Supporting Online Material

1. Experimental procedure

Before Experiment

16 subjects entered. Instructions were read aloud. (An English translation can be found below.) Decisions were monetarily incentivized. Earnings were expressed in Experimental Currency Units (ECU), where 1 ECU = 0.05 EUR.

Group Assignment

In each session, subjects were randomly allocated into four color-coded groups of equal size: green, orange, purple, and brown. Each subject's color group was shown on screen throughout the experiment. Each session was divided into two parts: a group quiz and a sequence of two-person public goods games.

Part I: Quiz

After the group assignment, groups were given a 10 minute quiz consisting of 20 multiple choice questions. Answers were chosen individually, but members of each group could communicate with each other via online chat. (It was announced in the instructions that no personal information was allowed to be communicated; chat records show that all subjects followed these instructions.) Each correct answer was rewarded with 10 ECU for the group, divided equally among the group members. 100 ECU per subject were used as an endowment for the second part of the experiment. To ensure that each subject had at least 100 ECU, minimum group earnings of 400 ECU were implemented. In effect, this is purely a framing manipulation: we increased subjects' sense that they had "earned" their ECU so as to strengthen the perception that taking ECU from the common fund was a norm violation.

The questions in the quiz were chosen to provoke communication, i.e. we expected that not every individual would be able to answer correctly, but possibly so within the group. The average number of chat entries per group were 81, i.e., roughly, each subject made one chat entry per question.

In 3 of the 15 sessions, the group with the most points was awarded a bonus of 100 ECU per person ("winner bonus"). In the remaining 12 sessions, this bonus was given to a randomly selected group ("random bonus"). In both cases, the instructions explained how the bonus would be awarded. The group receiving the bonus was announced at the end of the quiz.

Directly after the quiz, subjects answered a brief questionnaire containing three 5-point Likert scales. We asked these early to ensure that behavior in the public goods games did not affect subjects' answers. Subjects were asked:

1) How much did you enjoy the quiz? ("Not at all" = 1, "Very much" = 5)
2) How well do you think your group performed in the quiz? ("Very badly" = 1, "Very well" = 5)
3) How fair did you think the quiz was? ("Not at all fair" = 1, "Very fair" = 5)

Part II: Public Goods Games

The second part of the experiment consisted of 8 separate repetitions with 2 rounds in each repetition. Earnings in one repetition were randomly chosen for payment. For each repetition, subjects were rematched into groups of 4 with members of different colors. Within each repetition,

subjects were assigned an individual number from 1-4. An on-screen graphic illustrated each decision (screenshots are provided in the instructions below). This informed subjects about each of the 4 members' color, as well as their earnings from the quiz.

The 4 subjects were then paired for each of the two rounds. The logic of pairwise matching in the two rounds is illustrated in Figure S1 below. The subject (S) is matched with his first round partner and plays the first public good game, then receives feedback about another participant (F)'s first round take, then plays against a second round partner (P). In the first party treatments, subjects were paired "horizontally" in the first round, received feedback on their partner's play, then were paired "diagonally" for the second round. In third party treatments, first choices were made with the horizontal player, feedback was given (only) on the behavior of the diagonal player, and subjects then played the horizontal player again. Thus, subjects always played the second round against someone other than the participant F about whom they received feedback.

[Figure S1 about here]

As described in the main text, each round was a two-player public goods game with a "taking frame". 50 ECU of each subject's earnings were put in her pair's fund. Subjects could then withdraw up to 50 ECU from this fund. Any ECU remaining in the fund were multiplied by 1.5. It was therefore individually rational for self-interested subjects to withdraw all the 50 ECU (of each ECU left in the fund, only 0.75 ECU would end up in the subject's own pocket), but collectively optimal to withdraw 0 ECU (each ECU left in the fund was multiplied by a factor larger than 1).

After the second round, subjects were shown the choices of both their partners in the repetition, and their total earnings from the repetition. They were then rematched into different groups of 4 for the next repetition. Besides varying between first and third party treatments, we also changed the color composition of groups, as illustrated in Figure S2 below. In *Same group* repetitions, the two players opposite the subject were of the same color; in *Different group* repetitions, they were of different colors from each other. In *Own same group* (*Own different group*) repetitions, the subject and the player next to him were of the same color (different colors). All four possible combinations of color treatment were implemented. All subjects experienced all four color treatments in both first and third party varieties, making 8 repetitions in total. The rematching schedule was fixed to ensure that color and party treatments were balanced across repetitions. This within-subjects design allows more accurate inferences about group revenge's individual-level covariates.

[Figure S2 about here]

Our design lets us measure group revenge by observing how S's decision in the second round (against P) is affected by F's decision in the first round. Including the *Different group* treatments provides a baseline measure of generalized reciprocity. The design has two further advantages. First, since participants of the same color never play a public goods game with each other, we avoid the possible confound that in-group altruism is increased by external threats. Second, the setup makes it clear that F and P are different people. This avoids the potential confound of reciprocity towards individuals. The *Own same group* and *Own different group* treatments allow us to examine the effect of a third party victim's group membership on indirect group revenge.

Questionnaire

A final questionnaire ended the experiment. The questionnaire included questions on gender, age, major subject, native language, whether any of the other subjects were personally acquainted, and the possibility to comment on the experiment. It also included open questions on what subjects believed the experiment to be about and a brief explanation of their choices of the course of the experiment. Mostly, subjects thought the experiment to be about the influence of income on decision behavior, the correlation of certain behaviors with intelligence, or social dilemmas. Only 3 of the 240 subjects mentioned objectives related to group revenge ("treat colors differently", "memorize behavior according to color", "do decisions of un-encountered others affect my

behavior"). To get indicators of ingroup identity and fairness we added three statements which subjects could agree/disagree with on a 7-point Likert scale:

- I felt committed to my group
- I think the experiment was fair towards all (color) groups
- I enjoyed the experiment

Perceptions of other groups were also elicited by Likert scales. Statements read as follows (each statement was given 4 times, once for each color group):

- Members of the green/orange/purple/brown group worked together well as a team
- Members of the green/orange/purple/brown group behaved fairly towards other groups

After the questionnaire, subjects were told which round was chosen for payment and their total earnings. Subjects were called up individually by seat number and signed a receipt slip for the money.

Alternative Treatments

Expectations: In sessions 1-10 and 13-15, subjects were asked how much they expected their second round partner to take. To keep the experiment simple, expectations were only elicited in repetitions 2 and 7. Expectations were incentivized: the difference between the expectation and the true amount withdrawn by the partner determined the size of an extra bonus, shown in Table S1.

[Table S1 about here]

Randomized play: In sessions 11-12, in each group of four, one player's second round choice was randomly made by the computer. The amount to take was drawn from the uniform distribution on {0,...,50}. This player and his or her partner were informed of this before the second round. All players were paid as normal as a result of the second round decisions. As described in the main text, this gives us another way to examine the effect of expectations. In order to focus on first party group revenge, these sessions only included first party treatments, with two repetitions of each color treatment.

Second quiz: In 3 sessions (sessions 13-15) the public good games were interrupted after 4 rounds to play an additional 5 minute quiz containing 10 questions. As before, participants could chat with each other to answer the questions. However, this time, while one color group in each session chatted only within itself, the other 3 color groups were distributed within "quiz 2 groups" so that they chatted with members from different color groups. Color group membership was shown in the chat window. The public goods games were then continued for 4 final rounds.

Table S2 summarizes our sessions.

[Table S2 about here]

The experiment took place in the computer laboratory of the University of Hamburg, using the computer software zTree (33). Recruiting took place via ORSEE (34). 240 subjects participated in 15 sessions on four separate days. Each session had 16 participants. Table S3 shows participants' descriptive statistics, including demographics. Sessions lasted slightly less than an hour. Average earnings per session were 14.48 EUR; the maximum session average was 16.45 EUR and the minimum session average was 13.02 EUR. Individual earnings varied from a minimum of 9.40 EUR to a maximum of 21.85 EUR. These earnings are quite high compared to other experiments in Germany.

[Table S3 about here]

2. Supplementary analyses of main results

We first explore the basic patterns in our data. Figure S3 shows the distribution of amounts taken. There are many observations of both 0, the minimum possible take, and 50, the maximum, which means that tobit regressions may be appropriate.

[Figure S3]

Subjects' behavior within a single session may not be independent, because subjects may influence each other, either through their play or during the quiz. We use two alternative strategies to deal with this. First, we treat each session as a single independent observation and run non-parametric tests on session-level statistics. Second, we run regressions on individual decisions, cluster standard errors by individual, and include covariates to control for the history of play. We could also cluster standard errors at the session level. We believe that errors are likely to be most strongly correlated within individuals; in any case, the coefficient on *F take* × *Same group* remains highly significant if we cluster at session level (results available on request).

At session level, Figures S4 and S5 show the coefficient on *F take* × *Same group* in equation (1), estimated by linear regression without controls, separately for each session, and for first and third party treatments. We use Wilcoxon signed-rank tests to test whether the values of these coefficients are significantly different from 0 (equivalently, whether the coefficients on *F take* are significantly larger when *Same group* is 1: thus, the test uses matched pairs of observations from each session for *Same group* = 1 and *Same group* = 0). Table S4 shows two-sided p-values for first and third party treatments in winner bonus and random bonus sessions. It also shows tests pooling all sessions. In third party treatments, δ is never significantly different from 0, while in first party treatments δ is significantly different from 0, whether we pool all sessions or examine random bonus sessions alone.

[Figures S4 and S5 about here]

[Table S4 about here]

Next, we take individual decisions as the unit of observation. To check if we can pool our different session types for analysis, we estimated equation (1) separately for each type of session. In first party treatments, δ was not significantly different between the different sub-types of random bonus session (sessions 4-10 vs 11-12: p=0.171; 4-10 vs 13-15: p=0.395, 11-12 vs 13-15: p=0.622), but it was significantly different between the winner bonus sessions and sessions 11-12 (p=0.0146) and sessions 13-15 (p=0.0395), and narrowly missed significance at the 10% level between the winner bonus sessions and sessions 4-10 (p=0.107). This suggests that we can pool the random bonus sessions. In third party treatments, δ was always insignificant and did not vary significantly between session types.

Next, we pool data from all the random bonus sessions, and test equation (1) in various specifications. Column 1 of Table S5 reports an OLS regression without controls. Column 2 adds in subject and repetition dummies, to control for individual-level variation and for changes in average cooperation over time. Using subject dummies loses the information contained in differences between individuals. Column 3 removes the dummies, but adds controls for the history of play. We add the amounts taken by the subject's partners in the previous repetition, as well as the amount taken by the subject's feedback participant (F) in the previous repetition. Further lags were insignificant. We also add *Last take same group*, which is the amount taken by the subject's last partner (in any round and repetition) who came from the same group as the current second-round partner P. Lastly, column 4 estimates (1) using a tobit regression, censoring the data at 0 and 50.

The δ coefficient on *F take* × *Same group* remains almost unchanged in the first three specifications, and is significant for first party treatments. In column 4 the δ coefficient is larger,

because the tobit specification treats the censored observations as less informative. The lagged variables in general have the expected sign, but are not strongly significant. However, the coefficient on *Last take same group* is large and highly significant in both first and third party treatments. This suggests that even in third party treatments, subjects took group revenge for the previous behavior of others towards them. Identification is not clean, though, as subjects are not sure that their last partner was a different person from the current P. In later tables, we use the same history variables, but omit their coefficients for clarity.

[Table S5 about here]

We ran three further checks of the basic result. First, we estimated equation (1) separately for repetitions 1-4 and 5-8. Group revenge might only be observed early on, and not as subjects gain experience. In fact, δ was larger in later repetitions, although the difference was not significant (p=0.496).

Second, we spliup decisions by whether *Own same group* was 1 or 0, i.e., whether the subject was in the same group as the other subject on her side. This might affect indirect group revenge: subjects may reciprocate behavior harming someone in their group, but not behavior harming someone in a different group. Again, the difference between δ coefficients was small and insignificant (first party, p=0.347; third party, p=0.21).

Lastly, we replaced *F take* by a set of 6 dummies, 1 each for values of *F take* of 0-9, 10-19, 20-29, 30-39, 40-49 and 50. These were interacted with *Same group.* The field literature has many more examples of group revenge – returning evil for evil – than of positive "group reciprocity", so we expected to see larger and more significant interaction terms at high values of *F take*. This was broadly confirmed: coefficients on *F take 0-9* × *Same group* were significant, but smaller and less significant than coefficients on *F take 50* × *Same group* in most specifications.

Expectations

There are two possible explanations for group revenge. F's action may affect S's preferences, for example by making her feel more or less altruistic towards P. Or F's action may shift S's expectations about P's behavior. For example, if S wishes to take exactly as much as P, and assumes that people from the same group take similar amounts, then S's taking behavior will be affected by *F take* when F and P are from the same group. We approach this question in two ways: first by eliciting expectations, second by looking at S's behavior when she knows that P's take is determined randomly by a computer.

The variable *Expectations* gives S's expectations of P's second round take, in repetitions 2 and 7, elicited as described above. If we re-estimate equation (1) with this variable added, both the δ coefficient and the β coefficient on *F take* become insignificant in all treatments. However, re-estimating equation (1) without *Expectations*, but on repetitions 2 and 7 alone, also shows these coefficients becoming insignificant, so the smaller dataset may be to blame rather than the effect of controlling for *Expectations*. To resolve this we multiply impute the *Expectations* variable for other repetitions. Since the missingness of *Expectations* is wholly determined by the repetition number, it is "missing at random" with respect to *Expectations* once repetitions are controlled for, so that multiple imputation will be unbiased (35). Table S6 shows the results, using the same specifications as Table S5. *Expectations* is significantly correlated with subjects' second round take. Indeed in the basic OLS regression, the coefficient is not significantly different from unity, fitting the story that subjects wish to match the amount their partners take. Also, the value of δ is about halved in first party treatments, although it remains significant.

[Table S6 about here]

We also checked directly whether F's behavior affected subjects' expectations of P's take. In regressions, *F take* significantly affected *Expectations* in both first and third party sessions. The

effect was not significantly larger when F and P were in the same group. Finally, we tested whether F's and P's actual behavior was correlated. We regressed each subject's second round take on the first round take of the other subject on their "side". We found a small but significant correlation between the two, which was not significantly larger when P and F shared group membership. This result did not survive when time and session dummies were added.

As stated in the main text, subjects who intend to take a lot from the common resource in the second round may report that they expect their partners to do the same, due to a self-justification or false consensus effect (25, 36). This would bias our estimate of the causal effect of expectations. Therefore, we used an alternative approach to examine behavior when expectations were irrelevant. In 64 of the choices of sessions 11-12, subjects were informed beforehand that their second round partner's choice would be made randomly on their behalf by the computer (the partners were still paid, however). Thus, S's expectations about P's choice ought not to be affected by F's take in round 1.

Table S7 estimates equation (1) separately for when P's choice would be made by a human (*Human Choice*) and by the computer (*Random Choice*). The coefficient on *F take* × *Same group* is always positive for both values of *Random Choice*, and the difference between coefficients is never significant. In the fixed effects regression, the coefficients on *F take* × *Same group* are not significant. We attribute this to the small sample size and the inefficiency of fixed effects; in any case, the coefficient is substantially larger when *Random Choice*=1.

To sum up, the effect size of group revenge is reduced when we control for subjects' expectations. However, there is only weak evidence that subjects take group membership into account when forming expectations, and group revenge does not disappear when expectations are irrelevant. Shifts in expectations seem to help explain group revenge, but are not the whole story.

[Table S7 about here]

Fairness

Next, we examine perceptions of fairness. The pre-questionnaire contained the question "Did you think the quiz was fair?" Responses were on a 1-5 Likert scale. We created a *Fair* dummy which is 1 if subjects chose 4 or 5 and 0 if subjects chose 1, 2 or 3. Columns 1-4 of Table S8 estimate equation (1) for random bonus sessions, adding an interaction with *Fair*. For clarity, third party treatments are omitted. The interaction of *Fair* with our basic variable of interest *F take* × *Same group* is negative, and at least weakly significant in all specifications except column 3 when history is included. Further analysis (available on request) shows that this loss of significance is due to the lower *N* due to the history variables, rather than from the variables themselves. The sum of the coefficients on *F take* × *Same group* and *F take* × *Same group* × *Fair* is never significantly different from zero. Group revenge seems to be driven by those subjects who perceived the quiz as unfair.

[Table S8 about here]

The second quiz and the contact hypothesis

According to the "contact hypothesis", intergroup contact can help to reduce prejudice (37, 38). Specifically, if subjects cooperate on a task then this may foster good intergroup relations (26). In sessions 13-15, a second quiz was added between repetitions 4 and 5 of the public goods game. During this quiz, some participants could chat with members of other groups, while others only chatted within their previous color group. We create a dummy *Open quiz 2* which is 1 if the subject could chat with members of other groups. In contrast to the main text, we also include an *Early* dummy for repetitions 1-4. This avoids a confound with time, since *Open quiz 2* only takes the value 1 in repetitions 5-8. Table S9 shows the standard regressions, interacting (1) with both *Early*

and *Open quiz 2*. The interaction *F take* × *Same group* × *Open quiz 2* is only significant in the regression with history controls; this is likely to be due to the reduced N, since in other regressions the coefficient is not only insignificant but substantively small. We also tried replacing *Open quiz 2* with a dummy for if the subject had interacted with participants specifically of P's color during the second quiz. Again, the interaction was not significant.

These null results are not definitive. A longer interaction between groups might have broken down group revenge more effectively. Nevertheless, they suggest that group revenge is not easy to prevent.

[Table S9 about here]

3. Further results

Inequality

Between-group inequality is closely related to unfairness, and it may be an important channel leading from ethnic diversity to conflict (23) and inefficient public good provision (39). In our experiment, subjects could observe the quiz earnings of F and P. Table S10 interacts equation (1) with F's quiz earnings. The interaction *F take* × *Same group* × *F earnings* is positive and significant except under the fixed effects specification. So, there is some evidence that high earning groups were more likely to be targets of group revenge.

[Table S10 about here]

Males versus females

Some evolutionary psychological theories predict that males should care more than females about group membership (40). And certainly most perpetrators of intergroup violence are male (41). Table S11 shows equation (1) estimated separately for males and females. All coefficients are similar-sized and not significantly different. Differences observed in the field are likely to be caused by physical, social, economic or cultural differences which our lab setting does not capture.

[Table S11 about here]

In-group identity

Social Identity Theory (SIT) holds that individuals support their group, and discriminate against other groups, in order to protect the self-esteem they derive from their social identity as a group member (2). If revenge is a form of group discrimination, SIT would predict that subjects with the strongest in-group identity will be most likely to take group revenge. Our final questionnaire included standard measures of group identity (42). We sum answers to these to create the variable *Group ID*. Table S12 interacts equation (1) with Group ID. The interaction term *F take* × *Same group* × *Group ID* is significant in only two out of four specifications, although it always has the expected sign.

[Table S12 about here]

4. Participant Instructions

Translated from German.

Welcome to the Experimental Laboratory!

Please turn off your mobile phones and all other electronic devices now!

You are participating in an economic experiment. Depending on your own choices and choices of participants matched with you, you will be able to earn a non-trivial amount of money. For this, it is important that you read carefully and understand the following instructions.

During the experiment communication among the participants is strictly prohibited, except in situations in which it is explicitly allowed! In case you have any questions, please raise your hand and an experimenter will come to you to answer your question.

Non-compliance with this rule and with the instructions of the experimenters will lead to an exclusion from the experiment and all payments!

Your decisions during the experiment will be made anonymously. Only the experimenter will get to know your identity, but your decisions will not be relatable to your identity.

You will receive EUR 5 as show up fee. Additional payments will depend on your decisions and those of participants matched with you. Earnings will during the experiment be entitled Expected Currency Units, abbreviated as ECU. The total amount of ECU you gained during the experiment will be converted at the end, where

1 ECU = 5 CENT (0.05 EUR)

and be paid in cash.

In this experiment, you and the other participants will randomly be assigned one of 4 groups: green, orange, purple, and brown. Each group consists of 4 participants. The color of your group will be shown to you onscreen. During all parts and rounds of the experiment, you will see the time remaining for a choice in the upper right corner of the screen. The screen at the beginning of the experiment will look similar to the following (please note that no decision has to be made on this first screen):

[Figure S6 about here]

[THE TEXT ON THE SCREEN READS AS FOLLOWS:

UPPER RIGHT CORNER: “Remaining time”

MAIN BODY: “PART I – QUIZ

You are in group orange. The quiz will begin shortly.”]

The experiment consists of 2 parts.

PART I

Each group will play a quiz. The aim of the quiz is to answer different questions about general knowledge. On the whole, there are 20 questions with 4 possible answers each. Each question can be answered individually, but you have the option to exchange information with the other members of your group via computer chat. This is the only allowed form of communication over the course of the experiment.

The screen will look similar to the following. In the blue field on the right hand side you can enter your chat contributions. In the grey field above it you can read the contributions of the other members of your group.

[Figure S7 about here]

[THE TEXT ON THE SCREEN READS AS FOLLOWS:

CENTER BOX:

"What is the first letter of the abc?"

RIGHT BOX:

"Chat with other members of your team:

(Please press enter to send your contribution)]

For each correct answer, you will receive one point. On the whole you have 10 minutes to answer all questions. Questions not or wrongly answered will be evaluated with 0 points. The computer will add all points of each group's members.

Your group will receive 10 ECU for each of the 80 possible points. (4 participants per group x 20 correct answers = 80 points maximum.)

Example:

Assume the participants of a group answer 20, 15, 14, and 11 questions correctly. The overall number of points of this group will then be 20+15+14+11=60. The group will then receive 10x60=600 ECU.

There is however a minimum earning of 400 ECU per group, i.e. Should your group for instance achieve 0 points in the quiz, you will nevertheless receive 400 ECU.

The earnings of the group will be distributed as follows:

- 400 ECU will be subtracted from the overall earnings and divided equally among the group members. These will serve as endowment for part 2 of the experiment. Therefore, every participant will begin part 2 with 100 ECU.
- All remaining ECU will also be divided equally among the group members (partial amounts will be rounded up) and constitute your earnings of part 1.

Example continued:

Let's take the 600 ECU of the example group. 400 ECU will be used for part 2 of the experiment. The remaining 200 ECU will be divided equally among the participants: Each participant gets 200/4=50 ECU(=2.50 EUR) from part 1.

After the quiz, we ask you to briefly answer three questions to the quiz.

Bonus ECU

[IN WINNER SETTING]: The group achieving the most points in the quiz will receive a bonus of 100 ECU per participant.

[IN RANDOM SETTING]: A randomly selected group will receive a bonus of 100 ECU per participant.

PART II

The second part of the experiment consists of 8 rounds, in each of which you will have to make 2 decisions. At the end of the experiment, *one* of these 8 rounds will be *randomly* selected for your final payment. The earnings of this round only will be added to your earnings of part 1.

In each round you will be interacting with 3 other participants. These can be of any of the different groups – green, orange, purple, brown. After each round the composition of each group will be changed, such that you need not interact with the same participants. In each round participants will be given a number ranging from 1 to 4, which may change from round to round.

In each round, each of the 4 participants will have to make 2 decisions. After each decision, you will receive feedback on *one* of the other participants' choice.

[IN SESSIONS 11-12 THIS PARAGRAPH WAS CHANGED TO:

In each round, principally each participant will have to make 2 decisions. In some rounds the computer may make some of the decisions instead of the respective participant on a random basis.]

DESCRIPTION OF A ROUND

During each round the current participants are shown onscreen. For each participant you will be given information about his group membership and the amount he received in part 1.

DECISION 1

Participants 1 to 4 will be paired. Participants 1 and 2 are paired, and participants 3 and 4.

50 ECU of each of a pair's participants' earnings in part 1 will be put into a joint fund. The fund will thus contain 100 ECU.

Each participant of the pair may afterwards choose how much to withdraw from the fund. Both participants can simultaneously withdraw an amount between 0 and 50 ECU. Every ECU remaining in the fund will be multiplied by 1.5 and divided equally between the two (partial amount will be rounded up.)

Example:

Assume that participant 1 had withdrawn 33 ECU and participant 2 had withdrawn 37 ECU (the number mentioned were randomly chosen by a computer.) Then the fund would consist of 100-33-37=30 ECU. These are multiplied by 1.5 yielding 45, and distributed equally among the two participants in the pair. After rounding, each will receive 23 ECU. Participant 1 will receive 33+23=56, participant 2 37+23=60 ECU from this decision.

The screen will look similar to the following (please note that the numbers displayed were randomly drawn):

[Figure S8 about here]

[THE TEXT ON THE SCREEN READS AS FOLLOWS:

TEXT NEXT TO EACH CIRCLE:

“Player (No.)

Group (color)

Earnings from quiz: 0 ECU”

TEXT AT BOTTOM:

“Round 1: First Decision

You are player 2.

Player 1 is paired with player 3.

You are paired with player 4.

There are 100 ECU in your pair's fund.

You and player 4 can both withdraw up to 50 ECU from the fund.

The amount remaining in the fund will be multiplied by 1.5 and divided equally among you and player 4.

Please indicate how many ECU you withdraw from the fund."]

DECISION 1 FEEDBACK

After decision 1 every participant will be informed about exactly one choice of one of the 4 participants. This can be the decision of the direct partner in the pair, it can also be the decision of a participant of the other pair. The decision will be announced as follows (please again note that the displayed numbers were randomly drawn):

[Figure S9 about here]

[THE TEXT ON THE SCREEN READS AS FOLLOWS:

"Round 1: Feedback Decision 1

You were player 2.

Player 1 was paired with player 3.

You were paired with player 4.

Player 4 withdrew 41 ECU from your and his fund.

(The other participants may receive feedback from another decision than you do.)]

DECISION 2

Decision 2 equals decision 1. You are again matched with the same 3 other participants in a choice situation and be paired with one of them. But this can now be another participant than in decision 1. Again 50 ECU of each of two participants will be put into a fund, and both participants choose how much they withdraw from the fund. The amounts remaining in the fund will again be multiplied by 1.5 and divided equally among the two participants in the pair.

[IN SESSIONS 11-12 THIS PARAGRAPH WAS CHANGED TO:

In some rounds, some players' second decision may be made randomly by the computer. This will be shown onscreen by the words "random decision" next to the player. In these cases, the computer will automatically draw a number of ECU to take from 0 to 50. Each number from 0 to 50 is equally likely to be chosen. The player and his pair will be paid according to this decision, in the usual way.]

DECISION 2 FEEDBACK

After the second decision, the decisions of you and the participants you were matched with will be shown to you in a summary. The summary will show you how much you and the respective other participant withdrew from the joint fund and the amount of ECU overall achieved in this round. (Please again note that only one of the overall 8 rounds will be randomly selected for payment.)

The summary completes the round. In case another round follows, you will be matched with other participants and the procedure from decision 1 onwards begins anew. The screen of a summary will look similar to the following: (Please again note that the shown amounts are randomly drawn)

[Figure S10 about here]

[THE TEXT ON THE SCREEN READS AS FOLLOWS:

ROW 1: “Decision 1 / You withdrew

Player 1 withdrew

Remaining in fund

x 1.5

your share (50%)

Share player 1 (50%)”

LAST ROW: “In total”]

[IN SESSIONS 11-12 THE FOLLOWING PART WAS DROPPED]

OTHER QUESTIONS

During some rounds you may be asked about your expectations concerning the amount the participant assigned to your pair will withdraw from the fund. If this is the case, you will get the possibility to earn a bonus. The amount of the bonus will be calculated according to the difference of your expectation and the de facto amount the participant withdrew. This difference will be divided into “intervals of five”. If the difference is less than 5 ECU, you will receive 10 ECU bonus. If the difference is between 5 and 9 ECU, you will receive a bonus of 9 ECU, if it is between 10 and 14 ECU you will receive a bonus of 8 and so on, up to a bonus of 1 ECU if the difference is between 45 and 49 ECU, and no bonus if the difference is 50 ECU. The possible boni are summarized in the following table:

Difference	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50
Bonus (ECU)	10	9	8	7	6	5	4	3	2	1	0

Example:

If you believe the other participant will withdraw 45 ECU from the fund, but he only withdrew 27 ECU, the difference between your expectation and the true amount is 45-27=18 ECU. 18 is in the interval between 15 and 19. You will thus receive a bonus of 7 ECU.

The screen for an expectation will look similar to the following:

[Figure S11 about here]

[THE TEXT ON THE SCREEN READS AS FOLLOWS:

“Round 2: Expectation decision 2

You are player 4.

Player 1 is paired with you.

Player 2 is paired with player 3.

How many ECU do you think player 1 will withdraw?

You receive 10 ECU if the difference between your expectation and the true withdrawal is less than 5 ECU, 9 ECU if it is more than 5 but less than 10 ECU etc.

Please indicate your expectation (0-50 ECU):”]

After the experiment there will be a brief questionnaire. Please answer these questions truthfully.

PAYMENT

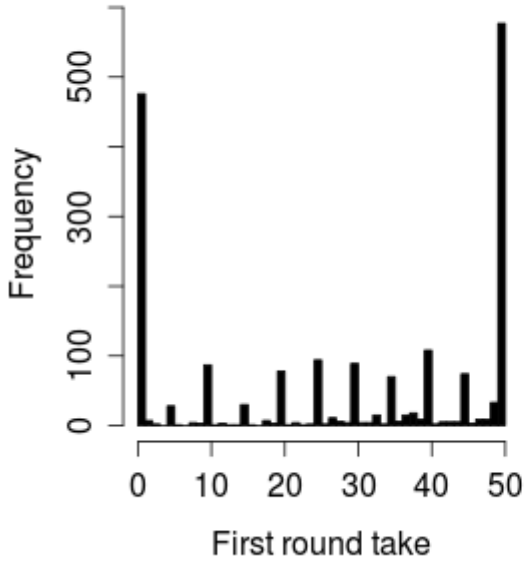
After the end of the experiment the round of part 2 chosen for payment will be announced. You will then be called separately and payed privately. Additionally to the ECU earnings of the experiment you will receive 5 EUR show up fee. You will have to sign a receipt for the money, but this receipt will in no way be associated with your choices during the experiment. After receiving your payment, please exit the lab silently.

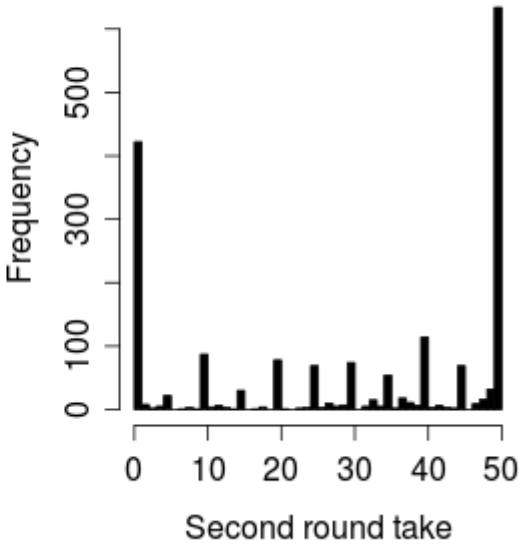
Do you have any questions regarding the experiment?

F**igures S1 to S11**

Figure S1: Pairing and feedback in rounds 1 and 2

Figure S2: Color treatments. Subject is marked with an S.


Frequency
0
100
300
500
0
10
20
30
40
50
First round take


Frequency
0
100
300
500
0
10
20
30
40
50
Second round take

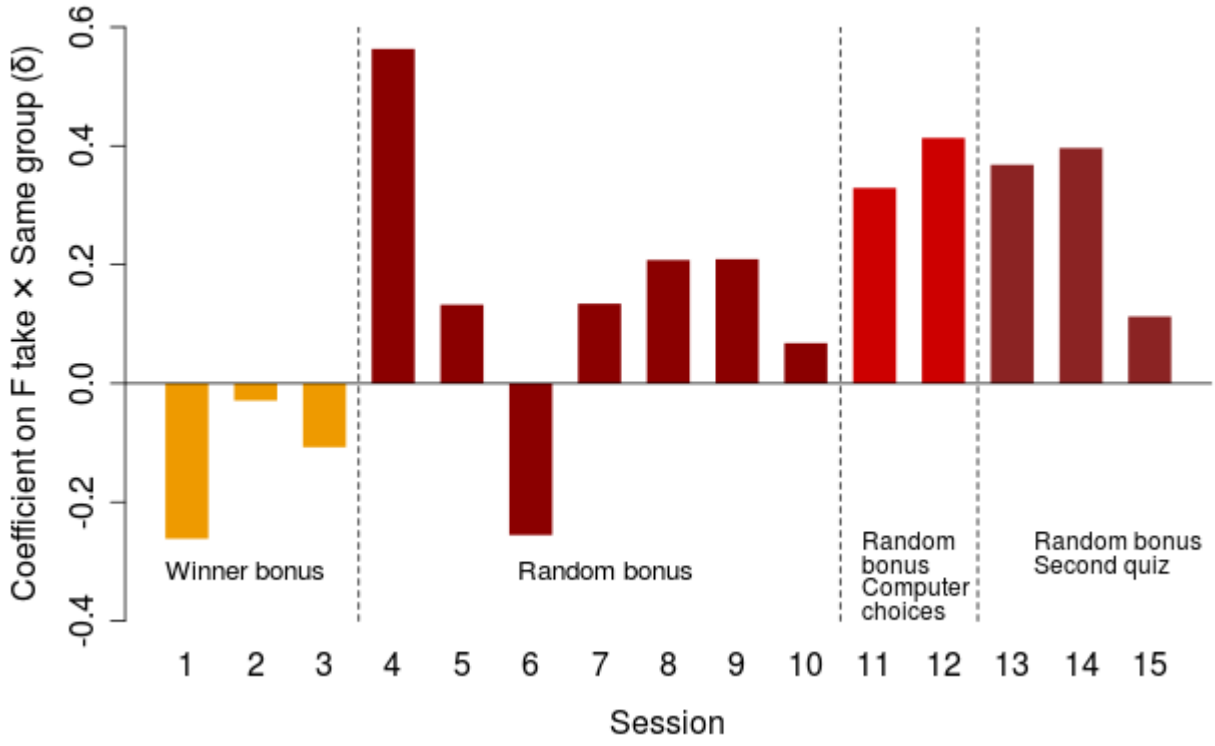


Figure S4: Per-session estimates of δ, first party treatments

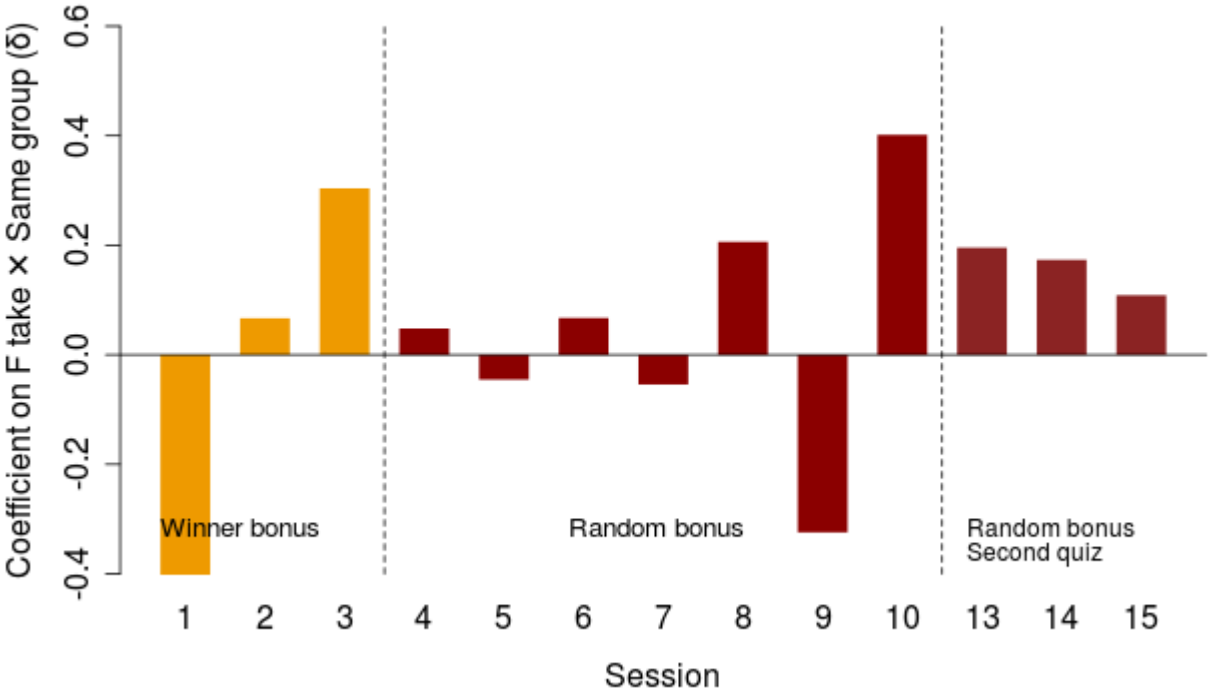


Figure S5: Per-session estimates of δ, third party treatments

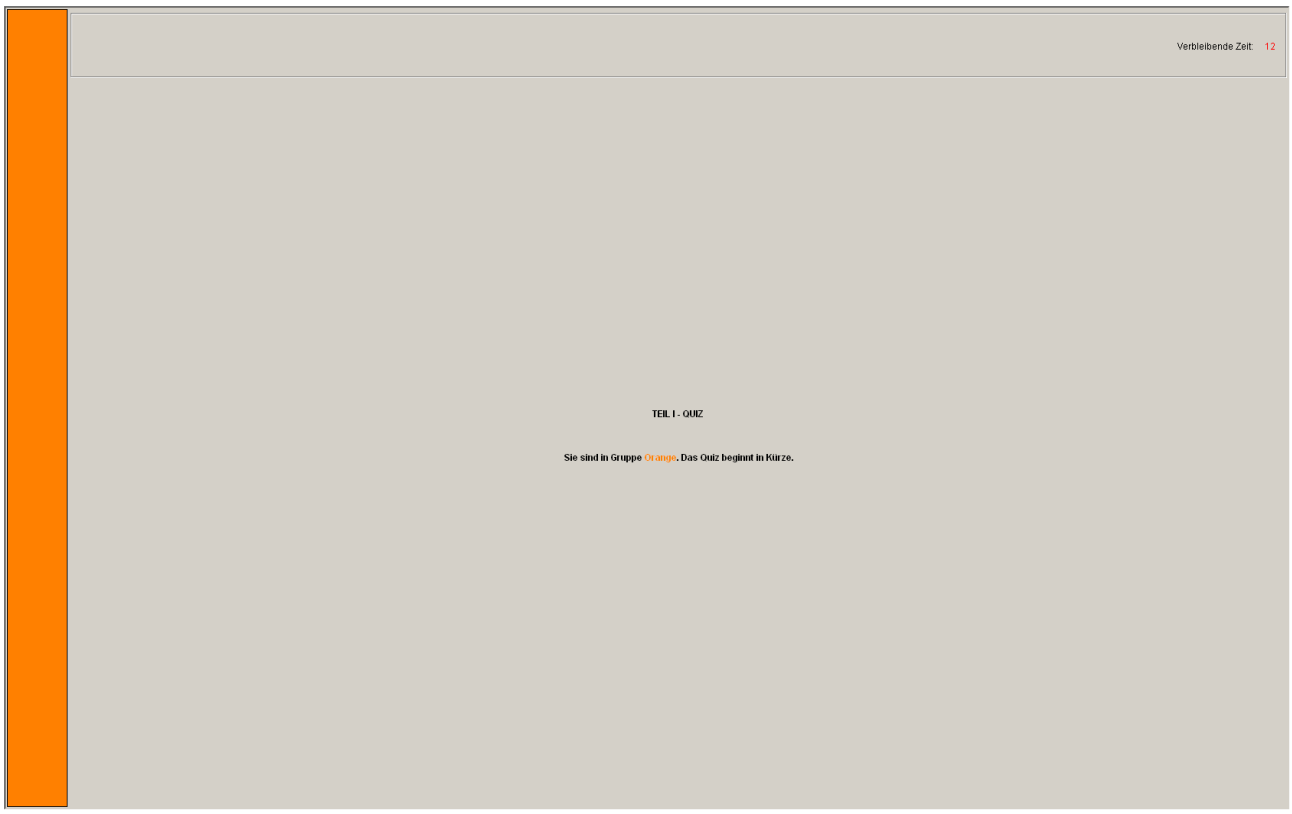

Verbleibende Zeit: 12
TEIL I - QUIZ
Sie sind in Gruppe Orange. Das Quiz beginnt in Kürze.

Figure S6

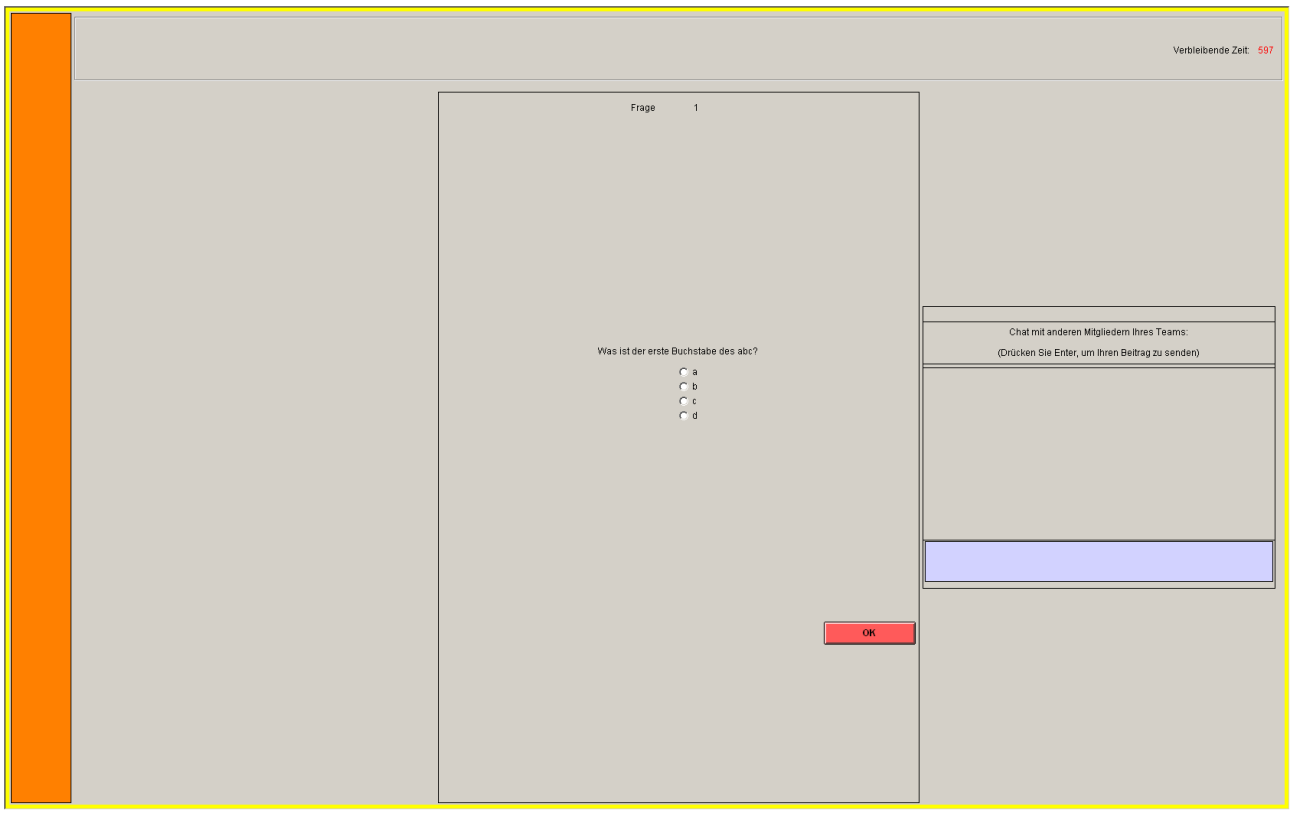

Verbleibende Zeit: 597
Frage 1
Was ist der erste Buchstabe des abc?
a
b
c
d
OK
Chat mit anderen Mitgliedern Ihres Teams:
(Drücken Sie Enter, um Ihren Beitrag zu senden)

Figure S7

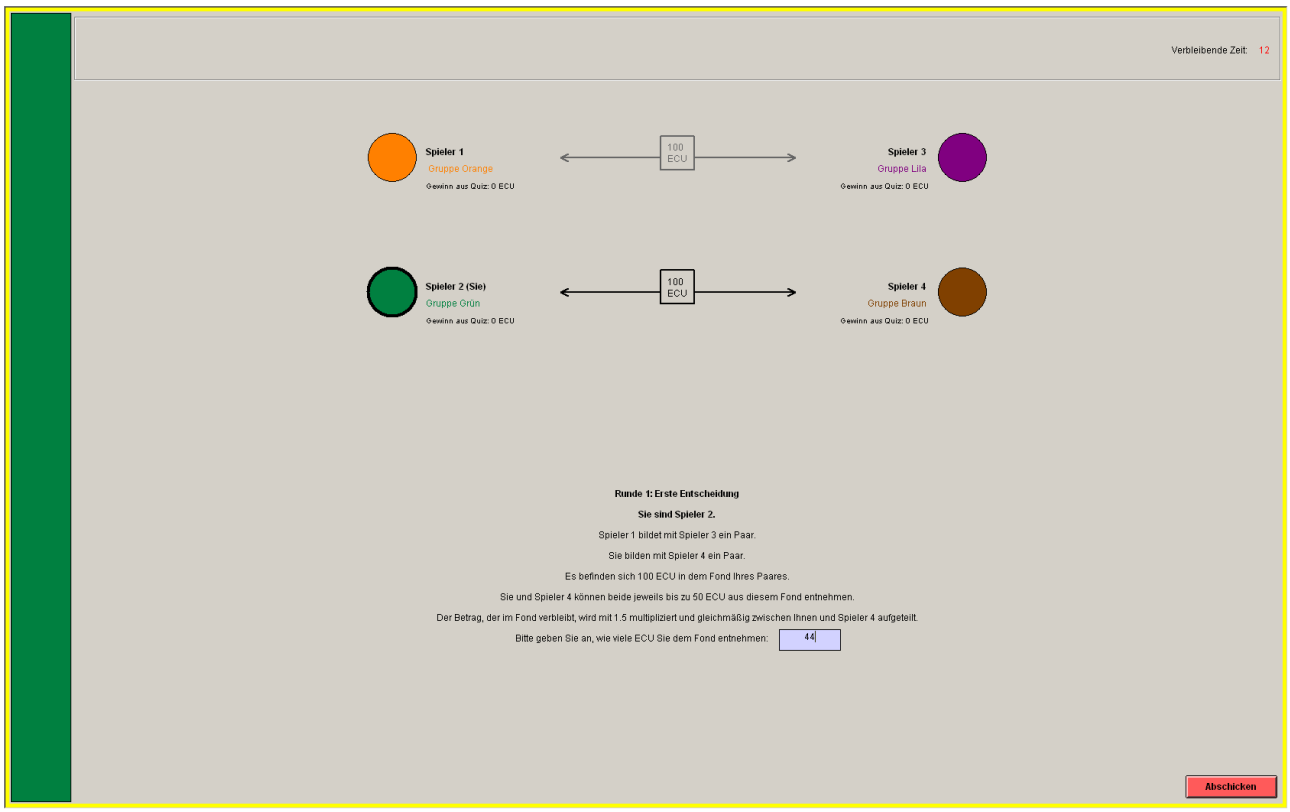

Verbleibende Zeit: 12
Spieler 1
Gruppe Orange
Gewinn aus Quiz: 0 ECU
100 ECU
Spieler 3
Gruppe Lila
Gewinn aus Quiz: 0 ECU
Spieler 2 (Sie)
Gruppe Grün
Gewinn aus Quiz: 0 ECU
100 ECU
Spieler 4
Gruppe Braun
Gewinn aus Quiz: 0 ECU
Runde 1: Erste Entscheidung
Sie sind Spieler 2.
Spieler 1 bildet mit Spieler 3 ein Paar.
Sie bilden mit Spieler 4 ein Paar.
Es befinden sich 100 ECU in dem Fond Ihres Paares.
Sie und Spieler 4 können beide jeweils bis zu 50 ECU aus diesem Fond entnehmen.
Der Betrag, der im Fond verbleibt, wird mit 1.5 multipliziert und gleichmäßig zwischen Ihnen und Spieler 4 aufgeteilt.
Bitte geben Sie an, wie viele ECU Sie dem Fond entnehmen:
44
Abschicken

Figure S8


Verbleibende Zeit: 17
Spieler 1
Gruppe Orange
Gewinn aus Quiz: 0 ECU
Spieler 3
Gruppe Lila
Gewinn aus Quiz: 0 ECU
Spieler 2 (Sie)
Gruppe Grün
Gewinn aus Quiz: 0 ECU
41 ECU
Spieler 4
Gruppe Braun
Gewinn aus Quiz: 0 ECU
Runde 1: Feedback zu Entscheidung 1
Sie waren Spieler 2.
Spieler 1 hat mit Spieler 3 ein Paar gebildet.
Sie haben mit Spieler 4 ein Paar gebildet.
Spieler 4 hat 41 ECU aus Ihrem und seinem Fond entnommen.
(Die anderen Teilnehmer erhalten evtl. Feedback über andere Entscheidungen als Sie.)
OK

Figure S9


Verbleibende Zeit: 20
Spieler 1
Gruppe Orange
Gewinn aus Quiz: 0 ECU
Spieler 3 (Sie)
Gruppe Lila
Gewinn aus Quiz: 0 ECU
Spieler 2
Gruppe Grün
Gewinn aus Quiz: 0 ECU
Spieler 4
Gruppe Braun
Gewinn aus Quiz: 0 ECU
Runde 1:
Zwischenfeedback
Ihr Gewinn:
Entscheidung 1
Sie haben entnommen: 49
Spieler 1 hat entnommen: 12
Im Fond verblieben: 39
x 1.5: 58.5
Ihr Anteil (50%): 30
Anteil Spieler 1 (50%): 30
49
30
Entscheidung 2
Sie haben entnommen: 48
Spieler 2 hat entnommen: 26
Im Fond verblieben: 26
x 1.5: 39.0
Ihr Anteil (50%): 20
Anteil Spieler 2 (50%): 20
48
20
INSGESAMT
147 ECU
OK

Figure S10

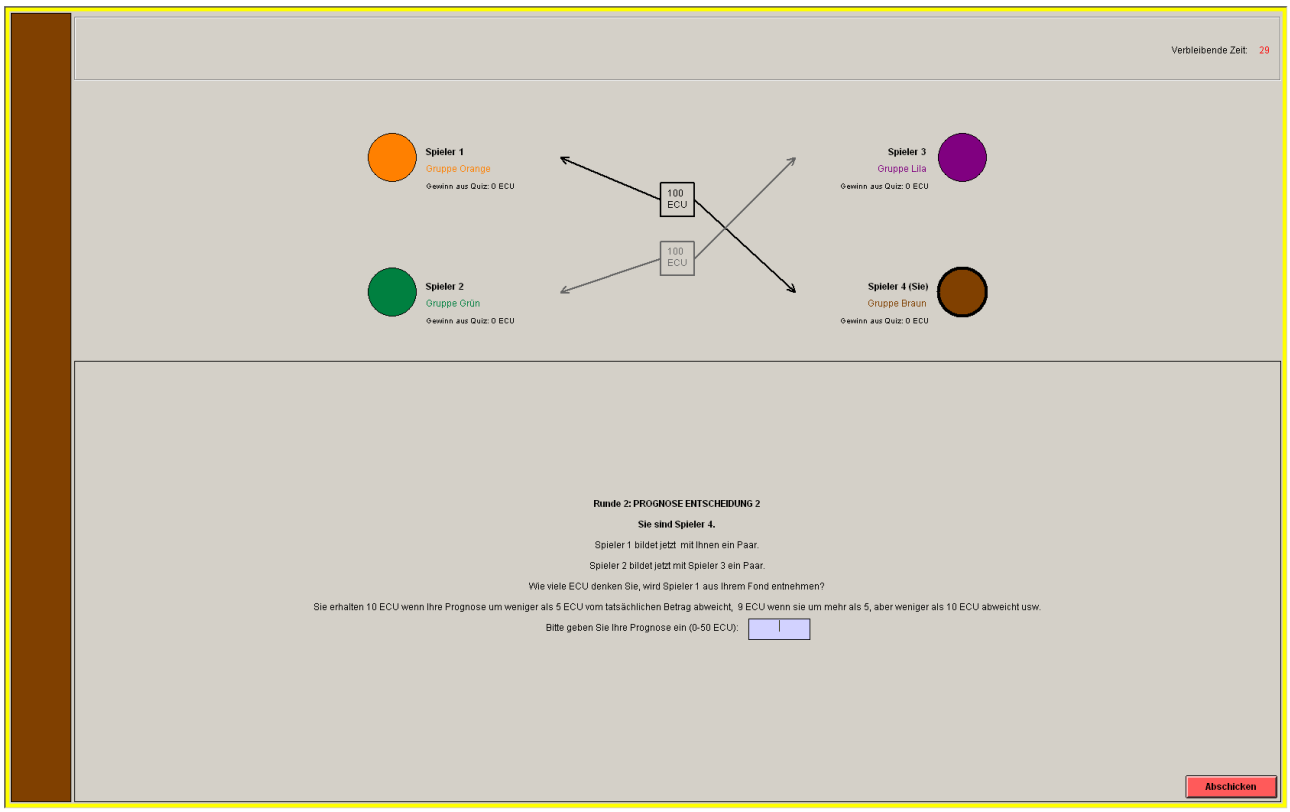

Verbleibende Zeit: 29
Spieler 1
Gruppe Orange
Gewinn aus Quiz: 0 ECU
Spieler 3
Gruppe Lila
Gewinn aus Quiz: 0 ECU
100 ECU
100 ECU
Spieler 2
Gruppe Grün
Gewinn aus Quiz: 0 ECU
Spieler 4 (Sie)
Gruppe Braun
Gewinn aus Quiz: 0 ECU
Runde 2: PROGNOSE ENTSCHEIDUNG 2
Sie sind Spieler 4.
Spieler 1 bildet jetzt mit Ihnen ein Paar.
Spieler 2 bildet jetzt mit Spieler 3 ein Paar.
Wie viele ECU denken Sie, wird Spieler 1 aus Ihrem Fond entnehmen?
Sie erhalten 10 ECU wenn Ihre Prognose um weniger als 5 ECU vom tatsächlichen Betrag abweicht, 9 ECU wenn sie um mehr als 5, aber weniger als 10 ECU abweicht usw.
Bitte geben Sie Ihre Prognose ein (0-50 ECU):
Abschicken

Figure S11

Tables S1 to S12

Table S1: Boni for expectations elicitation

Difference	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50
Bonus	10 ECU	9 ECU	8 ECU	7 ECU	6 ECU	5 ECU	4 ECU	3 ECU	2 ECU	1 ECU	0 ECU

Table S2: Experimental sessions

Sessions	Bonus	Treatments	Notes
1-3	Winner bonus	First and third party	
4-10	Random bonus	First and third party	
11-12	Random bonus	First party only	Some choices made by computer
13-15	Random bonus	First and third party	Second quiz after 4 repetitions

Table S3: Descriptive statistics

Courses				
	Law	Natural sciences	Social sciences	Economics
	22	17	42	88
	Other	Not a student	No reply	
	66	2	3	
Gender				
	Male	Female	No reply	
	110	128	2	
Native German speaker				
	Yes	No		
	188	52		
Any other participants known to subject				
	Yes	No		
	18	222		

	Min	Max	Mean	Median
Profit (EUR, inc. showup fee)	9.40	21.85	14.48	13.82
Quiz earnings (ECU, inc. bonus)	0	173	48.58	27.5
Age	19	42	24.67	24
First period take	0	50	28.2	33
Second period take	0	50	29.60	35
Quiz score (out of 20)	4	18	12.20	12
Quiz 2 score (out of 10)	1	8	4.04	4

*Table S4: Wilcoxon-Mann-Whitney tests of δ=0. Two sided p-values are shown. + p < 0.10; * p < 0.05; ** p< 0.01; *** p < 0.001.*

	Sessions		
Treatments	Winner bonus	Random bonus	All sessions
First party	0.25	0.00928 **	0.0353 *
Third party	1	0.16	0.216

*Table S5: Estimates of equation (1), random bonus sessions. Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	23.1	–	15.1	20.5
	(1.8) ***		(2.62) ***	(3.44) ***
First party × F take	0.223	0.0277	0.135	0.459
	(0.0483) ***	(0.0368)	(0.0518) **	(0.103) ***
———"——— × Same group	-5.24	-4.05	-6.85	-13.2
	(2.16) *	(1.73) *	(2.51) **	(5.12) *
———"——— × F take × Same group	0.229	0.187	0.257	0.597
	(0.0656) ***	(0.051) ***	(0.0725) ***	(0.152) ***
Third party	-2.97	-2.58	-3.04	-7.68
	(2.23)	(1.87)	(3.3)	(5.45)
———"——— × F take	0.279	0.0859	0.146	0.637
	(0.0558) ***	(0.0417) *	(0.0569) *	(0.12) ***
———"——— × Same group	0.667	1.19	-1.05	0.843
	(2.38)	(1.95)	(2.71)	(5.67)
———"——— × F take × Same group	0.0461	0.00627	0.123	0.121
	(0.072)	(0.0565)	(0.0774)	(0.165)
First party × Lag round 1 take	–	–	0.139	–
			(0.0576) *	
———"——— × Lag round 2 take	–	–	0.0406	–
			(0.0466)	
———"——— × Lag F take	–	–	0.0861	–
			(0.056)	
———"——— × Last take same group	–	–	0.142	–
			(0.0436) **	
Third party × Lag round 1 take	–	–	0.0284	–
			(0.0552)	
———"——— × Lag round 2 take	–	–	0.0771	–
			(0.0501)	
———"——— × Lag F take	–	–	0.146	–
			(0.0516) **	
———"——— × Last take same group	–	–	0.201	–
			(0.0477) ***	
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	1472	1472	1072	1472
N indiv.	192	192	192	192
Adj. R2	0.111	0.0279	0.218	–
LogLik	–	–	–	-3880

*Table S6: Estimates of equation (1), random bonus sessions, adding Expectations and multiply imputing in repetitions 1, 3-6, 8. 10 imputations. Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	3.46	–	3.22	-17.4
	(2) +		(2.06)	(3.99) ***
First party × F take	-0.00703	-0.0494	-0.00837	-0.0287
	(0.0511)	(0.0401)	(0.0514)	(0.103)
———"——— × Same group	-3.22	-3.5	-3.18	-7.16
	(1.89) +	(1.56) *	(1.83) +	(4.04) +
———"——— × F take × Same group	0.1	0.125	0.0995	0.239
	(0.0515) +	(0.0449) **	(0.0504) *	(0.111) *
———"——— × Expectations	0.965	0.627	0.963	1.87
	(0.0572) ***	(0.0448) ***	(0.0654) ***	(0.121) ***
Third party	-0.947	-1.23	-1.61	-1.19
	(2.11)	(1.87)	(2.16)	(4.96)
———"——— × F take	0.0174	-0.00835	0.0083	0.0378
	(0.0465)	(0.0388)	(0.0475)	(0.099)
———"——— × Same group	0.991	0.656	0.978	1.32
	(1.97)	(1.68)	(1.95)	(4.26)
———"——— × F take × Same group	-0.0107	0.00421	-0.0179	-0.00807
	(0.057)	(0.0483)	(0.0553)	(0.121)
———"——— × Expectations	0.965	0.617	0.94	1.84
	(0.0506) ***	(0.0544) ***	(0.0571) ***	(0.102) ***
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	1472	1472	1072	1472
N indiv.	192	192	192	192
Adj. R2	0.479	0.237	0.481	–

Table S7: Estimates of equation (1), sessions 11-12, first party treatments, interacted with Random Choice *and* Human Choice. *Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	24	–	19.6	25.2
	(4.24) ***		(5.81) ***	(8.14) **
Human Choice × F take	0.184	0.187	0.118	0.301
	(0.114)	(0.0956) +	(0.129)	(0.235)
Human Choice × Same group	-13.6	-2.91	-15.2	-31.8
	(6.12) *	(5.27)	(6.96) *	(13.9) *
Human Choice × F take × Same group	0.432	0.1	0.44	1.03
	(0.178) *	(0.15)	(0.193) *	(0.393) **
Random Choice	11.3	13.1	7.18	19.2
	(7.22)	(6.2) *	(8.1)	(15.5)
Random Choice × F take	-0.101	-0.194	-0.104	-0.186
	(0.174)	(0.142)	(0.177)	(0.369)
Random Choice × Same group	-11.9	-9.44	-12.2	-20.3
	(7.95)	(7.17)	(9.23)	(17.5)
Random Choice × F take × Same group	0.442	0.307	0.516	0.896
	(0.225) +	(0.199)	(0.244) *	(0.519) +
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	192	192	143	192
N indiv.	32	32	32	32
Adj. R2	0.125	0.055	0.183	–
LogLik	–	–	–	-520

Table S8: Estimates of equation (1), random bonus sessions, first party treatments, interacted with Fair *(perceptions of fairness). Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	27.1	–	19.3	30.2
	(2.61) ***		(3.46) ***	(5.1) ***
F take (β)	0.11	-0.0363	0.044	0.182
	(0.0677)	(0.055)	(0.0744)	(0.144)
Same group (γ)	-7.73	-5.39	-9.17	-18.9
	(3.11) *	(2.57) *	(3.75) *	(7.36) *
F take × Same group (δ)	0.362	0.271	0.342	0.945
	(0.0929) ***	(0.0758) ***	(0.105) **	(0.214) ***
Fair	-7.36	–	-6.86	-17.6
	(3.53) *		(3.92) +	(6.81) *
F take × Fair	0.214	0.134	0.162	0.524
	(0.0953) *	(0.0771) +	(0.104)	(0.201) **
Same group × Fair	4.56	2.73	3.92	11
	(4.22)	(3.52)	(4.96)	(10)
F take × Same group × Fair	-0.261	-0.174	-0.152	-0.699
	(0.128) *	(0.105) +	(0.142)	(0.297) *
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	832	832	592	832
N indiv.	192	192	192	192
Adj. R2	0.136	0.0404	0.232	–
LogLik	–	–	–	-2170

Table S9: Estimates of equation (1), random bonus sessions, first party treatments, interacted with Open quiz 2. *Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	23.5	–	14.3	20.6
	(2.64) ***		(3.23) ***	(5.85) ***
F take (β)	0.25	0.0159	0.198	0.549
	(0.0702) ***	(0.0581)	(0.0708) **	(0.16) ***
Same group (γ)	-6.07	-6.41	-6.29	-13.8
	(3.71)	(3.06) *	(3.87)	(8.94)
F take × Same group (δ)	0.272	0.235	0.223	0.703
	(0.103) **	(0.0853) **	(0.106) *	(0.246) **
Early	-0.442	–	5.71	1.21
	(3.4)		(3.95)	(7.76)
F take × Early	-0.0804	0.0218	-0.259	-0.251
	(0.101)	(0.0801)	(0.112) *	(0.223)
Same group × Early	1.47	4.46	-4.69	0.828
	(4.94)	(3.91)	(5.5)	(11.3)
F take × Same group × Early	-0.0976	-0.0884	0.155	-0.228
	(0.146)	(0.115)	(0.159)	(0.328)
Open quiz 2	-0.125	3.32	-7.18	-1.33
	(5.41)	(4.94)	(5.3)	(12.3)
F take × Open quiz 2	0.0494	0.0572	0.218	0.106
	(0.162)	(0.14)	(0.158)	(0.374)
Same group × Open quiz 2	0.561	-0.184	6.99	2.92
	(8.03)	(6.84)	(7.89)	(19.6)
F take × Same group × Open quiz 2	-0.0377	-0.0292	-0.145	-0.173
	(0.223)	(0.191)	(0.216)	(0.554)
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	832	832	592	832
N indiv.	192	192	192	192
Adj. R2	0.136	0.0408	0.241	–
LogLik	–	–	–	-2170

Table S10: Estimates of equation (1) interacted with F earnings*, random bonus sessions, first party treatments. Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	21.6	–	12.8	16.8
	(2.41) ***		(3.08) ***	(5.13) **
F take (β)	0.314	0.0702	0.251	0.673
	(0.0663) ***	(0.0538)	(0.0708) ***	(0.152) ***
Same group (γ)	-2.62	-4.14	-2.4	-6.18
	(3.06)	(2.5) +	(3.54)	(7.39)
F take × Same group (δ)	0.083	0.122	0.0698	0.205
	(0.0909)	(0.0736) +	(0.101)	(0.217)
F earnings	0.0308	-0.0121	0.0539	0.0726
	(0.034)	(0.0271)	(0.0401)	(0.0739)
F take × F earnings	-0.00186	-0.000818	-0.00238	-0.00434
	(0.00095) +	(0.000765)	(0.00109) *	(0.00214) *
Same group × F earnings	-0.0527	0.00392	-0.0921	-0.134
	(0.0459)	(0.0364)	(0.0542) +	(0.105)
F take × Same group × F earnings	0.003	0.00132	0.00384	0.00783
	(0.0013) *	(0.00105)	(0.00149) *	(0.00314) *
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	832	832	592	832
N indiv.	192	192	192	192
Adj. R2	0.132	0.0422	0.235	–
LogLik	–	–	–	-2170

*Table S11: Estimates of equation (1), random bonus sessions, males and females. Standard errors in parentheses, clustered by individual. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)
	Females	Males
(Intercept)	24.5	21.5
	(2.39) ***	(2.7) ***
First party × F take	0.221	0.221
	(0.0633) ***	(0.0735) **
———"——— × Same group	-6.19	-4.42
	(2.72) *	(3.43)
———"——— × F take × Same group	0.248	0.223
	(0.0856) **	(0.1) *
Third party	-2.89	-2.8
	(2.92)	(3.41)
———"——— × F take	0.28	0.26
	(0.0717) ***	(0.0866) **
———"——— × Same group	-0.201	0.995
	(3.04)	(3.74)
———"——— × F take × Same group	0.0793	0.0467
	(0.0932)	(0.11)
Model	Linear	Linear
Controls	–	–
N	776	696
N indiv.	101	91
Adj. R2	0.128	0.0992

Table S12: Estimates of equation (1), random bonus sessions, first party treatments, interacted with Group ID. *Standard errors in parentheses, clustered by individual for columns 1-3. + p < 0.10; * p < 0.05; p < 0.01; *** p < 0.001.*

	(1)	(2)	(3)	(4)
(Intercept)	23.2	–	15.9	21
	(1.72) ***		(2.52) ***	(3.56) ***
F take (β)	0.217	0.0322	0.134	0.437
	(0.0466) ***	(0.0384)	(0.0505) **	(0.104) ***
Same group (γ)	-4.1	-3.49	-5.87	-10.7
	(2.09) +	(1.75) *	(2.45) *	(5.16) *
F take × Same group (δ)	0.202	0.179	0.236	0.529
	(0.0633) **	(0.0525) ***	(0.071) ***	(0.151) ***
Group ID	-1.02	–	-0.354	-2.58
	(0.709)		(0.75)	(1.49) +
F take × Group ID	-0.00908	-0.02	-0.0101	-0.00176
	(0.0197)	(0.0163)	(0.0211)	(0.0454)
Same group × Group ID	-2.26	-1.9	-2.45	-3.81
	(0.916) *	(0.767) *	(1.05) *	(2.23) +
F take × Same group × Group ID	0.0593	0.0572	0.0497	0.0844
	(0.0277) *	(0.0231) *	(0.0307)	(0.0651)
Model	Linear	Linear	Linear	Tobit
Controls	–	Twoway FE	History	–
N	832	832	592	832
N indiv.	192	192	192	192
Adj. R2	0.162	0.0431	0.249	–
LogLik	–	–	–	-2160