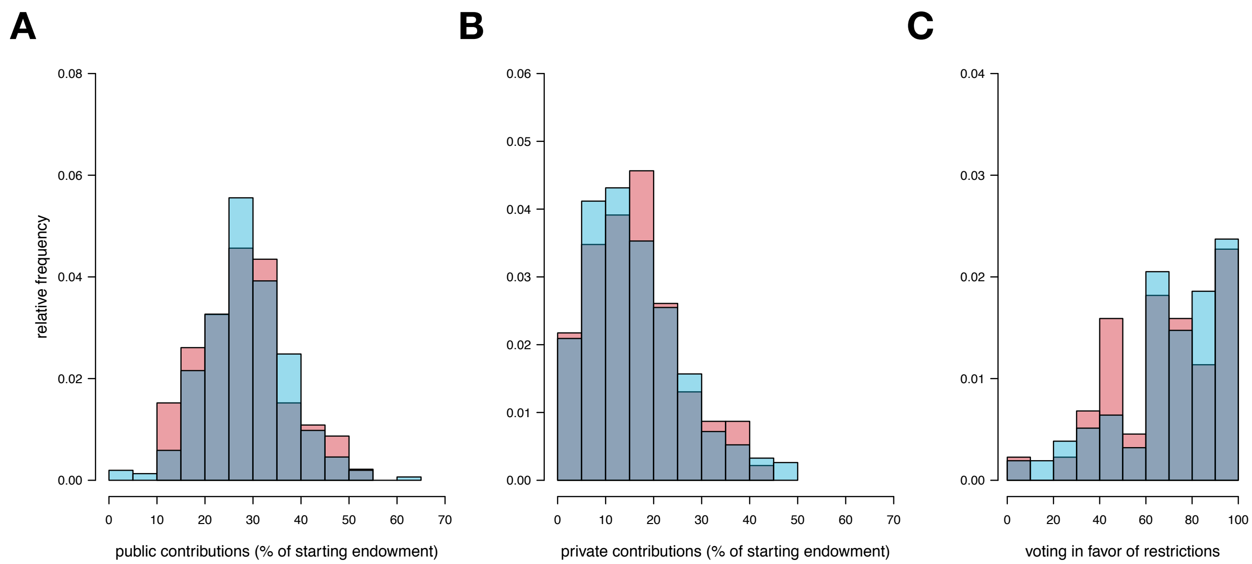


Figure S22. Gender effects. Stacked histograms showing the relative frequency of average (**A**) public and (**B**) individual contributions (as a percentage of the starting endowment), and (**C**) average voting in favor of removing the individual solution separated by gender across both studies (n = 398; two participants indicated a gender other than male or female and are omitted). Red = higher frequency of male participants, blue = higher frequency of female participants, grey = overlap.

References

1. Milinski M, Sommerfeld RD, Krambeck H-J, Reed FA, Marotzke J (2008) The collective-risk social dilemma and the prevention of simulated dangerous climate change. *Proc Natl Acad Sci USA* 105(7):2291–2294.

2. Milinski M, Semmann D, Krambeck H-J, Marotzke J (2006) Stabilizing the Earth's climate is not a losing game: Supporting evidence from public goods experiments. *Proc Natl Acad Sci USA* 103(11):3994–3998.

3. Andreoni J (1998) Toward a Theory of Charitable Fund-Raising James Andreoni. *Journal of Political Economy* 106(6):1186–1213.

4. Gross J, De Dreu CKW (2019) Individual solutions to shared problems create a modern tragedy of the commons. *Science Advances* 5:1–8.

5. Lindenberg S (1986) The Paradox of Privatization in Consumption. *Paradoxical Effects of Social Behavior*, eds Diekmann A, Mitter P (Physica-Verlag HD, Heidelberg), pp 297–310.

6. Lindenberg S (1982) Sharing groups: Theory and suggested applications. *J Math Sociol* 9:33–62.

7. Aktipis A, et al. (2018) Understanding cooperation through fitness interdependence. *Nature Human Behaviour* 2(7):429–431.

8. Balliet D, Tybur JM (2017) Functional interdependence theory: An evolutionary account of social situations. *Pers Soc Psychol Rev* 21(4):1–28.

9. Roberts G (2005) Cooperation through interdependence. *Anim Behav* 70(4):901–908.

10. van Lange PAM, Balliet D (2015) Interdependence theory. *Handbook of Personality and Social Psychology: Vol. 3. Interpersonal Relations*, eds Mikulincer M, Shaver PR (American Psychological Association, Washington), pp 65–92.

11. Fabbri D, Monfardini C (2016) Opt out or top up? Voluntary Health Care Insurance and the Public vs. Private Substitution. *Oxford Bulletin of Economics and Statistics* 78(1):75–93.

12. Doiron D, Kettlewell N (2018) The Effect of Health Insurance on the substitution between Public and Private Hospital Care. *Economic Record* 94(305):135–154.

13. Milinski M, Hilbe C, Semmann D, Sommerfeld R, Marotzke J (2016) Humans choose representatives who enforce cooperation in social dilemmas through extortion. *Nat Comm* 7(1):10915.

14. Tavoni A, Dannenberg A, Kallis G, Löschel A (2011) Inequality, communication, and the avoidance of disastrous climate change in a public goods game. *Proc Natl Acad Sci USA* 108(29):11825–11829.

15. Santos FC, Pacheco JM (2011) Risk of collective failure provides an escape from the tragedy of the commons. *Proc Natl Acad Sci USA* 108(26):10421–10425.

16. Gradstein M, Nitzan S (1990) Binary participation and incremental provision of public goods. *Soc Choice Welf* 7:171–192.

17. Murphy RO, Ackermann KA, Handgraaf M (2011) Measuring social value orientation. *Judgm Decis Mak* 6(8):771–781.

18. Gelfand MJ, Triandis HC (1998) Converging Measurement of horizontal and vertical individualism and collectivism. *J Pers Soc Psychol* 74(1):118–128.

19. A. Falk, A. Becker, T. Dohmen, D. Huffman, U. Sunde, "The preference survey module: A validated instrument for measuring risk, time, and social preferences" (Discussion Paper No. 9674; Institute for the Study of Labor, Bonn, Germany, 2016).

20. Kuznetsova A, Brockhoff PB, Christensen RHB (2017) Lmertest package: Tests in linear mixed effects models. *J Stat Softw* 82(13):1–26.

21. Gross J, Veistola S, Dreu CKW, Dijk E (2020) Self-reliance crowds out group cooperation and increases wealth inequality. *Nat Comm* 11:1–9.

22. Solow JL, Kirkwood N (2002) Group identity and gender in public goods experiments. *J Econ Behav Organ* 48(4):403–412.

23. Cadsby CB, Maynes E (1998) Gender and free riding in a threshold public goods game: Experimental evidence. *J Econ Behav Organ* 34(4):603–620.

24. Nowell C, Tinkler S (1994) The influence of gender on the provision of a public good. *J Econ Behav Organ* 25(1):25–36.

25. Zelmer J (2003) Linear public goods experiments: A meta-analysis. *Exp Econ* 6(3):299–310.