Online Appendix for

Social Preferences and the Variability of Conditional Cooperation

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Appendix A *Details on the experimental procedures of Study 1*

Here we provide procedural details for Study 1 reported in the main text. We conducted our initial online interactive experiment in Spring 2019 using Amazon MTurk across five sessions with a total of 138 participants. We refer to this as our AMT experiment. To further examine the robustness of our first data collection, we replicated the AMT experiment with a different subject pool in Summer 2021, referred to as our UoN experiment, using students from the University of Nottingham who had signed up to a subject database for participating in experiments. For this experiment we used ORSEE (Greiner (2015)) to recruit subjects and conducted an additional three sessions with a total of 152 participants.

Both online experiments were programmed using LIONESS Lab (Giamattei, et al. (2020)), and the same program was used for both experiments, with only minimal changes to the instructions related to the subject pools (for the instructions, see Appendix B).

Each participant was paired with another subject after they had read the instructions and passed some control questions. Each pair then played all eight games of Table 1 (main text) with no feedback between games. Before making decisions in a game subjects had to answer additional control questions about the payoffs to ensure that subjects recognized the payoff changes across games (see Screenshot 2 in Appendix B). These additional control questions were intended to ensure that participants understood the implications of their decisions and recognized the payoff changes across games. Participants then made decisions as FM as well as SM. Both decision tasks were presented on the same screen.

For the FM decision, participants simply chose whether to cooperate or to defect. For the SM decision, we asked participants to decide in the following two situations: i) if FM cooperates, and ii) if FM defects. Rather than use the terms "cooperate" or "defect", we labeled options neutrally as A or B, with labeling randomly chosen at the pair level in each game. To control for potential order effects, we randomized the sequence of games and the order of tasks (i.e., placing the FM or SM decision at the top of the screen) at the pair level. Once participants completed the tasks for all games, we asked them to complete a short post-experimental questionnaire eliciting basic demographic information.

We paired subjects with another participant on a real-time basis, and they made decisions in each game at the same time. That is, they could not proceed to the next game until both had completed their decisions for the current game.[1]

To elicit participants' responses in an incentive-compatible way, we implemented the following payment scheme. At the end of the session, one of the eight games was randomly chosen at the pair-level for payment. If both subjects completed the entire experiment, they were paid according to the outcome of this game as follows. One of the pair was randomly chosen to be FM, and the other was selected to be SM. Then, participants were reminded of their decisions and informed about the outcome for this game. As mentioned above, for SM's decision we used their conditional response to FM's decision. If one of the pair had dropped out during the experiment, the computer randomly selected the payoff-relevant game for the remaining subject. Then the computer randomly selected one out of four monetary outcomes (i.e., T, $R, P,$ or S) of the chosen game for payment to the remaining subject. We explained this payment scheme clearly in the instructions. This payment procedure gives subjects a monetary incentive to take both FM decisions and SM decisions seriously in all games as any of these decisions can become payoff relevant.

In line with other online experiments, there was a non-negligible attrition rate: 32 out of 138 AMT subjects (23%) and 9 out of 152 UoN subjects (6%) dropped out during the experiment.[2] For subjects who completed the AMT experiment, the average age was 34.2 years (s.d. 10.2 years) and 37% were female, while for the UoN experiment the average age was 22.5 years (s.d. 4.6 years) and 58% were female. On average, the experiments lasted about 30 minutes and subjects were informed of their payment immediately upon completion of the experiment and were paid within 24 hours. AMT subjects' earnings ranged from \$1.20 to \$9.00, averaging \$4.59, so somewhat higher than the median hourly rate of ~\$2 reported in Hara, et al. (2018). UoN subjects' earnings ranged from £1.20 to £9.00, averaging £4.53, similar to average hourly rates for similar online experiments and slightly lower than average hourly rates for lab experiments for that subject pool.

[1] To reduce the risk of decreased attention due to long waiting times as subjects waited for their opponent to decide, we took the following measures. Before participants entered the experiment, we told them to avoid distractions during the experiment. In addition, participants who were inactive for more than 30 seconds (i.e., no mouse movement or no keyboard input) got an alert voice message and a blinking text on their browser. If an inactive participant did not respond to the alert message for a further 30 seconds, such an inactive participant was removed from the experiment and the remaining person was able to continue the experiment.

[2] The dropout rate in our AMT sessions is similar to that of related interactive online experiments. For example, Arechar, et al. (2018) report a 20% dropout rate in their interactive four-player public goods game, and Gächter, et al. (2023) report a 24% dropout rate in their interactive eight simultaneous prisoner's dilemma games.

Appendix B ***Instructions for Study 1***

These are the instructions for the AMT experiment. Instructions for UoN online experiment were identical except that the terms 'HIT', 'dollar' and $ were replaced with 'experiment', 'pound', and '£', respectively.

Welcome

Thank you for accepting this HIT. To complete this HIT, you must make some decisions. Including the time for reading these instructions, the HIT will take about 30 minutes to complete. If you are using a desktop or laptop to complete this HIT, we recommend that you maximize your browser screen (press F11) before you start.

It is important that you complete this HIT without interruptions. During the HIT, please **do not close this window or get distracted from the task.** If you close your browser or leave the task, you will not be able to re-enter and we will not be able to pay you.

In this HIT, you will be matched with one other participant. Each of you will make decisions for 8 decision situations. In each situation, each of you will earn Tokens depending on your decisions.

At the end of the HIT, one of the decision situations will be randomly chosen. Your earnings from this situation will be converted from Tokens to Dollars at a rate of 1**00 Tokens = $ 1.** This will be added to **your participation fee of $1.00.** Depending on your decisions, you may make up to $8.00 more in addition to the $1.00 participation fee. In the same way, Tokens earned by the person matched with you in that same situation will also be converted to Dollars at a rate of 100 Tokens = $ 1.

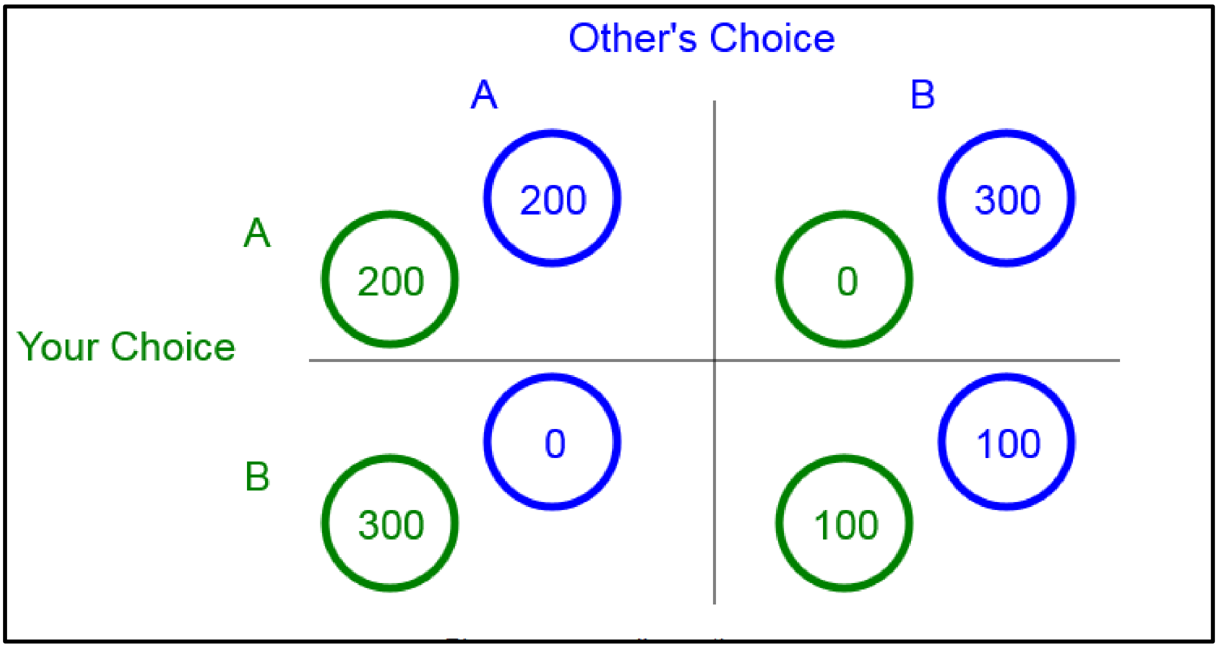
You will receive a code to collect your payment via MTurk upon completion.

Please click "Continue" to start the HIT.

Instructions

The HIT consists of 8 decision situations.

Each decision situation will be presented on a screen like the **example screen** below.



You and the other person will be making choices between **A** and **B**. Your earnings are the values in the green circle, and the other person's earnings are the values in the blue circle. The table is read as follows:

- If you choose A and the other person chooses A, you will earn 200 Tokens and the other person will earn 200 Tokens.
- If you choose A and the other person chooses B, you will earn 0 Tokens and the other person will earn 300 Tokens.
- If you choose B and the other person chooses A, you will earn 300 Tokens and the other person will earn 0 Tokens.
- If you choose B and the other person chooses B, you will earn 100 Tokens and the other person will earn 100 Tokens.

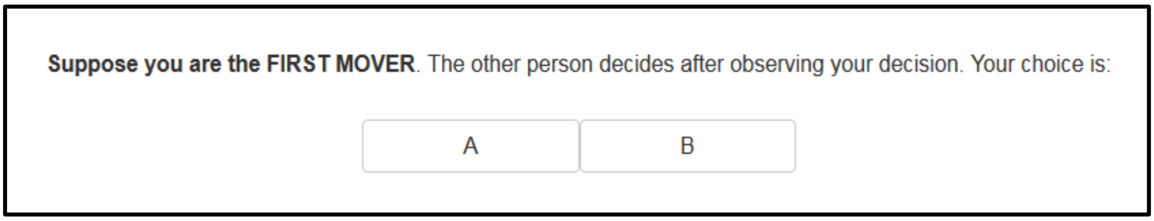
Please note that the values in the table will differ in each decision situation.

Tasks

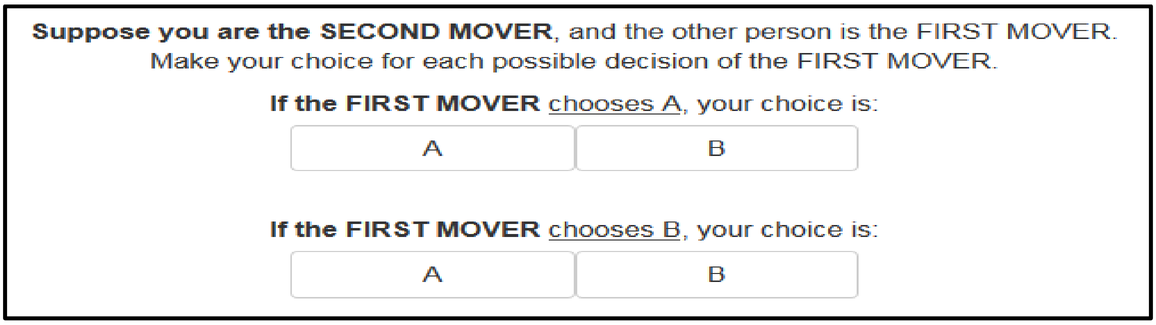
In each decision situation, you must complete **two types** of tasks, which we will refer to below as the "FIRST MOVER's decision" and "SECOND MOVER's decision". The FIRST MOVER decides first whether to choose A or B. The SECOND MOVER is then informed of the FIRST MOVER's decision. The SECOND MOVER then decides whether to choose A or B.

We want to know what you would do in the role of the FIRST MOVER and what would you do in the role of the SECOND MOVER. Thus you will be prompted to make decisions in both roles.

● For the "FIRST MOVER's decision" task, you will see the following screen and you must choose A or B:



● For the "SECOND MOVER's decision" task, You will see the following screen and you must choose A or B in two possible cases: (1) if the FIRST MOVER chooses A (2) if the FIRST MOVER chooses B



During the HIT, you will not receive any feedback on the other person's choice or the outcomes of the decision situations.

Your dollar earnings

On completion of the HIT, you will be paid your participation fee of $ 1.

In addition, one of the decision situations will be randomly chosen for your additional dollar earnings. The computer will randomly choose either you or the other person to be the first-mover. If you are chosen to be the first-mover, your first-mover's decision will be matched with the second-mover's decision of the other person. If the other person is chosen to be the first-mover, your second-mover's decision will be matched with the first-mover's decision of the other person. Your earnings and the other person's earnings will be determined depending on choices of you and the other person in that situation. Two examples should make this clear.

Example 1. Assume that **the computer randomly selects you to be the first-mover. This implies that your payoff relevant decision will be your first-mover's decision.** Assume that you choose A as the first-mover's decision in the above example screen. Assume that the other person matched with you makes the following second-mover's decisions: he/she chooses A if you choose A, and chooses B if you choose B. As a consequence, you will earn 200 Tokens and the other person will earn 200 Tokens.

Example 2. Assume that **the computer randomly selects the other person to be the first-mover. This implies that your payoff relevant decision will be your second-mover's decision.** Assume that you make the following second-mover's decisions: you choose B if the FIRST MOVER chooses A, and choose B if the FIRST MOVER chooses B in the above example screen. Assume that the other person matched with you chooses A as the first-mover's decision. As a consequence, you will earn 300 Tokens and the other person will earn 0 Tokens.

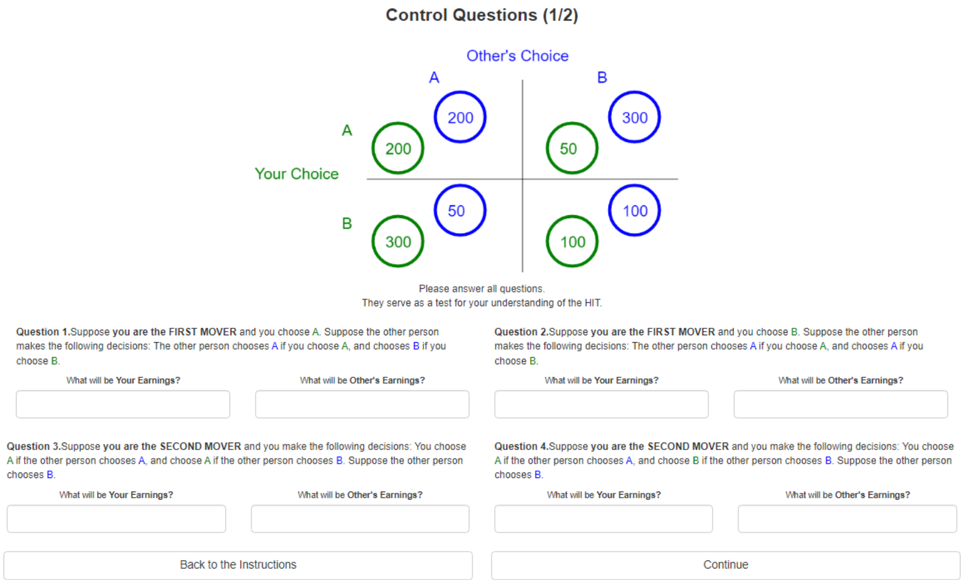
At the end of the HIT

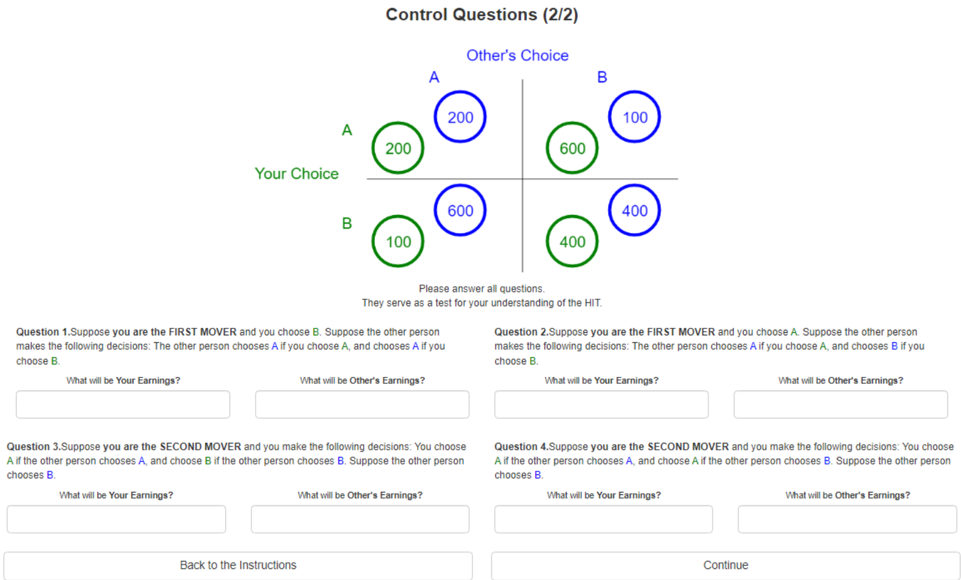
On completion of the HIT, one of the decision situations will be randomly chosen as explained above. You will be informed of your choices and earnings for that decision situation, and you will be paid these earnings in addition to your participation fee.

Note that we will not be able to pay you if you do not complete the HIT. If the person you are matched with does not complete the HIT, the computer will randomly select one of the four possible earnings in the randomly chosen decision situation, and you will be paid these earnings in addition to your participation fee.

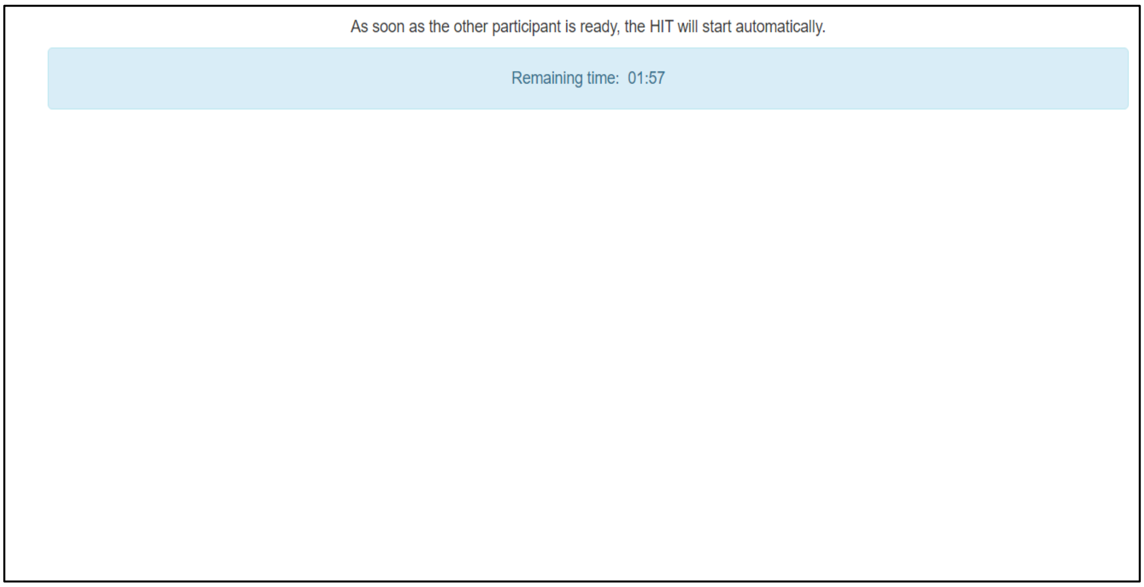
Your participation fee and the additional earnings will be paid to you within two working days.

Comprehension Questions

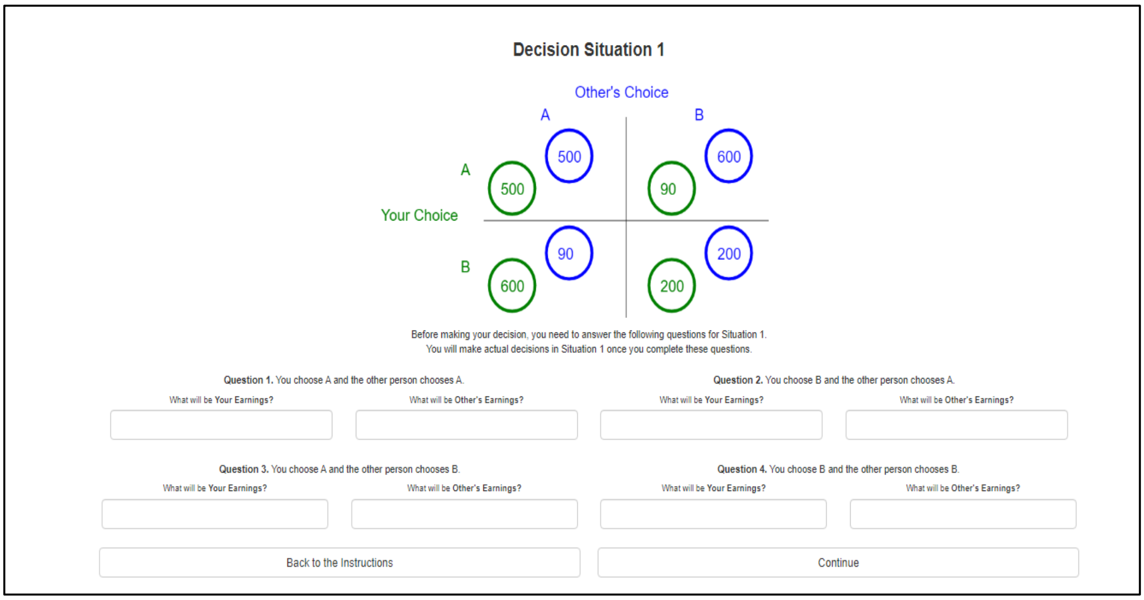




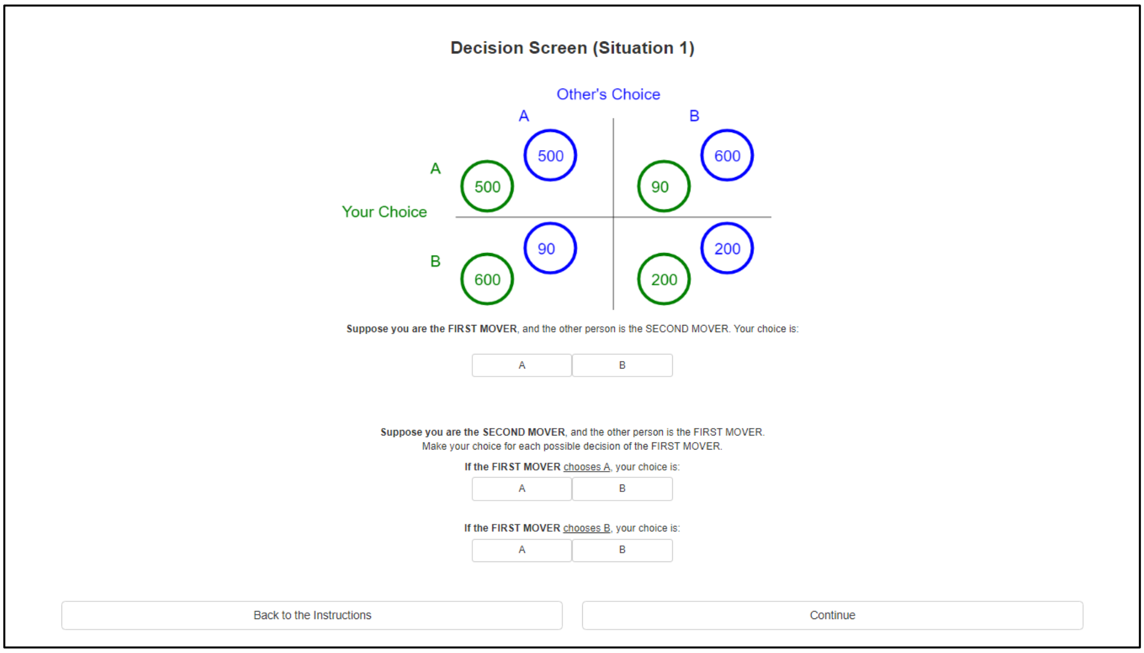
Screenshots of Online Experiment



Screenshot 1: Matching stage



Screenshot 2: Comprehension Question before Decision Screen



Screenshot 3: Decision screen

Appendix C *Comparison of AMT and UoN populations in Study 1*

Table C1 Comparison of demographic characteristics in Study 1 subject pools

	(1) Total	(2) AMT	(3) UoN	(4) Difference
Age	27.46	34.19	22.47	11.72***
	(9.50)	(10.22)	(4.64)	(0.97)
Gender				
Female	0.49	0.37	0.58	-0.21***
	(0.50)	(0.48)	(0.50)	(0.06)
Male	0.50	0.62	0.41	0.21***
	(0.50)	(0.49)	(0.49)	(0.06)
Other	0.01	0.01	0.01	0.00
	(0.09)	(0.10)	(0.08)	(0.01)
Ethnicity				
Asian	0.23	0.11	0.32	-0.21***
	(0.42)	(0.31)	(0.47)	(0.05)
Black or African	0.06	0.02	0.09	-0.07**
	(0.23)	(0.14)	(0.28)	(0.03)
Latin American	0.02	0.03	0.01	0.02
	(0.13)	(0.17)	(0.08)	(0.02)
Native Hawaiian	0.00	0.01	0.00	0.01
	(0.06)	(0.10)	(0.00)	(0.01)
White	0.62	0.80	0.49	0.31***
	(0.49)	(0.40)	(0.50)	(0.06)
Other	0.07	0.04	0.10	-0.06*
	(0.26)	(0.19)	(0.30)	(0.03)
Political view (0 - left to 10 – right)				
Political view	4.06	4.33	3.86	0.47
	(2.50)	(3.04)	(2.00)	(0.32)
Participations in previous studies				
Never	0.21	0.32	0.13	0.19***
	(0.41)	(0.47)	(0.33)	(0.05)
Once or Twice	0.37	0.32	0.41	-0.09
	(0.48)	(0.47)	(0.49)	(0.06)
3-10 Times	0.31	0.15	0.43	-0.28***
	(0.46)	(0.36)	(0.50)	(0.06)
11-50 Times	0.09	0.17	0.03	0.13***
	(0.29)	(0.38)	(0.18)	(0.04)
More than 50 Times	0.02	0.04	0.00	0.04**
	(0.13)	(0.19)	(0.00)	(0.02)
Observations	249	106	143	249

Note. Table includes demographics collected in both online experiments. Significance of differences is based on t-tests examining equality to zero. Some additional collected demographics are not reported in the table, but available in published data.

Table C2 Strategy classifications in Study 1 across subject pools

	AMT sample (n=106)				UoN sample (n=143)			
Game	CC	FR	UC	MM	CC	FR	UC	MM
G1	35.8	42.5	17.9	3.8	37.8	49.0	8.4	4.9
G2	42.5	39.6	12.3	5.7	44.1	44.8	9.1	2.1
G3	33.0	49.1	13.2	4.7	28.0	58.7	7.7	5.6
G4	38.7	43.4	9.4	8.5	32.9	56.0	9.1	2.1
G5	44.3	43.4	8.5	3.8	36.4	55.9	5.6	2.1
G6	48.1	42.5	6.6	2.8	48.3	43.4	4.9	3.5
G7	27.4	54.7	13.2	4.7	32.2	58.7	7.0	2.1
G8	34.9	43.4	17.0	4.7	38.5	53.8	4.9	2.8
Average	*38.1*	*44.8*	*12.2*	*4.8*	*37.2*	*52.5*	*7.1*	*3.1*

Note: AMT: Amazon MTurk sample. UoN: University of Nottingham student sample. CC: Conditional Cooperator; FR: Free-Rider; UC: Unconditional Cooperator; MM: Mismatcher. Each entry is the percentage of subjects using that strategy in that game.

Table C3 Determinants of Strategy Choice for Study 1 – AMT sample

	(1)	(2)	(3)	(4)
	CC	FR	UC	MM
LOSS	0.281**	-0.291**	-0.023	0.017
	(0.115)	(0.125)	(0.101)	(0.072)
GAIN	-0.240***	0.156**	0.059	0.027
	(0.070)	(0.071)	(0.050)	(0.030)
EFF	-0.082	-0.000	0.068	0.036
	(0.072)	(0.073)	(0.060)	(0.035)
Observations	800	800	760	800

Note. Average marginal effects from probit regression with robust standard errors clustered at the individual level. LOSS = (R – S)/R, GAIN = (T – R)/R, EFF = (R – P)/R. Regressions include controls for individual characteristics, task characteristics, round and session effects.
* p < 0.1; ** p < 0.05; *** p < 0.01

Table C4 Determinants of Strategy Choice for Study 1 – UoN sample

	(1)	(2)	(3)	(4)
	CC	FR	UC	MM
LOSS	0.332***	-0.269***	-0.045	-0.024
	(0.087)	(0.095)	(0.056)	(0.039)
GAIN	-0.198***	0.198***	-0.004	0.000
	(0.054)	(0.056)	(0.029)	(0.023)
EFF	-0.171***	0.050	0.091**	0.035
	(0.061)	(0.061)	(0.038)	(0.028)
Observations	1,112	1,112	1,104	1,104

Note. Average marginal effects from probit regression with robust standard errors clustered at the individual level. LOSS = (R – S)/R, GAIN = (T – R)/R, EFF = (R – P)/R. Regressions include controls for individual characteristics, task characteristics, round and session effects.
* p < 0.1; ** p < 0.05; *** p < 0.01

Appendix D *Effect of GAIN and LOSS in stochastic choice models*

In this appendix we examine the effects of GAIN and LOSS on the probability of SM conditional cooperation in a sequential prisoner's dilemma using a stochastic choice model without social preferences. In our experiment R is constant and so the effect of changes in GAIN = $(T - R)/R$ on the probability of conditional cooperation has the same sign as the effect of changes in T. The effect of LOSS = $(R - S)/R$ has the opposite sign as the effect of S.

Let q denote the probability that FM cooperates, and let V_j denote SM's expected (selfish) payoff from strategy j. The expected payoffs from conditional cooperation (cc), free riding (fr), unconditional cooperation (uc), and mis-matching FM's choice (mm) are:

$$V_{cc} = qR + (1-q)P,$$
$$V_{fr} = qT + (1-q)P,$$
$$V_{uc} = qR + (1-q)S,$$
$$V_{mm} = qT + (1-q)S.$$

Let $Z_j = V_j + \varepsilon_j$ be the perturbed payoff from strategy j, where the ε_j error terms are independent draws from an extreme value distribution with scale parameter $1/\lambda$. Assuming the individual chooses the strategy giving the largest perturbed payoff, this induces a multinomial logit choice structure where the probability of conditional cooperation, p_{cc}, is given by

$$p_{cc} = \frac{\exp\{\lambda V_{cc}\}}{\sum \exp\{\lambda V_j\}} = \frac{1}{1 + \exp\{\lambda(V_{fr} - V_{cc})\} + \exp\{\lambda(V_{uc} - V_{cc})\} + \exp\{\lambda(V_{mm} - V_{cc})\}}$$

$$= \frac{1}{1 + \exp\{\lambda q(T-R)\} + \exp\{\lambda(1-q)(S-P)\} + \exp\{\lambda q(T-R) + \lambda(1-q)(S-P)\}}$$

$$= (1 + \exp\{\lambda q(T-R)\})^{-1}(1 + \exp\{\lambda(1-q)(S-P)\})^{-1}$$

For fixed q the first term is decreasing in T and so p_{cc} decreases with T and with GAIN. For fixed q the second term is decreasing in S and so p_{cc} decreases with S and with LOSS.

In order to sign the comparative statics with endogenous q, we need a model of FMs choice. Using a QRE model (McKelvey and Palfrey (1995)), the choice probabilities are given by the solution to the system of equations:

$$p_{cc} = (1 + \exp\{\lambda q(T-R)\})^{-1}(1 + \exp\{\lambda(1-q)(S-P)\})^{-1}$$
$$p_{fr} = (1 + \exp\{\lambda q(R-T)\})^{-1}(1 + \exp\{\lambda(1-q)(S-P)\})^{-1}$$
$$p_{uc} = (1 + \exp\{\lambda q(T-R)\})^{-1}(1 + \exp\{\lambda(1-q)(P-S)\})^{-1}$$
$$p_{mm} = (1 + \exp\{\lambda q(R-T)\})^{-1}(1 + \exp\{\lambda(1-q)(P-S)\})^{-1}$$
$$q = \left((1 + \exp\{\lambda\left((P-S)p_{fr} + (P-R)p_{cc} + (T-S)p_{mm} + (T-R)p_{uc}\right)\}\right)^{-1}$$

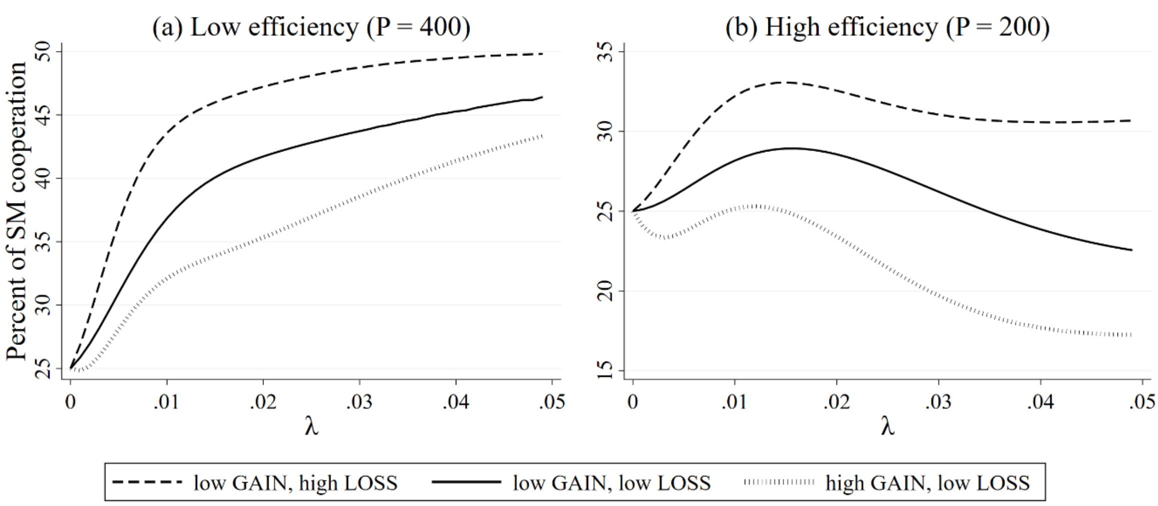
The solution gives the QRE probabilities as functions of the payoff parameters and precision parameter λ. We use numerical methods to solve these equations for our payoff parameters.

Figure D1(a) below shows the QRE probability of conditional cooperation as a function of λ for the *low efficiency* games ($R = 500, P = 400$). As a baseline take the low GAIN and low LOSS game ($T = 600, S = 180$). The QRE probability of conditional cooperation in this baseline is shown in Figure D1(a) as the middle line. Keeping $S = 180$ and increasing T to 800 gives the high GAIN and low LOSS game, and this results in a lower probability of conditional cooperation, as shown by the lowest line. Keeping $T = 600$ and reducing S to 40 gives the low GAIN and high LOSS game, and this results in a higher probability of conditional cooperation, as shown by the uppermost line.

Figure D1(b) shows the QRE probability of conditional cooperation for the high efficiency games ($R = 500, P = 200$). Again, take the low GAIN and low LOSS game ($T = 600, S = 90$) as a baseline. The QRE probability of conditional cooperation is the middle line in Figure D1(b). Keeping $S = 90$ and increasing T to 800 gives the high GAIN and low LOSS game, and this results in the lowest line. Keeping $T = 600$ and reducing S to 20 gives the low GAIN and high LOSS game, and results in the uppermost line.

In summary, for any given λ, the QRE probability of conditional cooperation increases with LOSS and decreases with GAIN.

Figure D1 QRE probability of conditional cooperation for low EFF (left panel) and high EFF (right panel) games



Appendix E *Instructions for Study 2*

Welcome

Thank you for participating in this experiment. At the end of this experiment you will receive £5 for your participation, in addition to other money to be paid as a result of decisions made in the experiment. These instructions explain how the additional money depends on decisions, so please read them carefully. If you have a question at any time, please raise your hand and an experimenter will come to you to answer it. During the session, please do not use mobile phones or try to communicate with any of the other participants. If you do not follow these rules, you will be excluded from the study and will not be paid.

General Instructions

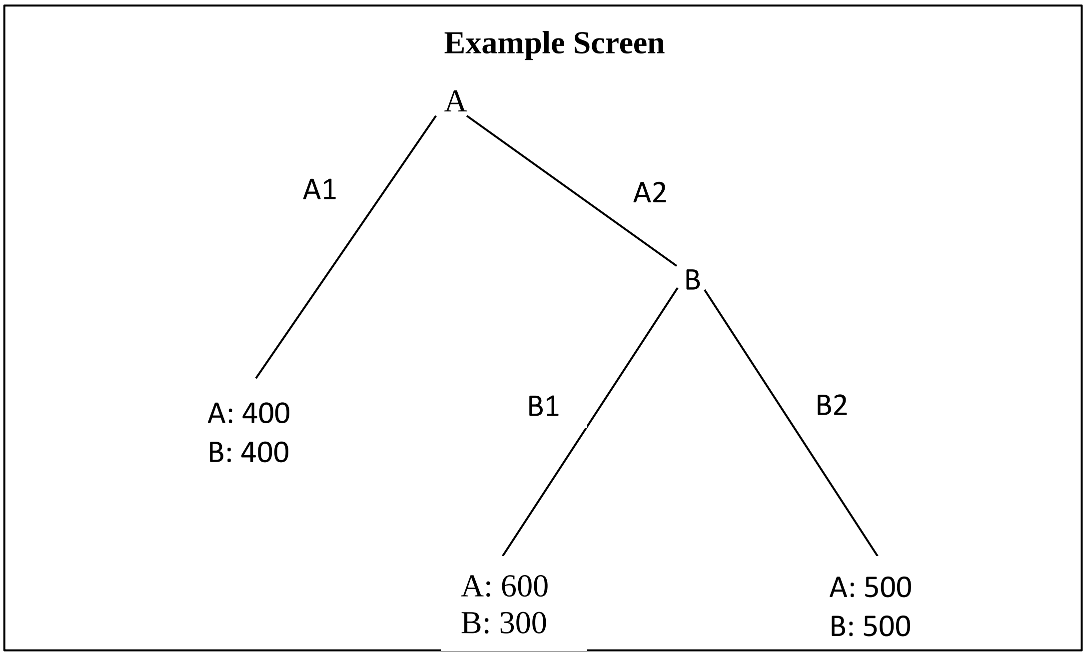
In this session, you will be anonymously matched with one other participant. Each of you will make decisions for 64 decision situations. In each situation, each of you will earn Tokens depending on your decisions.

At the end of the session, one of the decision situations will be randomly chosen. Your earnings from this situation will be converted from Tokens to pounds at a rate of 1 Token = £0.02. This will be added to your participation fee of £5.00. In the same way, Tokens earned by the person matched with you in that same situation will also be converted to pounds at a rate of 1 Tokens = £0.02, and they will earn this amount in addition to their £5 participation fee. Payments will be made individually and privately via PayPal.

The Decision Situation

In each decision situation there are two "roles", Person A and Person B. You will either be assigned the role of Person A or Person B at the beginning of the first decision situation and you will keep this role for all 64 situations. The person you are matched with will be assigned the other role for all 64 situations.

Each decision situation will be presented on a screen like the example screen below. The choices available to each player are represented by lines and the earnings are given by the numbers at the end of the lines. The earnings values will differ in each decision situation. Neither your choices, nor the choices of the person you are matched with, will affect the earnings values in each decision situation.



Person A will be making choices between A1 and A2. Person B will be making choices between B1 and B2. Earnings will depend on the choices as follows.

If Person A chooses A1 the token earnings are as shown at the end of the leftmost branch: Person A will earn 400 Tokens and Person B will earn 400 Tokens.

If Person A chooses A2 then Person B's choice will determine the outcome. If Person B chooses B1, Person A will earn 600 tokens and Person B will earn 300 Tokens. If Person B chooses B2, Person A will earn 500 Tokens and Person B will earn 500 Tokens.

Person A and Person B will make their choices at the same time. Thus, Person B will make a choice in every decision situation, even though Person B's choice only affects the outcome if Person A chooses A2.

You will not receive any feedback on the other person's choice or the outcomes of the decision situations until the end of the session.

To make a choice on the experimental screen, you can simply click on the line that you wish to choose. Once selected the chosen line will be highlighted.

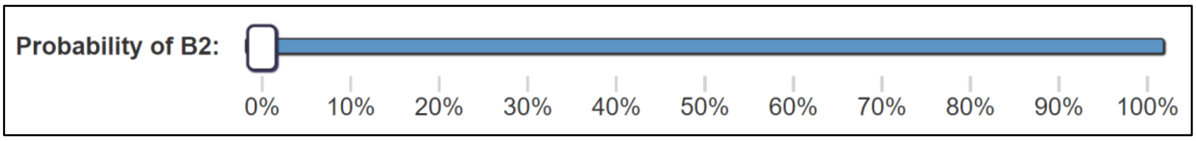
Probability task

For each decision situation you are also asked to provide your best guess that the other Player selects A2 or B2.

This means, Player A is asked to guess the likelihood that Player B chooses B2 and Player B is asked to guess the likelihood that Player A chooses A2.

Your guess is a percentage probability from 0 to 100 - with 0 indicating a 0-out-of-100 chance that the other Player chose A2/B2, and 100 indicating a 100-out-of-100 chance.

You choose Your Guess by clicking a response bar on your screen as can be seen below.



The width of the bar represents 100% and you can select the probability corresponding to Your Guess by clicking on the bar. Larger values represent a greater chance that the other Player chooses A2/B2 and smaller values represent a smaller chance that the other Player chooses A2/B2.

Your guess and the actual choice of the other Player will be used to determine your chance of winning an additional 200 Tokens. Your chance of winning the Tokens is set so that more accurate guesses lead to a higher chance of winning.

The payment rule is designed so that you can secure the largest chance of winning the additional 200 Tokens by reporting your most-accurate guess. That is, if you think there is a 20% chance the other Player chooses A2/B2, you maximise your chances of winning the additional 200 Tokens by submitting a guess of 20%; if you think there is a 78% chance the other player chooses A2/B2, you maximise your chances of winning the additional 200 Tokens by submitting a guess of 78%. Etc. The precise payment rule details are available by request at the end of the experiment.

Ending the Session

At the end of the session, two different decision situations will be randomly chosen as explained above.

You will be informed of the choices and token earnings of you and the person you are matched with for the first chosen decision situation.

You will also be informed about the choices of the person you are matched with in the second chosen decision situation. This will determine the chance of winning the 200 additional Tokens in the probability task.

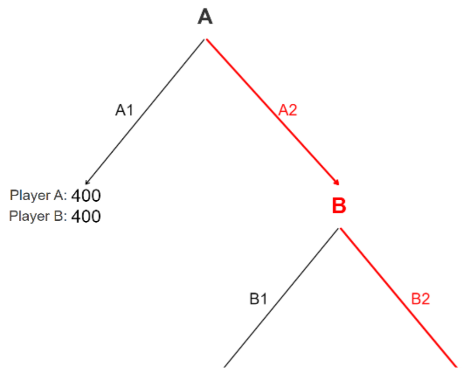
For both decisions you will be paid £0.02 per token in addition to your £5 participation fee.

Comprehension Questions

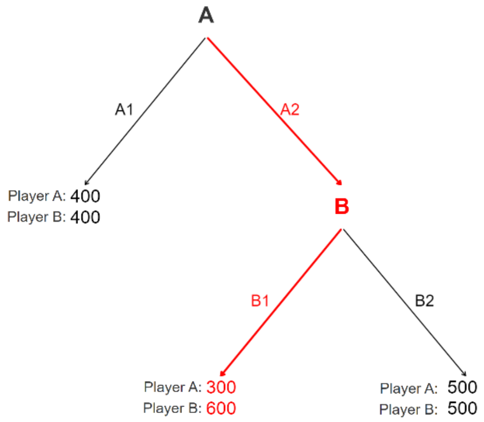
1. With whom are you grouped for each decision situation?
    a. With the same participant for the whole experiment.
    b. Each situation with a different participant.
2. Which "role" are you playing as?
    a. A different "role" each decision situation.
    b. The same "role" for the entire experiment

The following 4 images show possible decisions made by **Person A and Person B.**

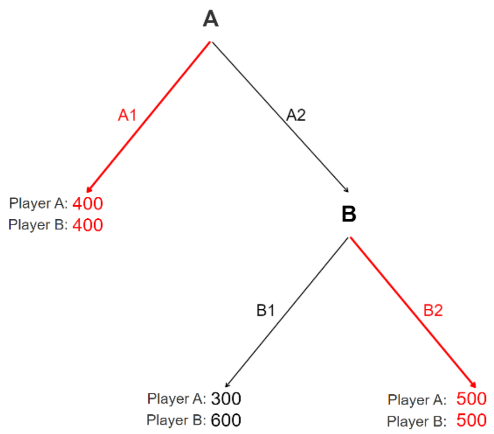
For each image, please use the boxes on the right to insert how many tokens Person A and Player B would receive with the decisions shown in the image.



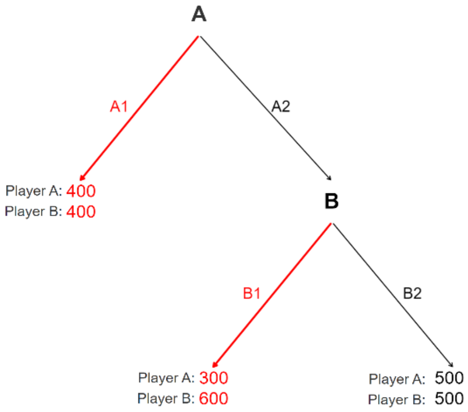
3a) How many Tokens would Person A receive?
3b) How many Tokens would Person B receive?



4a) How many Tokens would Person A receive?
4b) How many Tokens would Person B receive?

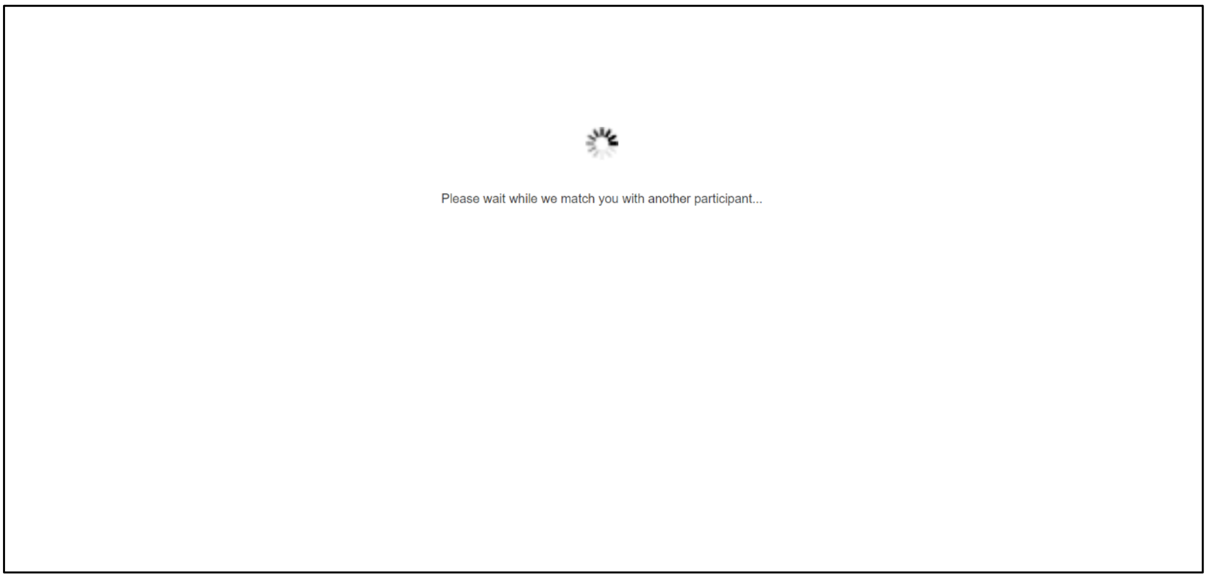


5a) How many Tokens would Person A receive?
5b) How many Tokens would Person B receive?



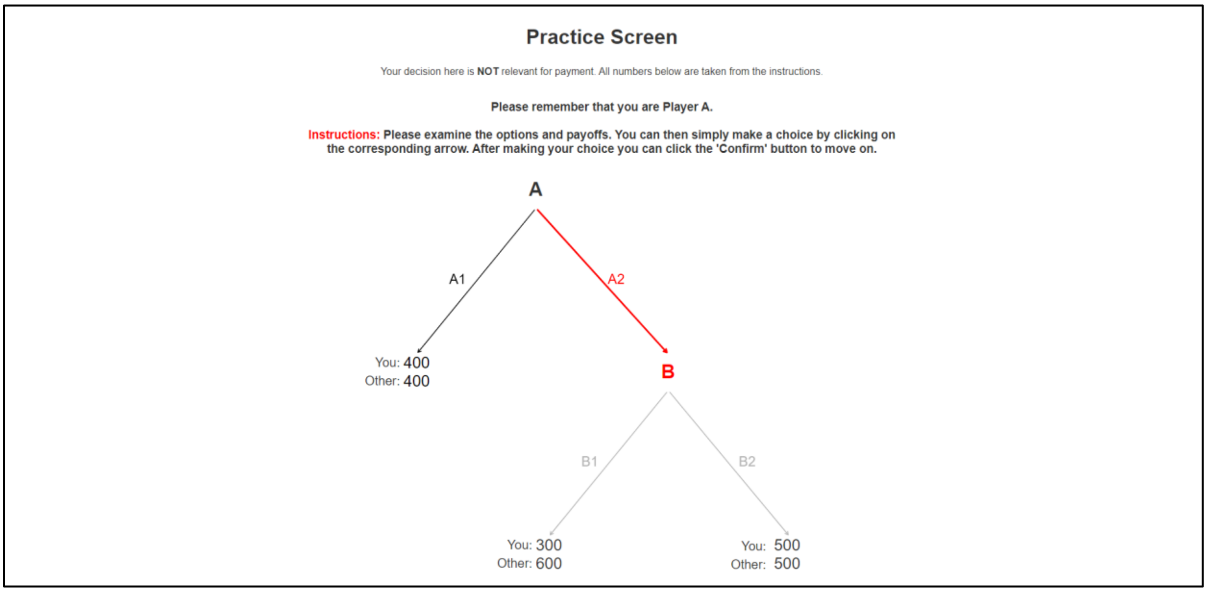
6a) How many Tokens would Person A receive?
6b) How many Tokens would Person B receive?

Screenshots of Lab Experiment

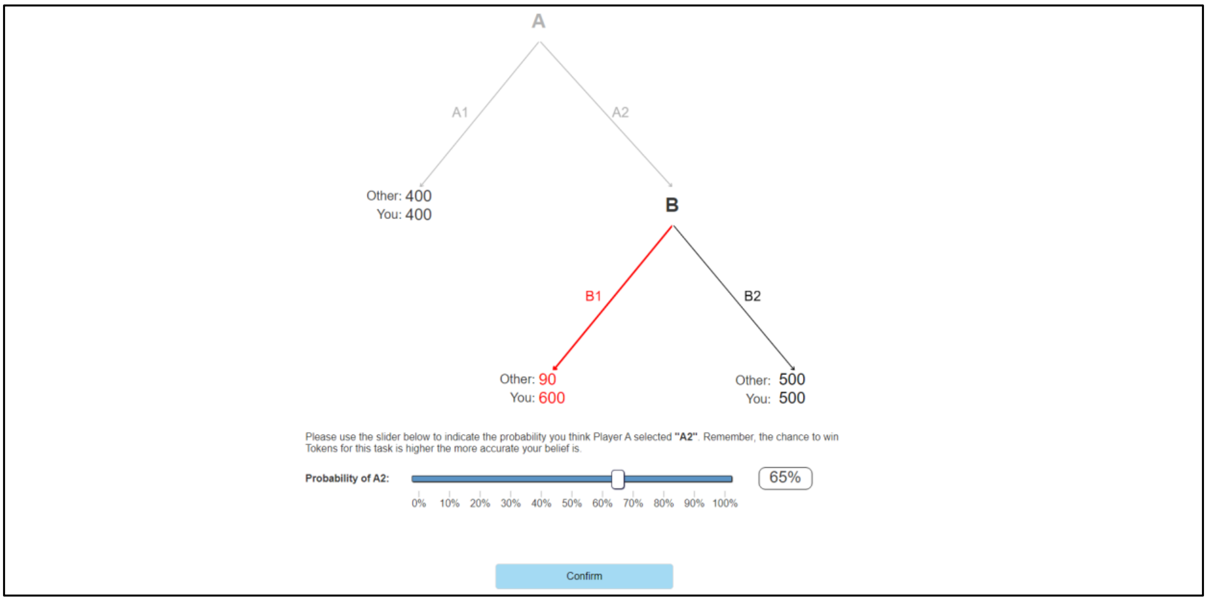


Screenshot 1: Matching stage

Screenshot 2: Role assignment



Screenshot 3: Practice screen



Screenshot 4: Decision screen

Questionnaire

1. How often have you previously participated in the experiments including similar decision problems (e.g. dividing an amount of money between yourself and another person)?
    a. Never
    b. Once or Twice
    c. 3-10 times
    d. 11-50 times
    e. More than 50 times
    f. Prefer not to say
2. What is your gender
    a. Female
    b. Male

    c. Other
    d. Prefer not to say
3. What is your age?
4. What is your nationality?
5. What is your citizenship?
    a. United Kingdom
    b. European Union
    c. United States
    d. Latin American Countries
    e. African Countries
    f. Asian Countries
    g. Other
    h. Prefer not to say
6. Which of the following describes you best?
    a. Asian
    b. Native Hawaiian or Other Pacific Islander
    c. Black or African
    d. Middle Eastern
    e. Latin American
    f. White
    g. Mixed background
    h. Other
    i. Prefer not to say
7. What is your current year of university?
    a. Year 1
    b. Year 2
    c. Year 3
    d. MA/MSc
    e. PhD
    f. Diploma
    g. Foundation Programme
    h. International Exchange Programme
    i. Other
    j. Prefer not to say
8. What is your major in the university?
9. How much do you spend per month, excluding rent?
    a. Less than £200
    b. £200 to £399
    c. £400 to £599
    d. £600 to £799
    e. £800 to £999
    f. £1,000 or more
    g. Prefer not to say
10. In politics, people sometimes talk about the ‘left’ and the ‘right’. Where would you place your own views on a scale from 0 to 10? (0 means the most left and 10 means the most right)

Appendix F *Monte Carlo simulations*

Prior to estimation we conducted Monte Carlo simulations to explore the properties of the estimators under alternative data generating processes. First, we generated data from model 1:

$$\Pr\{cooperate\} = \Phi(\mu/\sigma + (R-T)/\sigma + \rho(T-S))/\sigma).$$

using our Study 2 payoff parameters and various combinations of μ, σ and ρ. We used values of $\rho \in \{0,0.2,0.4\}$ corresponding to no, low and high weights on other's payoff. Low and high noise processes are represented by $\sigma \in \{100,200\}$, and negative, zero, and positive bias toward cooperation are represented by $\mu \in \{-100,0,100\}$.

We generated 1000 replications for each parameter combination, where a replication generates a sequence of 64 choices for our games. For each replication we ran two regressions. The first is a probit regression without a constant, estimating $\Phi(\beta_1(R-T) + \beta_2(T-S))$. Our estimate of ρ is $\hat{\rho} = \widehat{\beta_2}/\widehat{\beta_1}$ and standard errors are determined using the delta method. The second regression includes a constant and estimates $\Phi(\beta_0 + \beta_1(R-T) + \beta_2(T-S))$. Our estimate of μ is $\hat{\mu} = \widehat{\beta_0}/\widehat{\beta_1}$ and we again estimate ρ as $\hat{\rho} = \widehat{\beta_2}/\widehat{\beta_1}$, using the delta method to calculate standard errors.

Table F1 reports results. $\%id$ gives the proportion of 1000 replications in which we obtain 'sensible' estimates. We exclude cases where the model fails to converge due to under-identification and cases where $\hat{\sigma} < 0$ or $|\hat{\rho}| > 1$. $Av\ \hat{\rho}$ is the average estimate of ρ over the remaining cases, and $Av\ se(\hat{\rho})$ is the average of the associated standard errors. *Power* gives the proportion of 1000 replications that resulted in a significantly positive estimate of ρ (i.e. $\hat{\rho}$ / $se(\hat{\rho}) > 1.96$).

Note that neither the data generation process nor the regression models examined in Table F1 use beliefs and are essentially based on the model in the text with $q = 1$.

We studied the role of beliefs by generating data from an additional, belief-augmented, model

$$\Pr\{cooperate\} = \Phi(\mu/\sigma + q(R-T)/\sigma + \rho q(T-S))/\sigma).$$

We wanted to use beliefs that vary with game payoffs in a reasonable way, and so to fix beliefs we use Rapoport's K-index (Rapoport (1967)), $q = (R-P)/(T-S)$, which has been shown to be systematically related to cooperation rates in prisoner's dilemma experiments (e.g., Balliet and Van Lange (2013); Spadaro, et al. (2022); Gächter, et al. (2023)). We generated 1000 replications for each combination of parameters and ran two regressions for each replication. The first regression estimates $\Phi(\beta_0 + \beta_1(R-T) + \beta_2(T-S)))$, i.e., ignoring beliefs. The second model estimates $\Phi\left(\beta_0 + \beta_1 q(R-T) + \beta_2 q(T-S)\right)$ using the belief data. In both models we estimate μ as $\hat{\mu} = \widehat{\beta_0}/\widehat{\beta_1}$ and ρ as $\hat{\rho} = \widehat{\beta_2}/\widehat{\beta_1}$, using the delta method to calculate standard errors. Results are given in Table F2.

Table F1 Monte Carlo Results: Model 1

			No constant in regression				With constant in regression			
μ	ρ	*σ*	*%id*	*Av $\hat{\rho}$*	*Av se($\hat{\rho}$)*	*power*	*%id*	*Av $\hat{\rho}$*	*Av se($\hat{\rho}$)*	*power*
-100	0	100	.278	-.340	.213	0	.219	-.011	.675	.033
-100	0	200	.889	-.320	.269	0	.723	.113	.677	.156
-100	.2	100	.954	-.054	.087	.009	.885	.164	.397	.254
-100	.2	200	.989	-.072	.181	.044	.84	.214	.579	.246
-100	.4	100	.988	.210	.051	.909	.966	.337	.278	.506
-100	.4	200	.999	.196	.105	.613	.891	.359	.490	.398
0	0	100	.866	-.003	.065	.017	.72	.009	.474	.1
0	0	200	.998	-.026	.128	.061	.779	.048	.686	.124
0	.2	100	.845	.198	.045	.806	.786	.161	.386	.232
0	.2	200	1	.191	.077	.709	.845	.186	.590	.245
0	.4	100	.989	.398	.030	.989	.973	.342	.276	.511
0	.4	200	1	.400	.054	.996	.888	.357	.487	.392
100	0	100	.509	.187	.044	.487	.428	-.007	.515	.06
100	0	200	.998	.180	.065	.753	.762	.048	.661	.133
100	.2	100	.952	.349	.029	.952	.902	.141	.390	.243
100	.2	200	1	.349	.047	.998	.826	.184	.589	.244
100	.4	100	.978	.517	.025	.978	.94	.334	.300	.472
100	.4	200	1	.520	.049	1	.885	.354	.512	.381

1000 replications from the data generating process $\Pr\{cooperate\} = \Phi(\mu/\sigma + (R-T)/\sigma + \rho(T-S))/\sigma))$; $\%id$ is proportion of replications where parameters satisfying $\hat{\sigma} > 0$ and $|\hat{\rho}| < 1$ can be estimated. *power* is the proportion of replications with significantly positive ρ̂ at the 5% level.

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Table F2 Monte Carlo Results: Belief-augmented model

			No Beliefs in regression				With Beliefs in regression			
μ	ρ	σ	*%id*	*Av* $\hat{\rho}$	*Av se*($\hat{\rho}$)	*power*	*%id*	*Av* $\hat{\rho}$	*Av se*($\hat{\rho}$)	*power*
-100	0	100	.541	.069	.916	.067	.996	-.025	.232	.007
-100	0	200	.614	.311	1.021	.188	.960	-.007	.399	.016
-100	.2	100	.737	.108	.761	.120	1.000	.195	.198	.164
-100	.2	200	.642	.306	.995	.195	.959	.184	.340	.070
-100	.4	100	.783	.153	.747	.178	.997	.391	.176	.625
-100	.4	200	.652	.322	.976	.192	.940	.367	.341	.186
0	0	100	.754	.148	.794	.179	1.000	.005	.178	.046
0	0	200	.655	.348	.925	.229	.964	-.000	.358	.029
0	.2	100	.799	.197	.713	.217	1.000	.203	.165	.327
0	.2	200	.653	.337	.977	.213	.974	.171	.345	.097
0	.4	100	.806	.239	.758	.243	.997	.402	.162	.706
0	.4	200	.671	.356	.960	.239	.930	.372	.346	.251
100	0	100	.801	.238	.696	.229	.999	-.012	.200	.057
100	0	200	.670	.348	.915	.221	.971	.008	.356	.047
100	.2	100	.788	.300	.698	.273	.999	.196	.206	.293
100	.2	200	.662	.384	.947	.252	.964	.209	.367	.150
100	.4	100	.732	.375	.795	.292	.975	.397	.238	.558
100	.4	200	.664	.378	1.015	.228	.923	.361	.381	.286

1000 replications from the data generating process $\Pr\{cooperate\} = \Phi(\mu/\sigma + q(R-T)/\sigma + \rho q(T-S))/\sigma))$, where $q = (R-P)/(T-S)$; $\%id$ is proportion of replications where parameters satisfying $\hat{\sigma} > 0$ and $|\hat{\rho}| < 1$ can be estimated. *power* is the proportion of replications with significantly positive $\hat{\rho}$ at the 5% level.

Appendix G *Study 2 data*

Table G1 Cooperation Rates and Beliefs in Cooperation by Game

R	P	S	T	GAIN	LOSS	EFF	FM_C	SM_C	FM_q	SM_q		R	P	S	T	GAIN	LOSS	EFF	FM_C	SM_C	FM_q	SM_q
500	100	20	400	-.2	.64	.2	0.711	0.969	0.829	0.747		500	100	20	800	.6	.64	.2	0.134	0.309	0.312	0.283
500	200	20	400	-.2	.64	.4	0.887	0.969	0.863	0.770		500	200	20	800	.6	.64	.4	0.206	0.340	0.322	0.355
500	300	20	400	-.2	.64	.6	0.938	0.959	0.880	0.863		500	300	20	800	.6	.64	.6	0.608	0.278	0.351	0.553
500	400	20	400	-.2	.64	.8	0.948	0.990	0.860	0.929		500	400	20	800	.6	.64	.8	0.887	0.247	0.333	0.806
500	100	40	400	-.2	.82	.2	0.825	0.948	0.858	0.718		500	100	40	800	.6	.82	.2	0.072	0.320	0.312	0.226
500	200	40	400	-.2	.82	.4	0.784	0.979	0.818	0.800		500	200	40	800	.6	.82	.4	0.216	0.299	0.319	0.310
500	300	40	400	-.2	.82	.6	0.887	0.969	0.851	0.823		500	300	40	800	.6	.82	.6	0.351	0.309	0.325	0.358
500	400	40	400	-.2	.82	.8	0.959	0.979	0.892	0.898		500	400	40	800	.6	.82	.8	0.691	0.330	0.341	0.665
500	100	90	400	-.2	.92	.2	0.732	0.959	0.846	0.750		500	100	90	800	.6	.92	.2	0.113	0.340	0.336	0.233
500	200	90	400	-.2	.92	.4	0.794	0.948	0.808	0.741		500	200	90	800	.6	.92	.4	0.175	0.381	0.337	0.287
500	300	90	400	-.2	.92	.6	0.856	0.938	0.833	0.761		500	300	90	800	.6	.92	.6	0.361	0.330	0.335	0.379
500	400	90	400	-.2	.92	.8	0.918	0.990	0.871	0.859		500	400	90	800	.6	.92	.8	0.474	0.361	0.344	0.466
500	100	180	400	-.2	.96	.2	0.680	1.000	0.834	0.714		500	100	180	800	.6	.96	.2	0.072	0.340	0.339	0.226
500	200	180	400	-.2	.96	.4	0.804	0.979	0.826	0.809		500	200	180	800	.6	.96	.4	0.175	0.361	0.305	0.281
500	300	180	400	-.2	.96	.6	0.866	0.969	0.853	0.772		500	300	180	800	.6	.96	.6	0.392	0.381	0.337	0.364
500	400	180	400	-.2	.96	.8	0.887	0.979	0.858	0.815		500	400	180	800	.6	.96	.8	0.546	0.330	0.354	0.455
500	100	20	600	.2	.64	.2	0.165	0.495	0.409	0.309		500	100	20	1000	1	.64	.2	0.103	0.216	0.258	0.260
500	200	20	600	.2	.64	.4	0.392	0.515	0.433	0.408		500	200	20	1000	1	.64	.4	0.196	0.206	0.261	0.321
500	300	20	600	.2	.64	.6	0.753	0.515	0.483	0.606		500	300	20	1000	1	.64	.6	0.598	0.144	0.240	0.509
500	400	20	600	.2	.64	.8	0.928	0.474	0.422	0.874		500	400	20	1000	1	.64	.8	0.856	0.134	0.248	0.799
500	100	40	600	.2	.82	.2	0.196	0.557	0.420	0.296		500	100	40	1000	1	.82	.2	0.082	0.175	0.227	0.192
500	200	40	600	.2	.82	.4	0.351	0.485	0.425	0.352		500	200	40	1000	1	.82	.4	0.165	0.216	0.227	0.233
500	300	40	600	.2	.82	.6	0.546	0.526	0.433	0.450		500	300	40	1000	1	.82	.6	0.237	0.196	0.233	0.312
500	400	40	600	.2	.82	.8	0.773	0.515	0.466	0.638		500	400	40	1000	1	.82	.8	0.639	0.206	0.265	0.536
500	100	90	600	.2	.92	.2	0.124	0.567	0.438	0.292		500	100	90	1000	1	.92	.2	0.041	0.196	0.216	0.179
500	200	90	600	.2	.92	.4	0.309	0.536	0.415	0.355		500	200	90	1000	1	.92	.4	0.062	0.216	0.239	0.206
500	300	90	600	.2	.92	.6	0.433	0.567	0.425	0.410		500	300	90	1000	1	.92	.6	0.196	0.206	0.230	0.261
500	400	90	600	.2	.92	.8	0.711	0.536	0.479	0.499		500	400	90	1000	1	.92	.8	0.443	0.206	0.234	0.398
500	100	180	600	.2	.96	.2	0.124	0.588	0.418	0.302		500	100	180	1000	1	.96	.2	0.082	0.165	0.222	0.175
500	200	180	600	.2	.96	.4	0.340	0.577	0.443	0.340		500	200	180	1000	1	.96	.4	0.113	0.237	0.236	0.224
500	300	180	600	.2	.96	.6	0.464	0.639	0.462	0.425		500	300	180	1000	1	.96	.6	0.186	0.206	0.218	0.277
500	400	180	600	.2	.96	.8	0.608	0.546	0.462	0.444		500	400	180	1000	1	.96	.8	0.402	0.227	0.265	0.356

Table G2 SM Parameter Estimates

ID	$\hat{\sigma}$	se($\hat{\sigma}$)	$\hat{\rho}$	se($\hat{\rho}$)	$\hat{\mu}$	se($\hat{\mu}$)	Coop	Comment
4	1.70	1.04	0.22	0.02	-7.01	3.00	0.36	
6	n/a	n/a	n/a	n/a	n/a	n/a	1.00	Always cooperator[A]
7	11.13	9.09	0.58	0.10	-80.14	23.87	0.31	
8	1.47	2.77	0.26	0.01	-10.63	2.68	0.33	
10	61.26	17.29	0.49	0.09	-44.38	30.80	0.53	
12	22.55	5.85	0.45	0.05	-32.89	8.96	0.39	
14	n/a	n/a	n/a	n/a	n/a	n/a	1.00	Always cooperator[A]
16	n/a	n/a	n/a	n/a	n/a	n/a	0.28	underidentified[C]
18	58.44	30.45	0.26	0.18	145.13	101.69	0.84	
21	22.97	16.10	0.69	0.21	-33.11	23.07	0.48	
24	4.48	1.64	0.55	0.01	-6.76	2.98	0.80	
25	n/a	n/a	n/a	n/a	n/a	n/a	0.27	underidentified[C]
26	37.10	15.67	0.42	0.24	-106.41	68.34	0.25	
29	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
30	29.99	7.43	0.69	0.05	-90.13	19.82	0.66	
32	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
34	66.17	15.41	0.44	0.10	-57.57	26.04	0.42	
36	59.28	13.90	0.47	0.09	-130.50	35.24	0.27	
40	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
41	n/a	n/a	n/a	n/a	n/a	n/a	0.23	underidentified[D]
43	55.84	13.35	0.43	0.12	-87.56	36.39	0.33	
44	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
47	48.31	15.76	0.40	0.06	-10.51	14.15	0.53	
48	60.53	17.54	0.49	0.05	7.42	26.50	0.73	
50	57.36	12.97	0.38	0.07	-94.62	28.56	0.31	
52	20.36	5.93	0.73	0.09	-82.24	23.86	0.64	
54	38.83	19.32	0.31	0.08	-65.42	39.66	0.31	
56	15.41	6.86	0.22	0.21	-51.58	25.05	0.20	
58	89.99	46.71	-0.02	0.25	130.00	76.93	0.84	
60	24.83	6.61	0.41	0.04	-16.39	7.73	0.50	
62	n/a	n/a	n/a	n/a	n/a	n/a	0.52	underidentified[C]
64	47.54	11.17	0.52	0.06	-54.32	24.09	0.56	
67	61.25	12.93	0.59	0.06	-105.90	36.96	0.61	
68	11.71	3.01	0.46	0.03	-10.63	4.55	0.55	
71	3.45	1.52	0.26	0.02	-1.22	1.82	0.47	
72	58.30	15.82	0.67	0.09	-108.94	45.18	0.67	
74	34.70	7.98	0.53	0.07	-37.03	27.53	0.67	
76	9.22	3.32	0.40	0.03	2.51	2.59	0.69	
78	224.58	134.04	0.50	0.30	-222.47	100.79	0.25	
80	92.42	25.87	0.75	0.11	-121.75	32.87	0.42	
82	67.57	15.18	0.29	0.09	-33.97	27.15	0.42	
86	n/a	n/a	n/a	n/a	n/a	n/a	0.98	underidentified[C]
88	67.67	15.68	0.57	0.09	-131.87	32.02	0.33	
89	15.33	4.77	0.50	0.03	-6.45	7.64	0.73	
90	41.07	25.40	0.53	0.11	-102.48	58.86	0.25	
93	34.63	9.40	0.61	0.05	-50.47	21.55	0.72	
95	63.57	18.72	0.57	0.14	-54.09	35.65	0.58	
99	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
100	87.77	21.50	0.32	0.11	-85.55	39.44	0.28	
102	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
103	108.11	34.74	0.17	0.18	78.88	54.85	0.66	
104	45.50	15.73	0.36	0.17	-80.41	43.37	0.28	
107	5.03	2.92	0.40	0.01	-2.23	2.31	0.56	
108	n/a	n/a	n/a	n/a	n/a	n/a	0.27	underidentified[C]
112	89.54	58.72	0.36	0.19	127.50	103.22	0.92	
114	n/a	n/a	n/a	n/a	n/a	n/a	1.00	Always cooperator[A]
115	43.05	15.06	0.28	0.08	-2.24	12.13	0.52	
116	867.48	5387.21	-0.46	7.01	2091.30	13444.71	0.98	

121	334.13	766.01	-0.80	3.64	1006.42	2631.20	0.94	
122	0.52	0.40	0.25	0.00	-3.43	0.67	0.41	
124	12.66	4.78	0.45	0.03	-14.22	11.05	0.63	
125	37.86	11.92	0.37	0.11	-63.74	37.19	0.34	
127	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
129	64.16	20.48	0.44	0.07	-47.93	20.53	0.48	
130	n/a	n/a	n/a	n/a	n/a	n/a	1.00	Always cooperator[A]
132	80.39	62.12	0.67	0.21	42.34	162.68	0.97	
134	57.73	14.28	0.54	0.07	-60.84	17.35	0.39	
137	11.35	6.58	0.23	0.03	-14.15	9.60	0.31	
139	64.18	15.60	0.73	0.07	-133.02	28.49	0.39	
142	39.53	10.47	0.60	0.06	-71.42	19.33	0.47	
144	27.01	6.55	0.22	0.08	28.67	18.76	0.55	
145	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
146	16.74	7.24	0.67	0.05	-202.86	19.98	0.27	
149	n/a	n/a	n/a	n/a	n/a	n/a	0.98	underidentified[D]
150	n/a	n/a	n/a	n/a	n/a	n/a	1.00	Always cooperator[A]
152	n/a	n/a	n/a	n/a	n/a	n/a	0.27	underidentified[C]
155	31.06	10.21	-0.05	0.13	-11.57	20.54	0.28	
158	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
159	53.04	13.20	0.07	0.24	-8.88	47.65	0.27	
161	31.92	7.76	0.47	0.08	-61.37	19.37	0.34	
163	31.65	8.03	0.50	0.03	-23.27	13.77	0.67	
164	9.11	3.53	0.21	0.02	-1.26	4.13	0.38	
166	81.22	32.15	0.36	0.12	90.24	59.85	0.83	
168	32.48	9.56	0.64	0.05	-36.33	12.38	0.70	
170	19.18	5.86	0.45	0.05	-3.84	16.91	0.69	
172	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
174	170.96	62.77	0.73	0.19	-122.79	85.22	0.63	
176	61.14	18.38	0.62	0.09	-120.80	37.76	0.28	
181	n/a	n/a	n/a	n/a	n/a	n/a	1.00	Always cooperator[A]
182	16.45	4.59	0.43	0.04	-17.12	10.51	0.53	
184	84.20	24.71	0.46	0.06	-31.14	21.01	0.52	
187	68.89	21.06	0.43	0.08	-4.05	25.20	0.66	
189	33.65	10.21	0.59	0.05	-44.72	17.79	0.70	
190	34.83	20.85	0.30	0.17	-56.78	39.67	0.28	
192	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
193	n/a	n/a	n/a	n/a	n/a	n/a	0.25	Payoff maximizer[B]
194	2714.81	15354.74	-1.10	9.73	511.17	3379.62	0.52	Outlier

Notes. The estimates above are for SM and follow the econometric specification as outlined in the paper. For 26 individuals we cannot obtain maximum likelihood estimates because a linear combination of the regressors perfectly predicts outcomes. Of these cases of underidentification,
A: 6 always cooperate – choices perfectly predicted using a model with only a constant;
B: 12 maximise own payoff – choices perfectly predicted using a model with only $\boldsymbol{q}(\boldsymbol{R}-\boldsymbol{T})$;
C: 6 further underidentified cases can be perfectly predicted using a model with a constant and $\boldsymbol{q}(\boldsymbol{R}-\boldsymbol{T})$
D: 2 further underidentified cases can be perfectly predicted using a constant, $\boldsymbol{q}(\boldsymbol{R}-\boldsymbol{T})$ and $\boldsymbol{q}(\boldsymbol{T}-\boldsymbol{S})$.
One individual is treated as an outlier as the estimate of $\boldsymbol{\rho} < -\mathbf{1}$.

Appendix H *Further analyses regarding reciprocity (through EFF)*

1) Among the 64 games in study 2, we have 16 quadruples in each of which R, S and T are constant and EFF (through P) varies. Within each quadruple, SM cooperation only varies by 5.15% on average, and there is no monotonic relation between EFF and SM cooperation.
2) Fig. H1 plots fitted regression lines for each of the 16 quadruples to examine whether changes in EFF affect cooperation in each subset of games. Each line corresponds to a game where GAIN and LOSS are constant and only EFF varies across four levels. Observe that there is quite a lot of variation in cooperation across different values of GAIN and LOSS, but not much with respect to EFF.

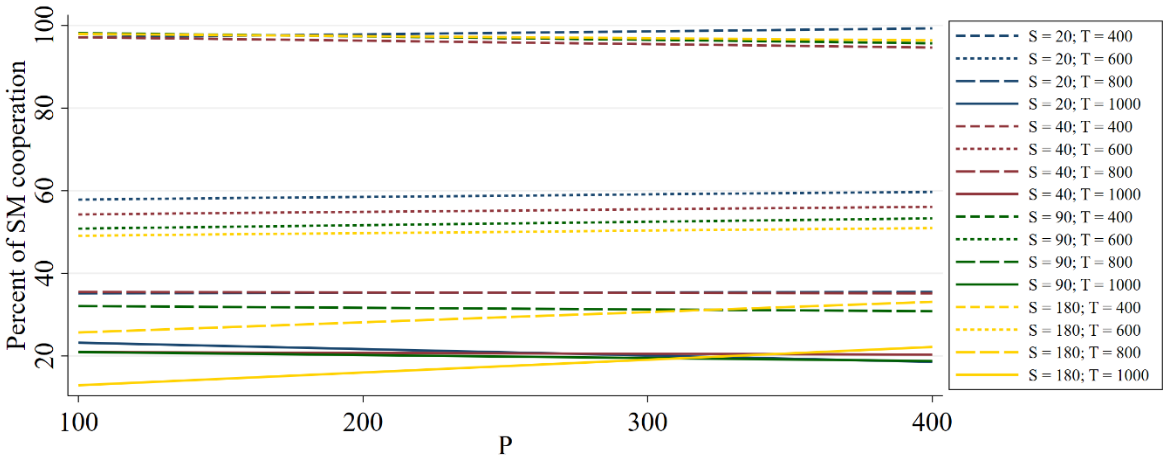

Fig. H1 The effect of EFF for each quadruple

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