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公共財ゲームにおけるピア・ツー・ピアの罰則と反撃の動機：実験による一考察

亀井憲樹、ケイティ・タベロ

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JEL Classification: C92, D01, H49
キーワード: experiment, public goods game, punishment, counter-punishment

【要旨】

公共財ゲームにおいては、ピア・ツー・ピアの罰則が可能であっても、罰則を科された者が反罰できる場合には、効率性が改善しないことがよく知られている。本論文では、意思決定形式の違い（個人かチームか）にかかわらず、反撃が可能であれば分権的な罰則の効果が限定的であることを実験室内実験を行うことで示すとともに、罰則と反罰の動機を考察する。「チーム」が意思決定主体であるトリートメントでは、被験者はランダムに3人組のチームに割り当てられ、コミュニケーションを通じて共同で一つの意思決定を行う。彼らのコミュニケーションのログに対する内容分析の結果、（A）公共財ゲームにおける一次のピア・ツー・ピアの罰則は、主に仲間の低い貢献に対する負の感情的反応によって、（B）罰則を科された者による反罰は、受けた罰則に対する負の感情的反応によって誘発されていることが明らかになった。

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Motivations behind Peer-to-Peer (Counter-)Punishment in Public Goods Games: An Experiment

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Abstract: It is well-known that efficiency often fails to improve in public goods games with peer-to-peer punishment when counter-punishment is possible. This paper experimentally demonstrates, for the first time, that the effects of sanctioning institutions are modest, regardless of the decision-making format (individual or team). In the "team" conditions, subjects are randomly assigned to teams of three, and make joint decisions through communication. Their dialogue provides valuable insights into the motivations behind (counter-)punishment, as well as the resulting behavioral effects. A coding exercise reveals that first-order punishments (and counter-punishments) are primarily emotional responses to peers' low contributions (and first-order punishments, respectively).

JEL classification: C92, D01, H49

Keywords: experiment, social norms, public goods game, punishment, counter-punishment

Acknowledgement: This project was funded by Zengin Foundation for Studies on Economics and Finance, JSPS KAKENHI (Grant #: 23H00833), and Keio University. The authors would also like to acknowledge support provided by UK Research and Innovation funding grant ref. MR/S032711/1. The study was ethically approved at the University of Southampton (reference #: 82061), and thank John Hey for facilitating the experiment sessions at the University of York.

1. Introduction

Social dilemmas characterize many economic situations, whether in our societies, organizations (e.g., firms), or educational institutions. While members' free-riding tendencies are ubiquitous, which strongly undermines cooperation, the opportunity for peer-to-peer punishment may improve efficiency (e.g., Fehr and Gächter, 2000; Gächter *et al.*, 2007). However, the positive effects are limited when counter-punishment is possible because members refrain from using punishment due to the fear of counter-punishment (e.g., Denant-Boemont *et al.*, 2007; Nikiforakis, 2008).

This paper addresses the following twin questions for the first time in the literature. The first question is whether the behavioral results of punishment/counter-punishment extend to teams as decision-making units. While teams are known to behave differently from individuals (e.g., Charness and Sutter, 2012), surprisingly, no investigations have been made thus far on the counter-punishment behavior of teams. The second question concerns why counter-punishment opportunities undermine efficiency. This study utilizes coding techniques to answer this question, as teams' communication dialogues contain rich information that may explain the reasoning behind their decisions.

The results show first that the punishment institution improves cooperation in a public goods game to some degree, but not significantly. The mild effects are robust to the decision-making units (individuals or teams). Second, their counter-punishment pattern is unfavorable for sustaining cooperative norms; first-order pro-social punishers receive counter-punishment as strongly as first-order anti-social punishers, whether individuals or teams. Lastly, the coding analysis uncovered that first-order punishments (counter-punishments) are emotional responses to the peers' low contributions (first-order punishments).

2. Experimental Design

This study is based on a finitely repeated linear public goods game. Four treatments are implemented using a 2×2 between-subjects design, varying along two dimensions. The first dimension concerns the decision-making unit ("Individual" or "Team"). The second dimension concerns the possibility of peer-to-peer punishment and counter-punishment ("Yes" or "No"). The four treatments are labelled "Individual-No," "Individual-Yes," "Team-No," and "Team-Yes" (Table 1). The conversion rate in the experiment is 1 point = 3 UK pence.

Table 1: *Summary of Treatments*

Treatment	Decision-making unit	Punishment institution	# of subjects (groups)
Individual-No	Individual	No	48 (12)
Individual-Yes	Individual	Yes	48 (12)
Team-No	Team	No	120 (10)
Team-Yes	Team	Yes	120 (10)
Total			336 (44)

2.1. Common Features

At the onset of the game, subjects are randomly assigned to groups of four decision-making units. The group composition remains fixed throughout the experiment. The units interact with each other in a public goods game over 15 periods. Specifically, in each period, every decision-making unit is endowed with 20 points and decides how to allocate them between their private account and the group account. The marginal per capita return (MPCR) is 0.4: For each point allocated to the group account, every unit receives 0.4 as earnings. The payoff of unit *i* in period *t* is expressed as follows:

$$u_{i,t}(c_{i,t}, c_{-i,t}) = 20 - c_{i,t} + 0.4 \sum_{j=1}^{4} c_{j,t},$$

where $c_{i,t}$ is unit i's contribution in period t. These are standard design parameters adopted in previous studies (e.g., Kamei and Putterman, 2015). The "No" treatments include only the allocation stage in each period.

The "Yes" treatments have two additional stages in each period. First, after everyone has made an allocation decision, they are informed of their peers' contributions and can assign punishment points (up to 10) to each other. Each punishment point assigned reduces the recipient's payoff by three points, while costing the assigner one point. Second, immediately following the first punishment stage, those who were punished have a second opportunity to reduce the earnings of those who had punished them, at the same rate of 1 point paid for 3 points deducted from the target. Units are randomly reassigned ID letters in each period to limit the opportunity for targeting specific units with punishment or counter-punishment across multiple periods for prior behavior.

Standard theory predicts no punitive behavior in the second and third stages of each period, as punishment is costly. Thus, through backward induction, it predicts that no decision-making unit contributes to the group account in any period across all four treatments. However, models of other-regarding preferences (e.g., Fehr and Schmidt, 1999) suggest the possibility of positive punitive behavior. Empirically, it is known that punishment institutions improve efficiency only mildly in this experimental setup, due to the harmful effects of retaliatory behavior (e.g., Nikiforakis, 2008; Kamei and Putterman, 2015).

2.2. Team Treatments

At the onset of the experiment, subjects are randomly assigned to teams of three under partner matching. Each team, acting as a decision-making unit, makes a joint decision in each stage. The team decision-making procedure is summarized as follows (Appendix A):

Step 1: Members communicate with one another for one minute using an electronic chat window.

Step 2: After one minute, each team member submits their preferred or agreed-upon team decision.

Step 3: The median of the three submissions is determined and used as the team's decision.

This procedure is applied to all three types of decisions: contribution, punishment, and counter-punishment. Teams are formed anonymously within experiment sessions. Subjects are prohibited from conveying any personal information or any details that could reveal their identity (e.g., their seat number).

All three members of a team receive identical earnings based on their team's payoff. This setup is typical in team decision-making experiments (e.g., Cox and Stoddard, 2018; Kamei, 2019).

2.3. Experimental Procedure

The experimental sessions were conducted at the University of York between August 2023 and November 2024. A total of 336 students participated in the experiment, with no subject taking part in more than one session. All parts of the experiment, except for the instructions, were programmed using the oTree software (Chen *et al.*, 2016). The instructions and verbal explanations provided during the experiment were neutrally framed.

3. Results

This section first presents the experimental results (Section 3.1), followed by an analysis of subjects' reasoning based on their communication logs (Section 3.2).

3.1. Contribution, Payoff and (Counter-)Punishment

The patterns of efficiency measures in the individual treatments replicate those observed in previous research. First, without the sanctioning institution, the average contribution is low (Panel A of Fig.1) and shows a significantly declining trend over time (Panel B of Fig.1). Second, the presence of the sanctioning institution helps prevent the decline in average contributions and leads to a modest improvement, although the increase is not statistically significant (Panel A of Fig.1).

Qualitatively similar weak effects of the sanctioning institution are also observed in the team treatments (see again Fig.1). These results suggest that the behavioral tendencies previously observed among individuals (e.g., Denant-Boemont *et al.*, 2007; Nikiforakis, 2008) extend to teams.

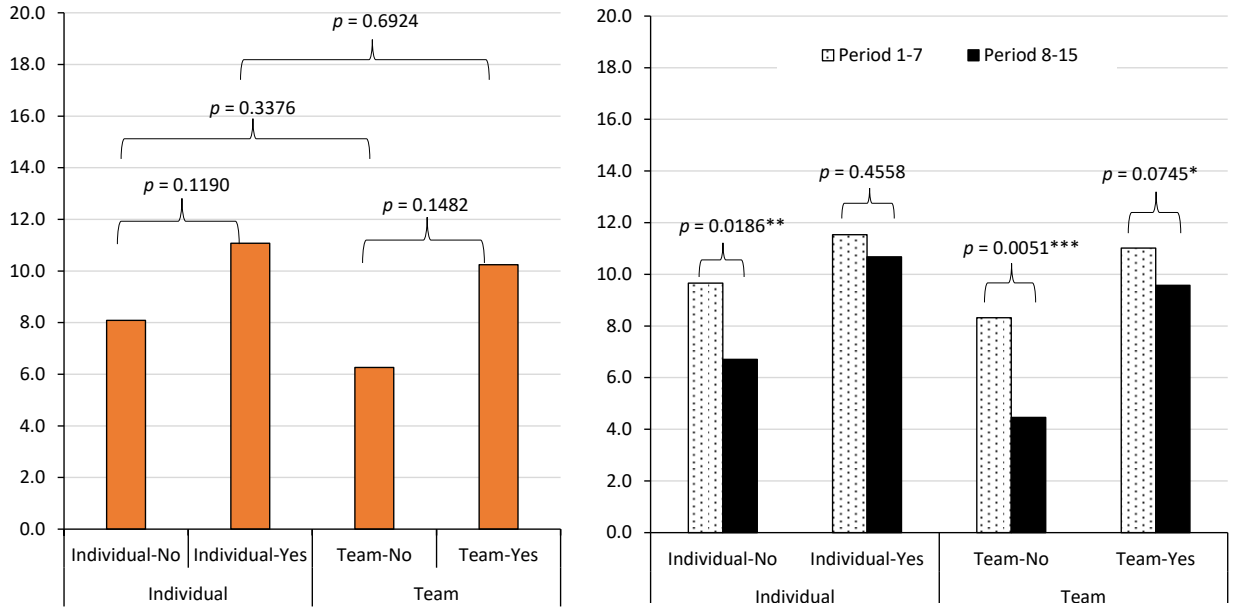
Appendix Figure B.1 presents average payoffs by treatment. The results are qualitatively the same as those for average contribution.[1]

Table 2 summarizes the average losses from punishment and counter-punishment received. It shows that punishment tendencies are robust across decision-making formats. First, regardless of whether the decision-making units are individuals or teams, pro-social punishments are significantly more common than anti-social punishments in the first punishment stage (Panel A). Second, the first-stage punishers—whether pro-social or anti-social—received similarly strong counter-punishment (Panel B). These counter-punishments are detrimental, as they discourage pro-social punishment, a pattern also documented in previous research (e.g., Nikiforakis, 2008; Denant-Boemont *et al.*, 2007; Kamei and Putterman, 2015).

[1] A group random effects GLS with robust standard errors were performed to supplement the non-parametric test results. It found that, whether controls are included or not, the effects of the punishment institution on neither the average contribution nor payoff is significant at the 5% level for both individuals and teams. The detail is omitted to conserve space.

Result 1: *Contribution and (counter-)punishment behaviors are qualitatively similar for individuals and teams. Specifically, (a) the effects of the sanctioning institution on efficiency—measured by either contributions or payoffs—are modest. (b) While pro-social first-stage punishments are far more common than anti-social ones, the former invite similarly strong counter-punishments.*

Figure 1: *Average Contributions by Treatment*



(A) Average for all periods (B) Average for the 1st and 2nd half

Notes: The *p*-values in Panels A and B are the results from two-sided group-level Mann-Whitney tests and Wilcoxon signed-rank tests, respectively.

Table 2: *Punishment and Counter-Punishment Received*

(A) Avg. loss of the punished in the first punishment stage

	(i) All cases	Breakdown			
		(ii) Pro-social	(iii) Anti-social	Ratio: (ii)/(iii)	H_0: (ii) = (iii)[#1]
Both treatments	0.979	1.821	0.360	5.058	< 0.001***
(a) Individual-Yes	1.354	2.440	0.450	5.418	0.002***
(b) Team-Yes	0.812	1.514	0.323	4.689	0.0284**
H_0: (a) = (b)[#2]	0.4285	0.6924	0.5105	0.3082	

(B) Avg. loss of the recipients of counter-punishment in the second punishment stage

	(i) All cases	Target of counterpunishment			
		(ii) Pro-social punisher	(iii) Anti-social punisher	Ratio: (ii)/(iii)	H_0: (ii) = (iii)[#1]
Both treatments	1.997	1.872	2.633	0.711	0.695
(a) Individual-Yes	2.110	1.927	2.925	0.659	0.263
(b) Team-Yes	1.688	1.732	1.333	1.299	0.0679*
H_0: (a) = (b)[#2]	0.7412	0.9737	0.0861*	0.0676*	

Notes: Pro-social punishment is defined as punishment directed toward *i* in Stage 2 if *i* contributed less than the group average in Stage 1 (the punishment that is not prosocial is anti-social punishment). [#1] Two-sided Wilcoxon signed rank tests using group-average matched data. [#2] Two-sided Mann-Whitney tests using group-average data. *, **, and *** indicate significance at the 0.10 level, at the 0.05 level, and at the 0.01 level, respectively.

3.2. Reasoning behind Punishment and Counter-Punishment

A coding exercise of communication logs was conducted to uncover decision-making motives. Two independent coders reviewed all communication logs in the Team-No and Team-Yes treatments. Using a predefined list of codes that describe various motives, they assigned relevant codes to each log. Following the literature (e.g., Cason and Mui 2015), only codes with a Cohen's Kappa (Cohen, 1960) value greater than 0.4 are used for data analysis below. Details of the coding procedure, the full set of codes, and the corresponding Kappa values are provided in Appendix C.

Table 3 summarizes the list of codes found to affect units' decisions (the full estimation results are included in Appendix C.4). It shows that, while recognizing the virtue of mutual contribution encourages cooperation (A9), conditional cooperative behavior can either increase or decrease contributions dependent on their intentions or beliefs (A5, A7). As is often the case, unconditional contributors (A1) and free riders (A2) are present.

First-order punishments are mainly targeted at low contributors (B1) and are driven by emotion (B5). As such, units do not inflict punishment if they are satisfied with the level of

contributions and interaction outcomes (B11, D6). Counter-punishments in the final stage are exclusively driven by emotions (C1).

Table 3: *Motives That Significantly Affected Decisions*

Three decisions to be explained by coded motives		
(a) Contribution in Stage 1[#1]	(b) Punishment in Stage 2	(c) Counter-punishment in Stage 3
A1: Suggests a high/higher or full contribution regardless of others' behaviour **(+)** **A2**: Suggests a low/lower or 0 contribution regardless of others' behaviour **(-)** **A5**: Suggests a high, stable, or increasing contribution to encourage cooperation or discourage non-cooperation **(+)** **A7**: Suggests a low/lower or 0 contribution out of distrust of the other teams **(-)** **A9**: Recognises that everyone earns more if they mutually contribute more to the group account **(+)**	**B1**: Suggests punishment towards a team for contributing less than the group average **(+)** **B5**: A suggestion for punishment is motivated by emotion e.g. anger towards an outcome, enjoyment of punishment **(+)** **B11:** Suggest that they should not punish as it isn't needed e.g. happy/content with the level of contributions **(-)** **D6:** Expresses positive emotion or positivity in relation to an outcome or decision e.g. that was good **(-)**	**C1:** Suggests counter-punishment towards a team that punished them for an emotive reason **(+)**

Notes: Two estimation methods were used for each regression specification (GLS and Tobit). The codes included in this table are those found to be significant regardless of the estimation method used. "+" are "–" in parentheses indicate the coded motives are positive and negative predictors, respectively, for each stage decision. [#1] The same codes were found to be significant for the Team-No and Tean-Yes treatments.

Result 2: *(i) Conditional cooperative behavior and recognition of the virtue of mutual contribution affect units' decisions to contribute in Stage 1. (ii) First-order punishments are mainly inflicted on low contributors when units are dissatisfied with their peers' contributions. (iii) Counter-punishments are exclusively driven by emotion.*

4. Conclusions

This paper shows that the sanctioning institution has only a mild effect on efficiency when counter-punishment is possible, irrespective of the decision-making unit (individuals or teams). It also demonstrates that first-order punishments are mainly targeted at low contributors driven by their dissatisfaction with their peers' behavior, and that counter-punishments are emotional responses to received first-order punishments.

References

Charness, G., Sutter, M. 2012. "Groups Make Better Self-Interested Decisions." *Journal of Economic Perspective* 26: 157-176.

Chen, D., Schonger, M., Wickens, C. 2016. "oTree - An Open-source Platform for Laboratory, Online and Field Experiments." *Journal of Behavioral and Experimental Finance* 9:88-97.

Cox, C., Stoddard, B., 2018. "Strategic Thinking in Public Goods Games with Teams." *Journal of Public Economics* 161:31-43.

Denant-Boemont, L., Masclet, D., Noussair, C. 2017. "Punishment, Counterpunishment and Sanction Enforcement in a Social Dilemma Experiment." *Economic Theory* 33:145-167.

Fehr, E., Schmidt, K., 1999. "A Theory of Fairness, Competition, and Cooperation." *Quarterly Journal of Economics* 114(3): 817-868.

Kamei, K., 2019. "Power of Joint Decision-Making in a Finitely-Repeated Dilemma." *Oxford Economic Papers*.

Kamei, K., Putterman, L., 2015. "In broad daylight: Fuller information and higher-order punishment opportunities can promote cooperation." *Journal of Economic Behavior and Organization* 120:145-159.

Nikiforakis, N., 2008. "Punishment and Counter-punishment in Public Good Games: Can We Really Govern Ourselves." *Journal of Public Economics* 92:91-112.

Not for Publication

Supplementary Online Appendix for Kamei and Tabero, 2025,

"Motivations behind Peer-to-Peer (Counter-)Punishment

in Public Goods Games: An Experiment"

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Appendix A: Instructions Used in the Experiment

Any loaded words, such as "contribute" and "punish," were avoided in the instructions.

A.1. The Individual-No Treatment

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment you are not allowed to communicate with other participants. If you have questions, raise your hand. One of us will come to answer your question.

During the experiment your earnings will be calculated in points. At the end of the experiment your points will be converted to U.K. pounds at the following rate:

1 point = 3 pence

At the end of the experiment your total earnings (including the **£3** participation fee) will be paid out to you in cash. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

At the beginning of the experiment, you are randomly assigned to **a group of four** and interact with each other. You will be part of the same group throughout the entire experiment. You will not be told which other participants are in your group, nor will you be informed who was in which group after the experiment ends.

In this experiment, participants and their group members interact together for a total of **15 periods**. In each period you will be required to make a decision. Please make your decision and click the submit/next button within 20 seconds. After 20 seconds have passed, a reminder will appear on the screen to remind you to submit your decision/click next (you must close the reminder before you can continue).

Allocation Decisions

In each period, you and your three group members are each given **an endowment of 20 points**. At the beginning of the period, you and the three others simultaneously decide how to use your endowments. There are two possibilities:

1. **You can allocate points to a group account.**
2. **You can allocate points to a private account.**

Specifically, you are asked how many points you want to allocate to the group account. Only integers between 0 and 20 are allowed for this purpose. The remaining points (i.e., 20 minus your allocation to the group account) will be automatically allocated to your private account. Your earnings depend on **(a) the number of points in your private account** and **(b) the total amount allocated to the group account**.

How to calculate your earnings:

Your earnings in a given period are calculated as in the following formula:

(sum of points in your private account) + 0.4 × (sum of points allocated by you and your group members to the group account)

In other words, your earnings from your private account **are equal to the number of points you allocated to the private account** (20 minus your allocation to your group account). The points you allocate to your private account do not affect the earnings of your group members.

By contrast, your earnings from the group account equal the **sum** of points allocated to the group account by you and the other three members in your group multiplied **by 0.4**. In other words, if you allocate 1 point to the group account, your earnings from your allocation are $0.4 \times 1 = 0.4$ points, which is less than 1 point. However, by allocating 1 point to the group account, the earnings of each of your group members also increase by 0.4 points. Therefore, the total earnings in this example are 1.6 ($= 0.4 \times 4$) points, which is greater than 1 point. Note that you also obtain earnings of 0.4 points for each point your other group members allocate to the group account.

Once all group members make allocation decisions, you will be informed of the interaction outcomes (your earnings, along with each of the three group members' allocation decisions anonymously and in a random order).

Summary:

You will interact with three other individuals whose identities will not be made known to you either during or after the experiment, for a total of **fifteen** periods.

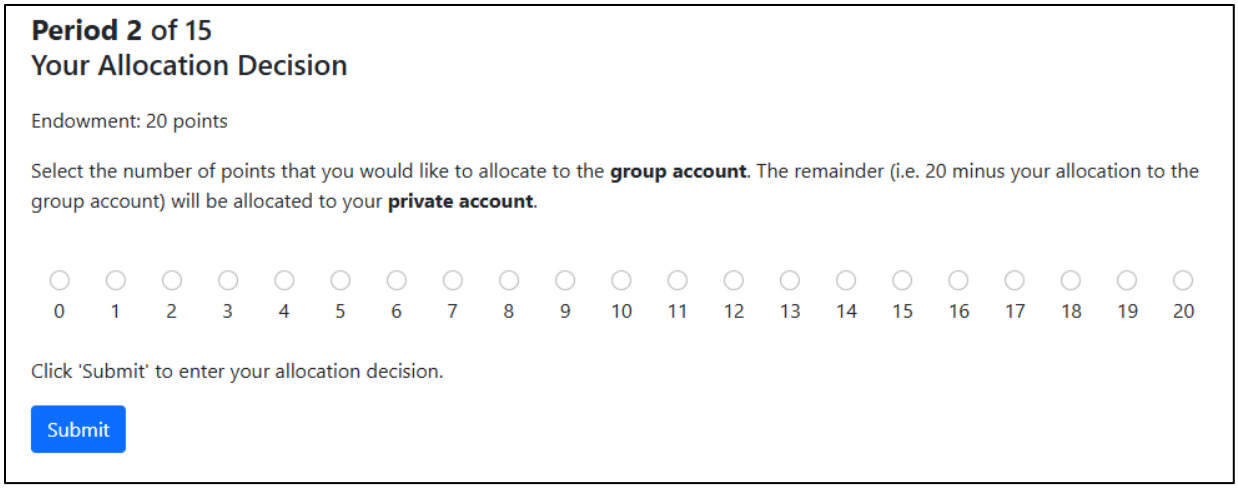
Each period, you and each other member of your group will receive an endowment of 20 points and will decide on its **allocation** between a private and a group account. Once each group

member has made their allocation decisions, each will see how much each other has allocated to the group account.

After fifteen repetitions of this process, the experiment will be over, and you will be asked to answer a few questions while the experimenters count out payments based on each person's accumulated earnings.

Please raise your hand now if you have any questions. Once all questions have been answered, we will move on to the comprehension questions which will become available for you to complete on-screen. The experiment will begin once everyone has answered all of the comprehension questions completely.

[Remark to readers: The following is an example of the computer screen for the allocation stage]



A.2. The Team-No Treatment

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment you are not allowed to communicate with other participants. If you have questions, raise your hand. One of us will come to answer your question.

During the experiment your earnings will be calculated in points. At the end of the experiment your points will be converted to U.K. pounds at the following rate:

1 point = 3 pence

At the end of the experiment your total earnings (including the **£3** participation fee) will be paid out to you in cash. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

At the beginning of the experiment, you are randomly assigned to a **team with two other participants.** The team is the decision-making unit in the experiment. The team composition stays the same throughout the entire experiment. Your team is then randomly assigned to a **group with three other teams**, and interact with each other. This means that you are in a group with 11 other participants (two in the same team, and nine in the other teams). You will be part of the same group throughout the entire experiment. You will not be told which other participants are in your group, nor will you be informed who was in which team or group after the experiment ends.

In this experiment, participants interact together for a total of **15 periods**. In each period you will be required to make a decision. Please make your decision and click the submit/next button within 20 seconds. After 20 seconds have passed, a reminder will appear on the screen to remind you to submit your decision/click next (you must close the reminder before you can continue).

Allocation Decisions

In each period, the four teams in your group are each given **an endowment of 20 points**. At the beginning of the period, you and the three other teams simultaneously decide how to use your endowments. There are two possibilities:

1. **You, as a team, can allocate points to a group account.**
2. **You, as a team, can allocate points to a private account.**

Specifically, each team is asked how many points they want to allocate to the group account. Only integers between 0 and 20 are allowed for this purpose. The remaining points (i.e., 20 minus the allocation to the group account) will be automatically allocated to their private account. Your earnings depend on **(a) the number of points in your team's private account** and **(b) the total amount allocated to the group account in your group**.

How to calculate your team's earnings:

Your team's earnings in a given period are calculated as in the following formula:

(sum of points in your team's private account) + 0.4 × (sum of points allocated by your team and the other three teams to the group account)

In other words, your team's earnings from the private account **are equal to the number of points your team allocated to the private account** (20 minus your team's allocation to the group account). The points your team allocates to the private account do not affect the earnings of the other three teams in your group.

By contrast, your team's earnings from the group account equal the **sum** of points allocated to the group account by your team and the other three teams in your group multiplied **by 0.4**. In other words, if your team allocates 1 point to the group account, your team's earnings from the allocation are $0.4 \times 1 = 0.4$ points, which is less than 1 point. However, by allocating 1 point to the group account, the earnings of each of the other three teams also increase by 0.4 points. Therefore, the total earnings in this example are 1.6 ($= 0.4 \times 4$) points, which is greater than 1 point. Note that your team also obtains earnings of 0.4 points for each point the other teams in your group allocate to the group account.

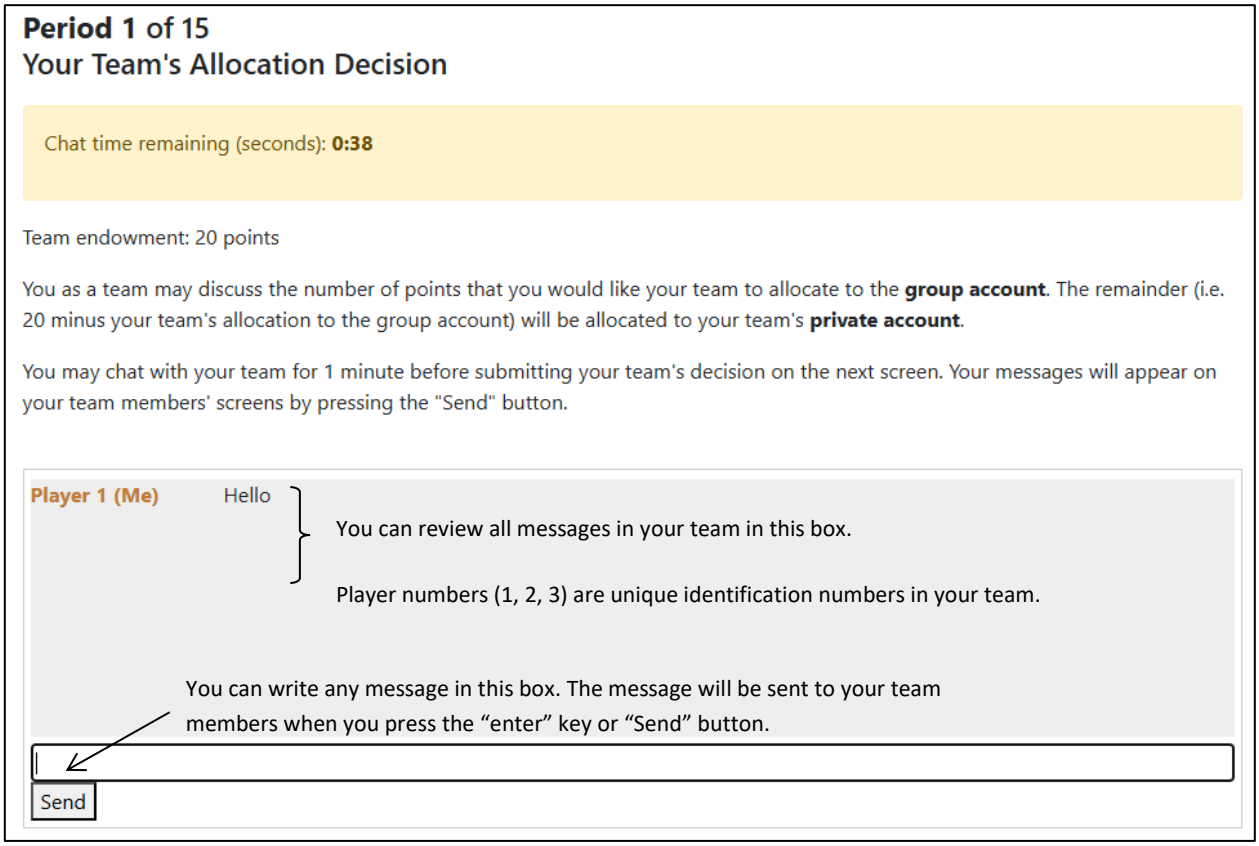
Once all four teams in your group make allocation decisions, you will be informed of the interaction outcomes (your team's earnings, along with each of the other three teams' allocation decisions anonymously and in a random order).

How to decide allocation amounts in your team:

At the beginning of each period, you and your two team members have 1 minute to communicate using the computer to **jointly decide the allocation amount** for the period. Specifically, you can send any messages via a chat window as illustrated below. You are not allowed to verbally

communicate with anyone during the entire experiment except via the computer screen with the two members.

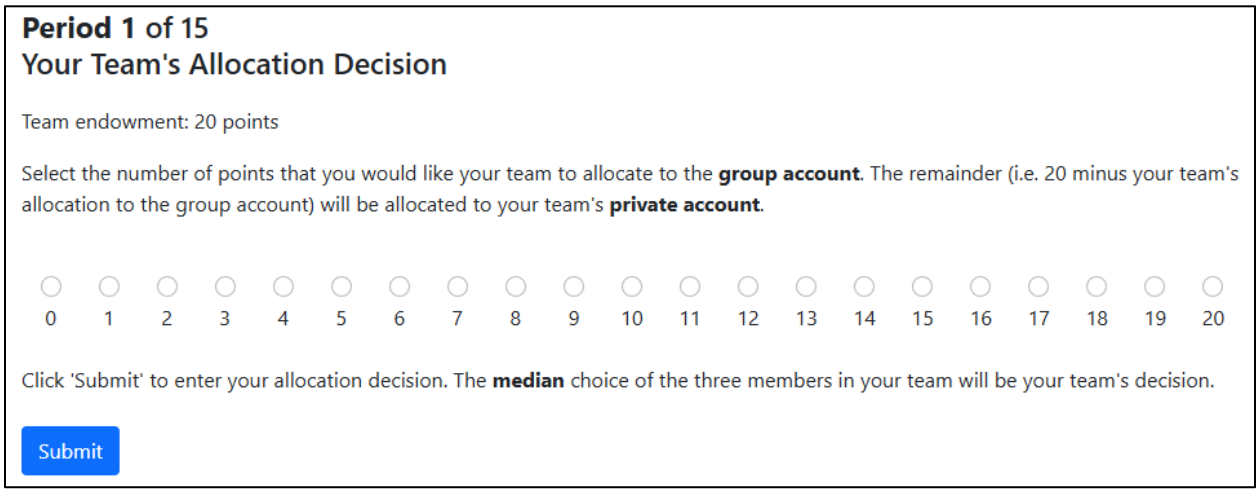
An example of the computer screen:



In the communication stage, any kind of offensive language is prohibited. Also, you are not allowed to convey any personal information nor information that can identify you including which seat you are sitting. With a clear violation of this rule, you will be deducted 10 pounds from your payment.

Once the communication stage is over, you and the other two members in your team each submit your agreed joint allocation decision on your computer screen (see the next page). If you do not agree what to allocate as a team, you can submit whatever amount you prefer to allocate as a team to the group account.

An example of the computer screen:



If all three members in your team submit the same (agreed) amount, then the amount becomes your team's joint allocation decision in this period. Otherwise, the median of the three submitted amounts will be used as your team's joint allocation decision. Once the three team members press the "Submit" button to submit your team's allocation decision, you will be informed of what allocation amount the other two members in your team submitted as well as of the outcome of the allocation stage in the period.

Summary:

You will interact with three other teams whose members' identities will not be made known to you either during or after the experiment, for a total of **fifteen** periods.

Each period, your team and each other team in your group will receive an endowment of 20 points and will decide on its **allocation** between a private and a group account. Once each team has made their allocation decision, each will see how much the others have allocated to the group account.

After fifteen repetitions of this process, the experiment will be over, and you will be asked to answer a few questions while the experimenters count out payments based on each person's accumulated earnings.

Please raise your hand now if you have any questions. Once all questions have been answered, we will move on to the comprehension questions which will become available for you to complete on-screen. The experiment will begin once everyone has answered all of the comprehension questions completely.

A.3. The Individual-Yes Treatment

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment you are not allowed to communicate with other participants. If you have questions, raise your hand. One of us will come to answer your question.

During the experiment your earnings will be calculated in points. At the end of the experiment your points will be converted to U.K. pounds at the following rate:

1 point = 3 pence

At the end of the experiment your total earnings (including the **£3** participation fee) will be paid out to you in cash. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

At the beginning of the experiment, you are randomly assigned to **a group of four** and interact with each other. You will be part of the same group throughout the entire experiment. You will not be told which other participants are in your group, nor will you be informed who was in which group after the experiment ends.

In this experiment, participants and their group members interact together for a total of **15 periods**. In each period you will be required to make multiple decisions. Please make your decision and click the submit/next button within 20 seconds. After 20 seconds have passed, a reminder will appear on the screen to remind you to submit your decision/click next (you must close the reminder before you can continue). Each period consists of three stages.

Stage 1: Allocation Decisions

In each period, you and your three group members are each given **an endowment of 20 points**. At the beginning of the period, you and the three others simultaneously decide how to use your endowments. There are two possibilities:

1. **You can allocate points to a group account.**
2. **You can allocate points to a private account.**

Specifically, you are asked how many points you want to allocate to the group account. Only integers between 0 and 20 are allowed for this purpose. The remaining points (i.e., 20 minus your allocation to the group account) will be automatically allocated to your private account. Your earnings in Stage 1 depend on **(a) the number of points in your private account** and **(b) the total amount allocated to the group account**.

How to calculate your earnings:

Your earnings in a given period are calculated as in the following formula:

(sum of points in your private account) + 0.4 × (sum of points allocated by you and your group members to the group account)

In other words, your earnings from your private account **are equal to the number of points you allocated to the private account** (20 minus your allocation to your group account). The points you allocate to your private account do not affect the earnings of your group members.

By contrast, your earnings from the group account equal the **sum** of points allocated to the group account by you and the other three members in your group multiplied **by 0.4**. In other words, if you allocate 1 point to the group account, your earnings from your allocation are $0.4 \times 1 = 0.4$ points, which is less than 1 point. However, by allocating 1 point to the group account, the earnings of each of your group members also increase by 0.4 points. Therefore, the total earnings in this example are 1.6 ($= 0.4 \times 4$) points, which is greater than 1 point. Note that you also obtain earnings of 0.4 points for each point your other group members allocate to the group account.

Once all group members make allocation decisions, you will be informed of the interaction outcomes (your earnings, along with each of the three other group members' allocation decisions anonymously and in a random order).

Another set of decisions will follow the allocation decisions in each period, so your earnings for the period are not yet final.

If you have any questions, please raise your hand. Once all questions are answered we will continue to explain Stage 2.

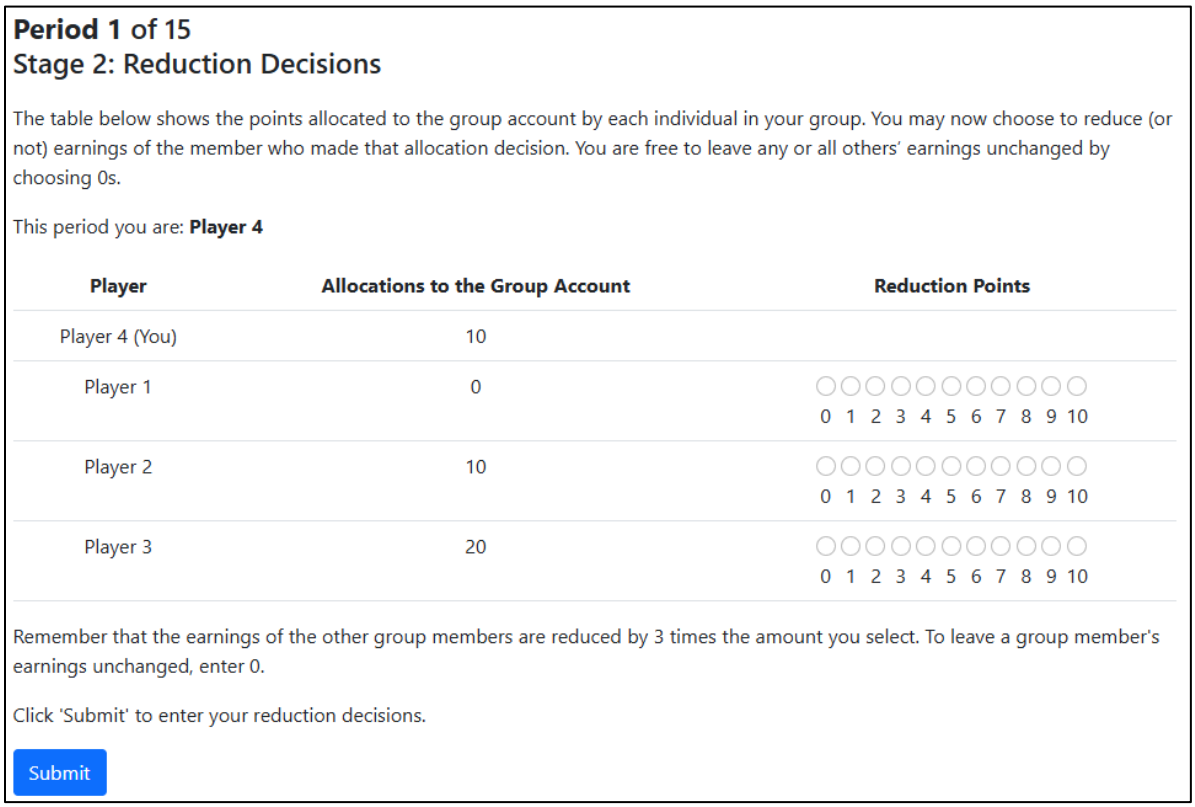
Stage 2: Reduction Decisions

At the end of the first stage of each period, you will be shown the amount allocated to the group account by each of your group members in a random order. Each member (yourself included)

will be identified as Player 1, Player 2, Player 3 or Player 4, although the label "You" rather than a player number will identify you on your own screen. These identification numbers are fixed for one period only and **then randomly changed**. This means that the group member identified to you as Player 2 in a certain period is equally likely to have any of the four player numbers in the next period.

In Stage 2, you have an opportunity to **reduce** the earnings of others in your group at a cost to your own earnings. You can assign reduction points to each of your group members. Specifically, in a column to the right of the allocation information (the column labelled "Reduction Points"), you will be asked to choose a number of points (if any) that you wish to use to reduce the earnings of the member who made that allocation decision. These points are called "reduction points." Each reduction point you allocate to reducing another's earnings **reduces your own earnings by 1 point** and **reduces that individual's earnings by 3 points**. Thus, the **cost ratio is 1:3**. Your own earnings can be reduced in the same way by the decisions of others in your group. You are free to leave any or all others' earnings unchanged by choosing 0s in the relevant decisions.

Screen Image of Stage 2 Reduction Decisions:



Note: Numbers shown are for illustration only.

Earnings reductions directed at you cannot bring your earnings for the period to less than zero. However, you always incur the cost of giving reductions to others even if it makes your period earnings negative. (If you lose points in a period, they are deducted from those you accumulate in other periods.) Thus, earnings in each period of this phase can be calculated as follows:

Part A: Earnings from the allocation stage **minus** reductions by others in your group {i.e., 3×(sum of reduction points directed at you by others in your group)}, or 0 if it is negative

minus

Part B: Points you use to reduce others' earnings

Note that you incur the cost in Part B even if it causes your net earnings for the period to be negative.

At the end of the reduction stage, you will learn by what amount others decided to reduce your earnings.

Example: Suppose that you are Player 1 in a period and you use, 0, 2, and 1 points to reduce the earnings of Player 2, Player 3, and Player 4, respectively. Suppose further that these three other members use, respectively, 1, 1, and 3 points to reduce your earnings. Then Player 3's earnings will be reduced by 6 points, and Player 4's earnings reduced by 3 points, in that period due to your reduction decisions. Your own earnings for the period will be reduced by 3 (= 2 + 1) points [i.e., your cost to impose reductions on the others], plus (1×3)+(1×3)+(3×3) =15 points [i.e., the reductions imposed on your earnings by others].

In addition to the fact that earnings from the allocation stage and reductions received cannot go below zero, the earnings reduction process is subject to two requirements. First, your reduction points must be an integer. Second, you cannot assign more than 10 reduction points to any one individual in your group.

Remember that if no reductions are imposed (everyone chooses 0s for reduction points), earnings after the reduction stage are the same as those before it.

Stage 3: Another Set of Reduction Decisions

There is a final stage in each period during which each individual has an additional opportunity to reduce others' earnings should they wish to. Specifically, you will be shown the amounts (if any) by which other group members reduced your earnings during Stage 2, and you will have an

opportunity in Stage 3 to **reduce the earnings of those individuals who reduced your own earnings**.

The reduction process in Stage 3 is the same as in Stage 2 in that you must choose an integer between 0 and 10 as reduction points to assign to each other member if such an opportunity arises. Each point you spend on reducing another member's earnings causes **that person's earnings for the period to decline by 3 points** (although they cannot take their earnings for that period below 0). As with Stage 2, your own earnings are always reduced **by the number of reduction points you assign to others**, even if this causes your earnings for the period to become negative. (Note that if no group member reduces your earnings in Stage 2 of a certain period, there is no one whose earnings you can reduce in Stage 3 of that period, so you will have no decision to make at that time.)

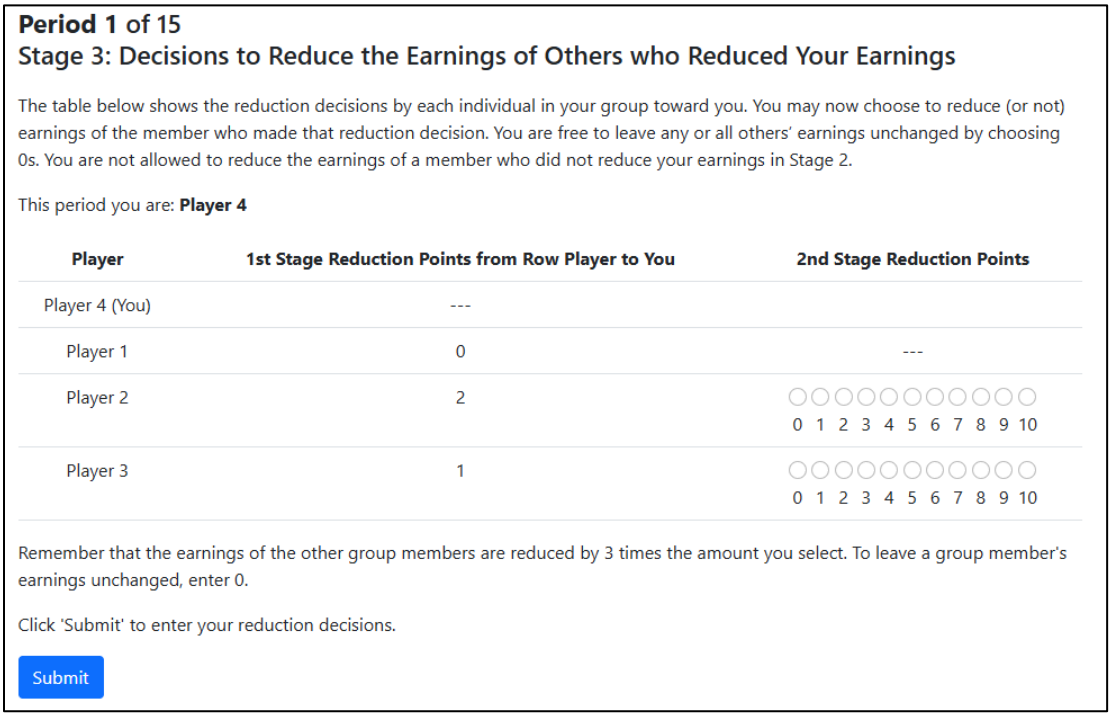
Your final earnings for the period as a whole are equal to:

(a) **your earnings from the allocation stage** minus **your total losses from reductions assigned to you by other group members in stages 2 and 3** (or zero if (a) is negative)

minus

(b) **the total number of points you spend to reduce others' earnings in stages 2 and 3**.

Screen Image of Stage 3 reduction decisions



Note: Numbers shown are for illustration only.

At the end of Stage 3, you'll see a summary of your earnings for the period and how they were calculated, which will include information on the total number of points (if any) that were deducted from your earnings due to points directed at you by others in Stage 3.

Summary:

You will interact with three other individuals whose identities will not be made known to you either during or after the experiment, for a total of **fifteen** periods.

Each period, you and each other member of your group will receive an endowment of 20 points and will decide on its **allocation** between a private and a group account.

Once each group member has made their allocation decisions, each will see how much each other has allocated to the group account and has an opportunity to **reduce their earnings at a cost of 1 point** to the assigner per 3 points lost by the recipient of the reduction.

Each period then has a third and final stage in which group members learn by how much (if at all) their earnings were reduced by each other group member and have a second opportunity to **reduce the earnings of those who had reduced their own earnings**, at the same cost of 1 point per 3 points lost.

Information regarding other group members will be presented in a random order using the identifications Player 1, 2, 3, or 4. These numbers are reshuffled each period, so that the information about a given group member is equally likely to be identified by any of the numbers this period, regardless of which number they were associated with during the previous period.

After fifteen repetitions of this process, the experiment will be over, and you will be asked to answer a few questions while the experimenters count out payments based on each person's accumulated earnings.

Please raise your hand now if you have any questions. Once all questions have been answered, we will move on to the comprehension questions which will become available for you to complete on-screen. The experiment will begin once everyone has answered all of the comprehension questions completely.

A.4. The Team-Yes Treatment

Instructions

You are now taking part in a decision-making experiment. Depending on your decisions and the decisions of other participants, you will be able to earn money in addition to the £3 guaranteed for your participation. Please read the following instructions carefully.

During the experiment you are not allowed to communicate with other participants. If you have questions, raise your hand. One of us will come to answer your question.

During the experiment your earnings will be calculated in points. At the end of the experiment your points will be converted to U.K. pounds at the following rate:

1 point = 3 pence

At the end of the experiment your total earnings (including the **£3** participation fee) will be paid out to you in cash. Your payment will be rounded to the nearest 10 pence (e.g., £12.30 if it is £12.33; and £12.40 if it is £12.37).

At the beginning of the experiment, you are randomly assigned to a **team with two other participants.** The team is the decision-making unit in the experiment. The team composition stays the same throughout the entire experiment. Your team is then randomly assigned to a **group with three other teams**, and interact with each other. This means that you are in a group with 11 other participants (two in the same team, and nine in the other teams). You will be part of the same group throughout the entire experiment. You will not be told which other participants are in your group, nor will you be informed who was in which team or group after the experiment ends.

In this experiment, participants interact together for a total of **15 periods**. In each period you will be required to make multiple decisions. Please make your decision and click the submit/next button within 20 seconds. After 20 seconds have passed, a reminder will appear on the screen to remind you to submit your decision/click next (you must close the reminder before you can continue). Each period consists of three stages.

Stage 1: Allocation Decisions

In each period, the four teams in your group are each given **an endowment of 20 points**, and simultaneously make allocation decisions based on the endowment. There are two possibilities:

1. **You, as a team, can allocate points to a group account.**
2. **You, as a team, can allocate points to a private account.**

Specifically, each team is asked how many points they want to allocate to the group account. Only integers between 0 and 20 are allowed for this purpose. The remaining points (i.e., 20 minus the allocation to the group account) will be automatically allocated to their private account. Your earnings in Stage 1 depend on **(a) the number of points in your team's private account** and **(b) the total amount allocated to the group account in your group**.

How to calculate your team's earnings in Stage 1:

Your team's earnings in this stage are calculated as in the following formula:

(sum of points in your team's private account) + 0.4 × (sum of points allocated by your team and the other three teams to the group account)

In other words, your team's earnings from the private account **are equal to the number of points your team allocated to the private account** (20 minus your team's allocation to the group account). The points your team allocates to the private account do not affect the earnings of the other three teams in your group.

By contrast, your team's earnings from the group account equal the **sum** of points allocated to the group account by your team and the other three teams in your group multiplied **by 0.4**. In other words, if your team allocates 1 point to the group account, your team's earnings from the allocation are $0.4 \times 1 = 0.4$ points, which is less than 1 point. However, by allocating 1 point to the group account, the earnings of each of the other three teams also increase by 0.4 points. Therefore, the total earnings in this example are 1.6 ($= 0.4 \times 4$) points, which is greater than 1 point. Note that your team also obtains earnings of 0.4 points for each point the other teams in your group allocate to the group account.

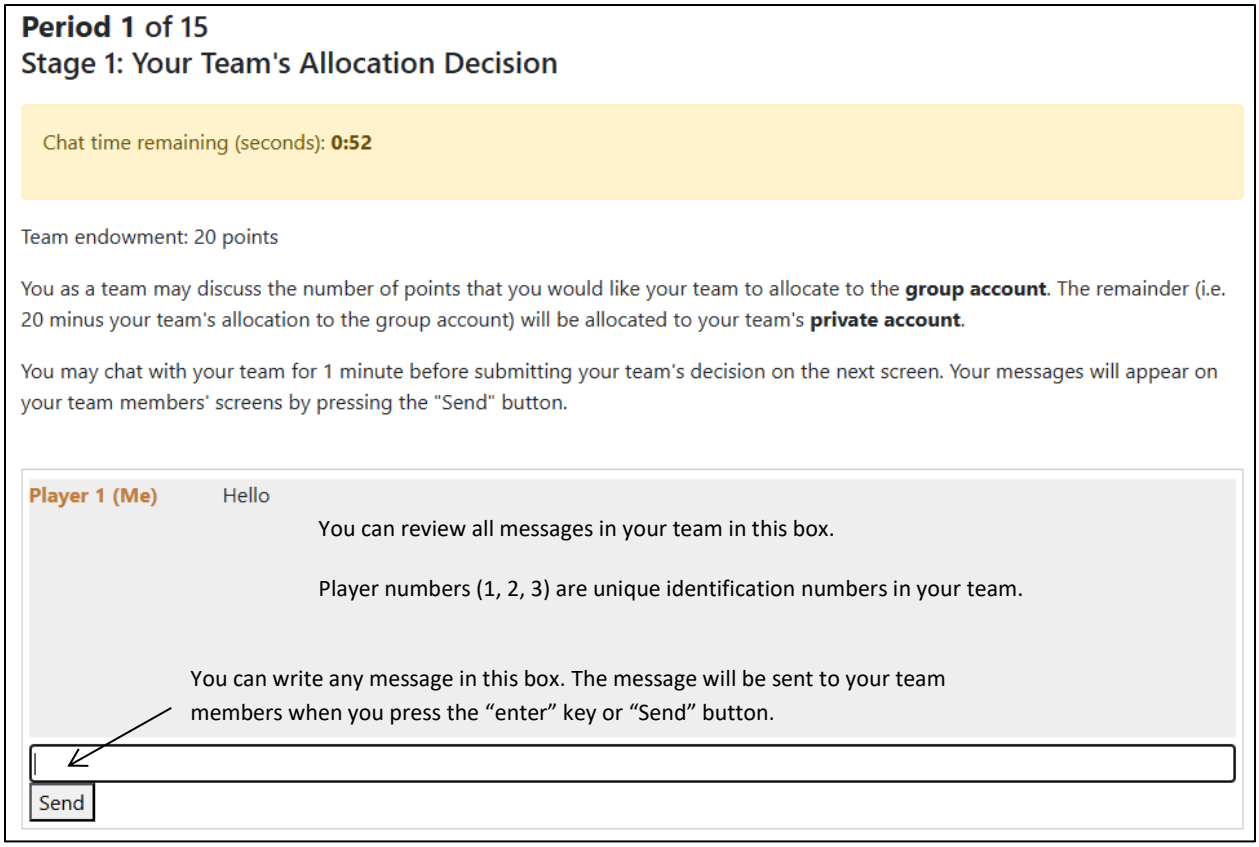
Once all four teams in your group make allocation decisions, you will be informed of the interaction outcomes (your team's earnings, along with each of the other three teams' allocation decisions anonymously and in a random order).

How to decide allocation amounts in your team:

At the beginning of each period, you and your two team members have 1 minute to communicate using the computer to **jointly decide the allocation amount** for the period. Specifically, you can send any messages via a chat window as illustrated below. You are not allowed to verbally

communicate with anyone during the entire experiment except via the computer screen with the two members.

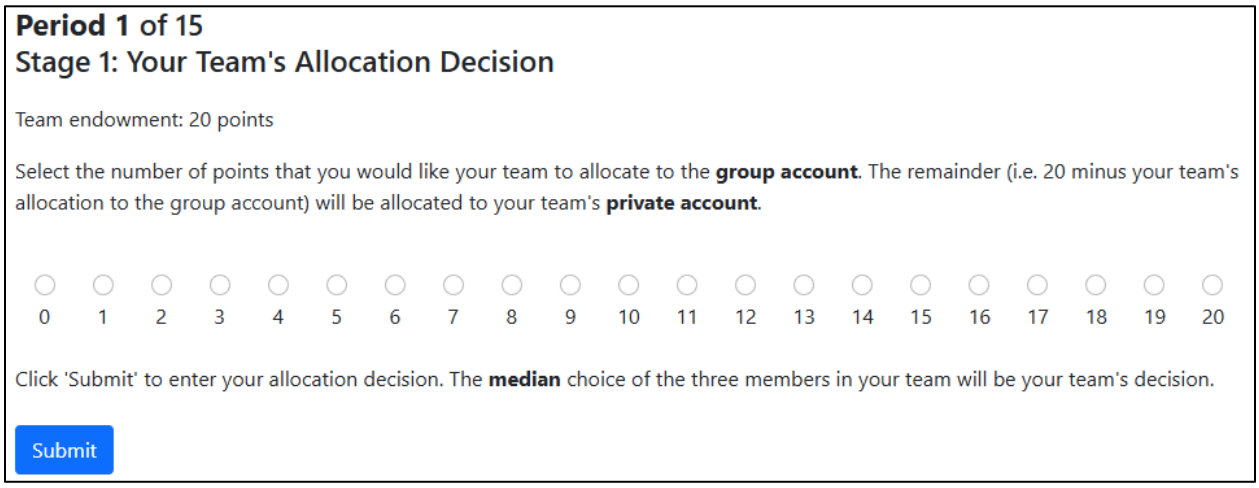
An example of the computer screen:



In the communication stage, any kind of offensive language is prohibited. Also, you are not allowed to convey any personal information nor information that can identify you including which seat you are sitting. With a clear violation of this rule, you will be deducted 10 pounds from your today’s payment.

Once the communication stage is over, you and the other two members in your team each submit your agreed joint allocation decision on your computer screen (see the next page). If you do not agree what to allocate as a team, you can submit whatever amount you prefer to allocate as a team to the group account.

An example of the computer screen:



If all three members in your team submit the same (agreed) amount, then the amount becomes your team's joint allocation decision in this period. Otherwise, the median of the three submitted amounts will be used as your team's joint allocation decision. Once the three team members press the "Submit" button to submit your team's allocation decision, you will be informed of what allocation amount the other two members in your team submitted as well as of the outcome of the allocation stage in the period.

Another set of team decisions will follow the allocation decisions in each period, so your earnings for the period are not yet final.

If you have any questions, please raise your hand. Once all questions are answered we will continue to explain Stage 2.

Stage 2: Reduction Decisions

At the end of the first stage of each period, your team will be shown the amount allocated to the group account by each of the other three teams in your group in a random order. Each team (your team included) will be identified as Team 1, Team 2, Team 3 or Team 4, although the label "Your Team" rather than a player number will identify your team on your own screen. These identification numbers are fixed for one period only and **then randomly changed**. This means that the team identified to you as Team 2 in a certain period is equally likely to have any of the four team numbers in the next period.

In Stage 2, your team has an opportunity to **reduce** the earnings of other teams in your group at a cost to your team's earnings. Your team can assign reduction points to each of the other three teams in your group. Each reduction point you allocate to reducing another's earnings **reduces**

your team's own earnings by 1 point and **reduces that team's earnings by 3 points**. Thus, the **cost ratio is 1:3**. Your team's own earnings can be reduced in the same way by the decisions of other teams in your group.

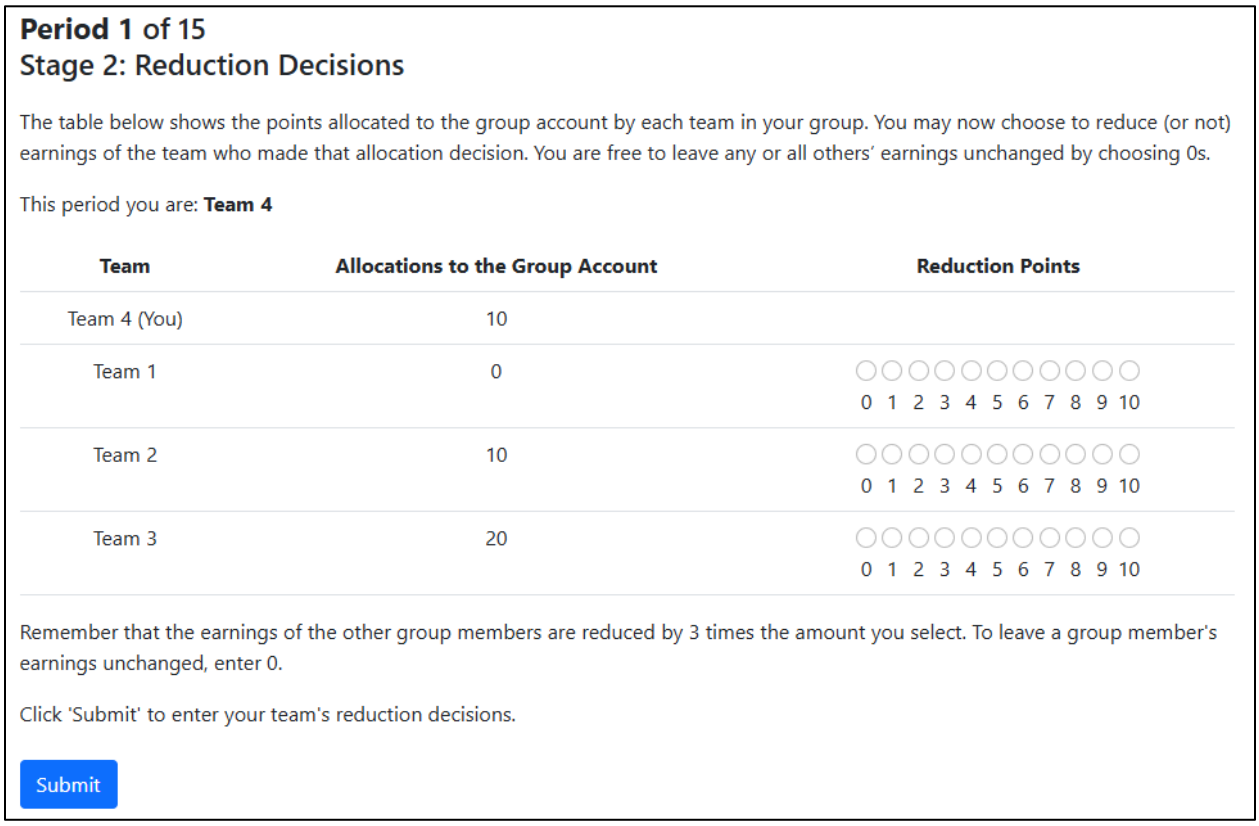
The way to jointly decide reduction points to another team is the same as the team decision-making of an allocation amount. You will be first given an opportunity to communicate with your two team members for 1 minute using an electronic chat window. During the communication stage, you will be shown the allocation decisions made by the three other teams in your group.

After the communication, you and the two members simultaneously submit your team's agreed reduction decisions. Specifically, in a column to the right of the allocation information (the column labelled "Reduction Points"), you will be asked to choose a number of points (if any) that your team wishes to use to reduce the earnings of the team who made that allocation decision. These points are called "reduction points." Your team is free to leave any or all other teams' earnings unchanged by choosing 0s in the relevant decisions.

Note that in case that you do not agree what to do as a team, you can submit whatever decision you prefer to make as a team. If all three team members submit the same (agreed) decision, then it becomes your team's reduction decision. Otherwise, the median of the three submissions will be used as your team's joint decision.

After submissions, each of you will be informed of (a) your team's joint reduction decision and (b) what the other two members in your team- submitted.

Screen Image of Stage 2 Reduction Decisions:



Period 1 of 15
Stage 2: Reduction Decisions

The table below shows the points allocated to the group account by each team in your group. You may now choose to reduce (or not) earnings of the team who made that allocation decision. You are free to leave any or all others' earnings unchanged by choosing 0s.

This period you are: **Team 4**

Team	Allocations to the Group Account	Reduction Points
Team 4 (You)	10	
Team 1	0	○○○○○○○○○○○ 0 1 2 3 4 5 6 7 8 9 10
Team 2	10	○○○○○○○○○○○ 0 1 2 3 4 5 6 7 8 9 10
Team 3	20	○○○○○○○○○○○ 0 1 2 3 4 5 6 7 8 9 10

Remember that the earnings of the other group members are reduced by 3 times the amount you select. To leave a group member's earnings unchanged, enter 0.

Click 'Submit' to enter your team's reduction decisions.

Submit

Note: Numbers shown are for illustration only.

Earnings reductions directed at your team cannot bring your team's earnings for the period to less than zero. However, your team always incurs the cost of giving reductions to other teams even if it makes your team's period earnings negative. (If your team loses points in a period, they are deducted from those your team accumulates in other periods.) Thus, earnings in each period of this phase can be calculated as follows:

Part A: Earnings from the allocation stage **minus** reductions by other teams in your group {i.e., 3×(sum of reduction points directed at your team by other teams in your group)}, or 0 if it is negative

minus

Part B: Points your team uses to reduce other teams' earnings

Note that your team incurs the cost in Part B even if it causes your team's net earnings for the period to be negative.

At the end of the reduction stage, your team will learn by what amount other teams decided to reduce your team's earnings.

Example: Suppose that you are in Team 1 in a period and your team uses, 0, 2, and 1 points to reduce the earnings of Team 2, Team 3, and Team 4, respectively. Suppose further that these three other teams use, respectively, 1, 1, and 3 points to reduce your team's earnings. Then Team 3's earnings will be reduced by 6 points, and Team 4's earnings reduced by 3 points, in that period due to your team's reduction decisions. Your team's earnings for the period will be reduced by 3 (= 2 + 1) points [i.e., your team's cost to impose reductions on the others], plus (1×3)+(1×3)+(3×3) =15 points [i.e., the reductions imposed on your earnings by other teams].

In addition to the fact that earnings from the allocation stage and reductions received cannot go below zero, the earnings reduction process is subject to two requirements. First, your team's reduction points must be an integer. Second, you team cannot assign more than 10 reduction points to any one team in your group.

Remember that if no reductions are imposed (every team chooses 0s for reduction points), earnings after the reduction stage are the same as those before it.

Stage 3: Another Set of Reduction Decisions

There is a final stage in each period during which each team has an additional opportunity to reduce other teams' earnings should they wish to. Specifically, you will be shown the amounts (if any) by which other teams reduced your team's earnings during Stage 2, and your team will have an opportunity in Stage 3 to **reduce the earnings of those teams who reduced your team's own earnings in Stage 2**.

The reduction process in Stage 3 is the same as in Stage 2 in that your team must choose an integer between 0 and 10 as reduction points to each team if such an opportunity arises. Each point your team spends on reducing another team's earnings causes **that team's earnings for the period to decline by 3 points** (although they cannot take their earnings for that period below 0). As with Stage 2, your team's earnings are always reduced **by the number of reduction points your team assigns to other teams**, even if this causes your team's earnings for the period to become negative. (Note that if no team reduces your team's earnings in Stage 2 of a certain period, there is no one whose earnings your team can reduce in Stage 3 of that period, so your team will have no decision to make at that time.)

Your team's final earnings for the period as a whole are equal to:

(a) **your team's earnings from the allocation stage** minus **your team's total losses from reductions assigned to your team by other teams in stages 2 and 3** (or zero if that result from (a) is negative)

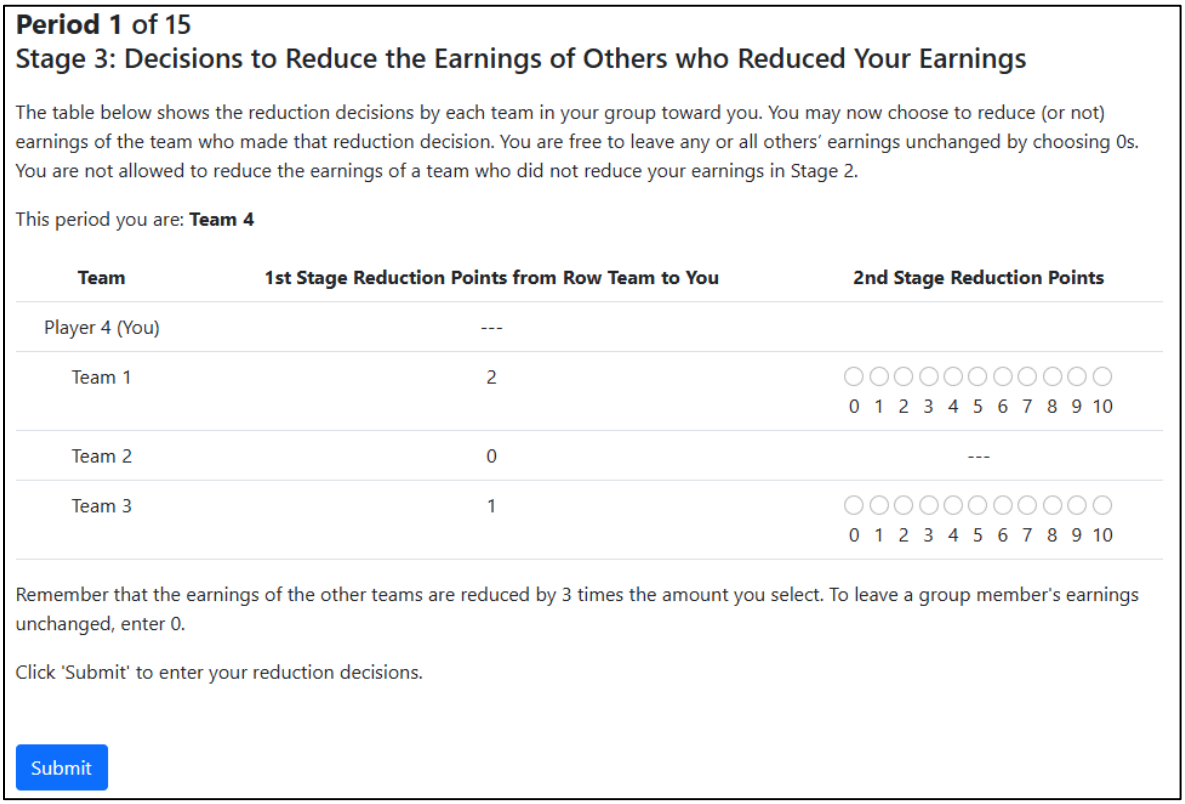
minus

(b) **the total number of points your team spends to reduce other teams' earnings in stages 2 and 3**.

The way to jointly decide reduction points to another team in Stage 3 is the same as that in Stage 2. You will be first given an opportunity to communicate with your two team members for 1 minute using an electronic chat window. During the communication stage, you will be informed of the reduction decisions made by the three other teams to your team.

After the communication, you and the two members simultaneously submit your team's agreed reduction decisions. Specifically, in a column to the right of the allocation information (the column labelled "Reduction Points"), you will be asked to choose a number of points (if any) that your team wishes to use to reduce the earnings of the member who made that allocation decision. This point is called "reduction points." Your team are free to leave any or all other teams' earnings unchanged by choosing 0s in the relevant decisions.

Screen Image of Stage 3 reduction decisions:



Note: Numbers shown are for illustration only.

Note that in case that you do not agree what to do as a team, you can submit whatever decision you prefer to make as a team. If all three team members submit the same (agreed) decision, then it becomes your team's reduction decision. Otherwise, the median of the three submissions will be used as your team's joint decision.

At the end of Stage 3, you'll see a summary of your team's earnings for the period and how they were calculated, which will include information on the total number of points (if any) that were deducted from your team's earnings due to points directed at your team by other teams in Stage 3.

Summary:

Your team will interact with three other teams whose identities will not be made known to you either during or after the experiment, for a total of **fifteen** periods.

Each period, your team and each of the other three teams in your group will receive an endowment of 20 points and will decide on its **allocation** between a private and a group account.

Once each team has made their allocation decision, each will see how much each other has allocated to the group account and has an opportunity to **reduce their earnings at a cost of 1 point** to the assigner per 3 points lost by the recipient team of the reduction.

Each period then has a third and final stage in which teams learn by how much (if at all) their earnings were reduced by each other team and each has a second opportunity to **reduce back the earnings of the teams that had reduced their own earnings**, at the same cost of 1 point per 3 points lost.

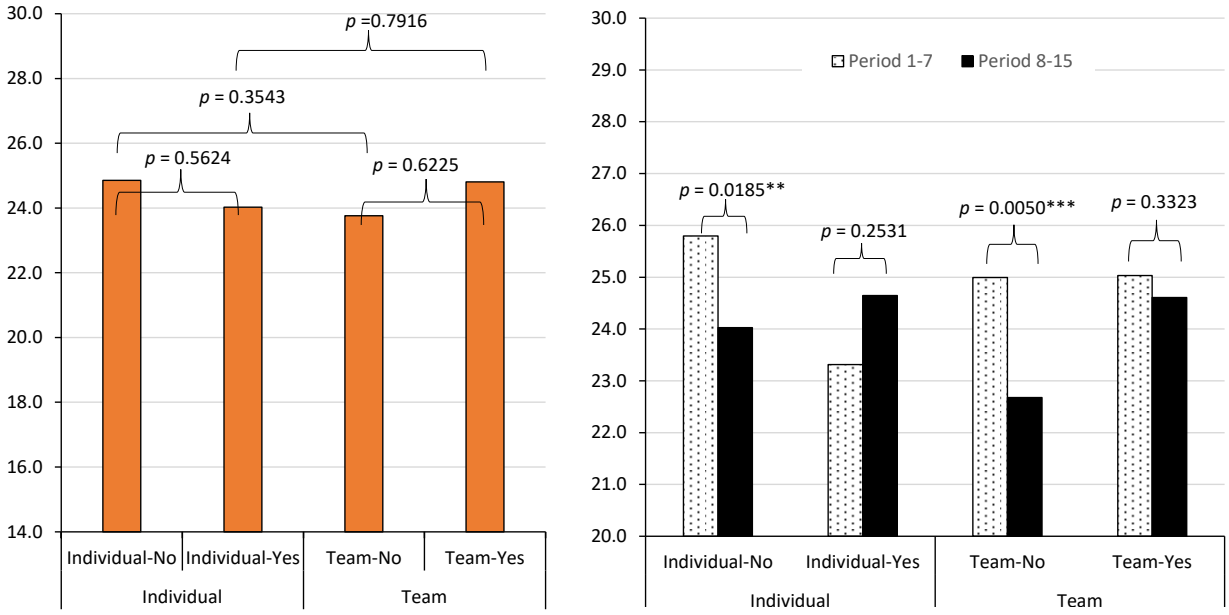
Information regarding other teams will be presented in a random order using the identifications Team 1, 2, 3 or 4. These numbers are reshuffled each period, so that the information about a given team is equally likely to be identified by any of the numbers this period, regardless of which number it was associated with during the previous period.

After fifteen repetitions of this process, the experiment will be over, and you will be asked to answer a few questions while the experimenters count out payments based on each person's accumulated earnings.

Please raise your hand now if you have any questions. Once all questions have been answered, we will move on to the comprehension questions which will become available for you to complete on-screen. The experiment will begin once everyone has answered all of the comprehension questions completely.

Appendix B: Additional Figures

Figure B.1: *Average Payoffs by Treatment*



(A) Average for all periods (B) Average for the 1st and 2nd half

Notes: The *p*-values in panels (a) and (b) are the results from two-sided group-level Mann-Whitney tests and Wilcoxon signed-rank tests, respectively.

Appendix C: Coding Procedure and Analysis Results

C.1. Coding Procedure

Two coders were hired to code (summarized in Section C.2) the communication content for every decision made by each team, period by period. Each coder read the content of a dialogue segment (e.g. all communication by team members within a given team during the 1-minute chat phase before submitting a decision) and assigned any code(s) they deemed applicable, starting from the early periods and working in ascending order.

Both coders worked on the treatment without punishment (known to them as Treatment A) first, followed by the treatment with punishment (Treatment B), however, the order of the groups within those treatments was randomized. Further, each coder completed a sample set before the remainder of the dialogue segments were coded to become familiar with the codes and as an opportunity to raise questions to the researchers. Given this, each coder received four Communications files, two per treatment, and five Code Entry Sheets, two per treatment, in addition to a reconsideration Code Entry Sheet. The files contained the data for ten groups in Treatment A and 10 groups in Treatment B, for a total of 20 groups, resulting in 2,208 dialogue segments.

The Communication files were organized by team, group, and round for each session. Reading from top to bottom, each file contained the respective information for teams 1 to 4 of Group 1 in each stage of Period 1, then for the same teams in Period 2, and so on. Each dialogue segment was assigned a number so that the Excel files could be filtered to view one segment at a time. Coding took place in the order specified in the Code Entry Sheet; all communication for each team in stage 1 (allocation stage), followed by all communication for each team in stage 2 (punishment) and all communication for each team in stage 3 (counter-punishment), where applicable.

Code Entry Sheets contained rows for each code relevant to a given treatment, and columns with the corresponding numbers for each dialogue segment, allowing the coders to enter a '1' where they felt a code was appropriate. The reconsideration Code Entry Sheet contained all highlighted differences between one coder's coding and the others, to allow them the opportunity to reconsider their codes.

Coding was conducted as in the three blocks described below across approximately three months. The coders were not made aware of each other's identities at any point throughout the process (hence, they were not able to communicate with each other).

<u>First block (approximately 2.5 weeks):</u>

The coder guidelines, list of codes, and experiment instructions for the treatment without punishment (Team-No) were provided in advance of the first meeting to allow the coders to read

them in their own time and prepare any questions. On the first day, a meeting was scheduled by the researchers with each of the coders to explain the coding process and the first treatment as well as to demonstrate the use of the files. The coders were not made aware of the purpose of the research, other treatments, or any of the data analysis/results throughout the coding process, to avoid any experimental demand effects.

To reduce the likelihood of problems and to give the coders feedback, the data from one group in the Team-No treatment was provided as a sample to code before moving on to the remaining sessions. The sample Communication File and Code Entry Sheet were provided after the first meeting and the coders were given three days to complete the set. Once the sample set had been coded, a researcher met with each of the coders independently to discuss any problems or difficulties they had before providing the remainder Communication File and Code Entry Sheet. The coders were given a further 12 days to code the remainder set.

Second block (approximately 3 weeks):

At the onset of the second block, the coders were given the list of codes and instructions for the treatment with punishment (Team-Yes) and had a meeting with the researchers regarding the coding and the treatment to clarify questions. Immediately after that, coders were given the sample Communication File and Code Entry Sheet. The rest of the procedure is the same for the coding practice of the Team-No treatment. Each coder was given four days to code the sample set, after which the coder had a meeting with one of the researchers. Once any questions had been answered, the remainder Communication File and Code Entry Sheet were sent to be completed in the following 13 days. Again, feedback was not given to the coders for their coding practice.

Third block (approximately 1 week):

The coding results were compared for discrepancies by the researchers. The discrepancies were then highlighted in the Reconsideration Code Entry Sheet and a copy given to each coder. The coders were asked to re-evaluate these discrepancies, with the additional knowledge of the other coder's codes, and either confirm or alter their initial findings. Each coder was also informed that their codes would be sent to the other coder for the same process. The coders neither communicated nor become aware of each other's identity, at any stage. This re-consideration process was used in van Elten and Penczynski (2020)#1, confirming its effectiveness.

Note: #1 van Elten, Jonas, and Stefan Penczynski, 2020. "Coordination games with asymmetric payoffs: An experimental study with intra-group communication." *Journal of Economic Behavior & Organization* 169, pp. 158-188.

C.2. List of Codes

(a) Communication Codes – the Team-No treatment

Stage:	**Allocation**
Code	**Description**
A1	Suggests a high/higher or full contribution regardless of others' behaviour (does not mention reason/strategy)
A2	Suggests a low/lower or 0 contribution regardless of others' behaviour (does not mention reason/strategy)
A3	Suggests a contribution of 10/a middle contribution regardless of others' behaviour (does not mention reason/strategy)
A4	Recognises that their own team earns more by contributing a smaller amount (e.g., less than others)
A5	Suggests a high, stable, or increasing contribution to encourage cooperation or discourage non-cooperation
A6	Suggests contributing more/less based on the contributions of other teams in previous periods
A7	Suggests a low/lower or 0 contribution out of distrust of the other teams
A8	Discusses strategy from the point of view of other teams e.g. what they expect other teams to do
A9	Recognises that everyone earns more if they mutually contribute more to the group account
A10	Discuss the level of contribution across the group in the previous period/s (individually or as an average/trend)
A11	Suggests the same strategy as in the previous period (does not mention reason/strategy)
A12	Suggests a higher or lower contribution based on which strategy led to higher earnings in a previous period
D1	Compares the experiment to a real-world scenario or decision
D2	Discuss applying strategies that they use in the real world e.g. being cooperative
D3	Error or confusion (shows that they do not understand the experiment, incentives, or fail a condition e.g. anonymity)
D4	No communication or only communication about unrelated topics
D5	Expresses positive emotion or positivity in relation to an outcome or decision e.g. that was good
D6	Expresses negative emotion or negativity in relation to an outcome or decision e.g. that was bad
D7	Discussing changing behaviour (any decision) in a future period
D8	A team member tries to/claims to have mathematically worked out the optimal solution
Stage	**Allocation (Team Behavior)**
E1	Team members disagree during the dialogue segment and it is unresolved
E2	Team members disagree during the dialogue segment and it is resolved
E3	Team members agree throughout the entire dialogue segment
E4	A team member asks other members about their opinion on a decision/strategy e.g. 'what do you think?'
E5	A team member is positive about the team dynamics or another team member
E6	A team member is negative about the team dynamics or another team member
E7	A team discusses the/a decision-making rule e.g. voting, majority rule, being outnumbered
E8	A participant discusses knowledge of economic theory/evidence of studying economics relating to the experiment

(b) Communication Codes – the Team-Yes treatment

Stage:	**Allocation**
Code	**Description**
A1	Suggests a high/higher or full contribution regardless of others' behaviour (does not mention reason/strategy)
A2	Suggests a low/lower or 0 contribution regardless of others' behaviour (does not mention reason/strategy)
A3	Suggests a contribution of 10/a middle contribution regardless of others' behaviour (does not mention reason/strategy)
A4	Recognises that their own team earns more by contributing a smaller amount (e.g., less than others)
A5	Suggests a high, stable, or increasing contribution to encourage cooperation or discourage non-cooperation
A6	Suggests contributing more/less based on the contributions of other teams in previous periods
A7	Suggests a low/lower or 0 contribution out of distrust of the other teams
A8	Discusses strategy from the point of view of other teams e.g. what they expect other teams to do
A9	Recognises that everyone earns more if they mutually contribute more to the group account
A10	Discuss the level of contribution across the group in the previous period/s (individually or as an average/trend)
A11	Suggests the same strategy as in the previous period (does not mention reason/strategy)
A12	Suggests a higher or lower contribution based on which strategy led to higher earnings in a previous period
A13	Suggests a high/higher or full contribution after experiencing punishment in a previous period
A14	Suggests a high/higher or full contribution to avoid anticipated/future punishment
A15	Suggests a low/lower or 0 contribution after experiencing punishment in a previous period
A16	Suggests a low/lower or 0 contribution based on the low/lack of use of punishment towards them or others in a previous round
A17	Express fear of being punished (unrelated to their contribution)
Stage	**Reduction**
B1	Suggests punishment towards a team for contributing less than the group average
B2	Suggests punishment towards a team for contributing less than their own team
B3	Suggests punishment towards a team for contributing more than the group average
B4	Suggests punishment towards a team for contributing more than their own team
B5	A suggestion for punishment is motivated by emotion e.g. anger towards an outcome, enjoyment of punishment
B6	Suggests punishment towards a team for redistributive reasons e.g. to reduce their reward relative to others
B7	Suggests punishment but do not give a reason
B8	Suggest that they should not punish due to the cost
B9	Suggest that they should not punish due to fear of retaliation
B10	Suggest that they should not punish for ideological reasons e.g. see it as unfair, disagree with punishment
B11	Suggest that they should not punish but do not give a reason
B12	Suggest that they should not punish as it isn't needed e.g. happy/content with the level of contributions
B13	Discuss the level of punishment across the group in the previous period/s (individually or as an average/trend)
B14	Suggests the same strategy as in the previous period (does not mention reason/strategy)
B15	Discuss the consequences of their punishment decisions in a previous period
B16	Discuss the ability to counter-punish in the next stage if they are punished

Communication Codes – Team-Yes - Continued

Stage:	**Counter**
Code	**Description**
C1	Suggests counter-punishment towards a team that punished them for an emotive reason
C2	Suggests counter-punishment towards a team that punished them to prevent punishment in future periods
C3	Suggests counter-punishment towards a team but do not give a reason
C4	Suggests counter-punishment because counter-punishment in previous periods is believed to have reduced first-stage punishment
C5	Suggests that they should not counter-punish due to the cost
C6	Suggest that they should not punish due to fear of retaliation in future periods
C7	Suggest that they should not punish for ideological reasons e.g. see it as unfair, disagree with punishment
C8	Suggest that they should not punish as it isn't needed e.g. happy/content with the level of punishment
C9	Discuss the level of counter-punishment across the group in previous period/s (individually or as an average/trend)
C10	Suggests the same strategy as in the previous period (does not mention reason/strategy)
Stage:	**All**
D1	Compares the experiment to a real-world scenario or decision
D2	Discuss applying strategies that they use in the real world e.g. being cooperative
D3	Error or confusion (shows that they do not understand the experiment, incentives, or fail a condition e.g. anonymity)
D4	No communication or only communication about unrelated topics
D5	Expresses positive emotion or positivity in relation to an outcome or decision e.g. that was good
D6	Expresses negative emotion or negativity in relation to an outcome or decision e.g. that was bad
D7	Discussing changing behaviour (any decision) in a future period
D8	A team member tries to/claims to have mathematically worked out the optimal solution
D9	No available action e.g. unable to punish or counter-punish
Stage:	**All (Team Behavior)**
E1	Team members disagree during the dialogue segment and it is unresolved
E2	Team members disagree during the dialogue segment and it is resolved
E3	Team members agree throughout the entire dialogue segment
E4	A team member asks other members about their opinion on a decision/strategy e.g. 'what do you think?'
E5	A team member is positive about the team dynamics or another team member
E6	A team member is negative about the team dynamics or another team member
E7	A team discusses the/a decision-making rule e.g. voting, majority rule, being outnumbered
E8	A participant discusses knowledge of economic theory/evidence of studying economics relating to the experiment

C.3. Agreement Rates between Coders

The followings show the agreement rates and the Kappa-values between coders before and after the reconsideration step.

C.3.1. Team-No Treatment

[Agreement Rate by Code:]

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
Before reconsideration	92.5%	86.8%	91.2%	88.7%	80.5%	75.8%	76.3%	67.7%	81.7%	61.7%	82.5%	85.7%
After reconsideration	98.0%	95.2%	96.5%	96.2%	90.0%	90.0%	86.2%	89.3%	93.5%	73.0%	93.3%	90.8%

	D1	D2	D3	D4	D5	D6	D7	D8
Before reconsideration	93.5%	94.2%	96.3%	99.5%	91.7%	85.7%	81.8%	92.5%
After reconsideration	94.2%	95.2%	96.7%	99.5%	94.2%	89.5%	93.7%	94.3%

	E1	E2	E3	E4	E5	E6	E7	E8
Before reconsideration	87.0%	74.5%	57.7%	79.5%	92.2%	98.3%	99.0%	99.8%
After reconsideration	91.2%	79.2%	65.5%	97.8%	93.5%	98.5%	99.8%	99.8%

[Kappa value by Code:]

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
Before reconsideration	0.23	0.30	0.28	0.35	0.34	0.06	0.35	0.33	0.19	0.05	0.28	0.24
After reconsideration	0.72	0.74	0.75	0.75	0.63	0.67	0.63	0.79	0.53	0.21	0.57	0.49

	D1	D2	D3	D4	D5	D6	D7	D8
Before reconsideration	0.12	0.16	0.14	0.40	0.50	0.62	0.33	0.23
After reconsideration	0.27	0.31	0.16	0.40	0.65	0.72	0.80	0.46

	E1	E2	E3	E4	E5	E6	E7	E8
Before reconsideration	0.51	0.28	0.16	0.13	0.31	0.44	0.00	0.80
After reconsideration	0.68	0.40	0.30	0.94	0.48	0.52	0.00	0.80

C.3.2. Team-Yes Treatment

[Agreement Rate by Code:]

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Before reconsideration	89.6%	86.4%	86.8%	94.6%	87.9%	92.0%	92.2%	76.5%	95.0%	92.2%
After reconsideration	96.5%	93.8%	93.1%	96.8%	93.3%	97.2%	96.5%	97.0%	96.8%	93.7%

A11	A12	A13	A14	A15	A16	A17
90.1%	95.1%	97.9%	90.7%	98.3%	96.1%	97.4%
92.5%	96.3%	98.7%	93.1%	99.1%	97.8%	97.8%

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Before reconsideration	94.0%	99.3%	99.6%	100.0%	93.7%	96.1%	93.8%	90.7%	90.9%	95.0%
After reconsideration	95.3%	99.6%	99.8%	100.0%	98.1%	98.5%	97.2%	95.1%	97.6%	98.5%

B11	B12	B13	B14	B15	B16
78.9%	88.8%	93.5%	95.3%	95.3%	96.3%
92.0%	96.6%	95.1%	96.5%	97.9%	98.5%

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10

Before reconsideration	97.4%	98.3%	97.0%	99.6%	97.9%	96.5%	96.5%	91.6%	93.8%	89.0%
After reconsideration	97.4%	98.3%	97.0%	99.6%	97.9%	96.5%	96.5%	91.6%	93.8%	89.0%

	D1	D2	D3	D4	D5	D6	D7	D8	D9
Before reconsideration	88.6%	84.0%	97.2%	96.6%	88.4%	91.6%	83.0%	97.0%	95.1%
After reconsideration	88.6%	98.5%	97.3%	97.2%	94.2%	94.3%	94.2%	97.3%	95.7%

	E1	E2	E3	E4	E5	E6	E7	E8
Before reconsideration	89.2%	91.1%	53.2%	69.5%	91.9%	99.1%	99.3%	99.5%
After reconsideration	92.7%	95.0%	62.9%	99.3%	91.9%	99.1%	99.3%	99.8%

[Kappa value by Code:]

	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Before reconsideration	0.63	0.54	0.57	0.46	0.30	0.25	0.02	0.23	0.48	0.02
After reconsideration	0.87	0.78	0.77	0.67	0.64	0.80	0.69	0.93	0.68	0.33

A11	A12	A13	A14	A15	A16	A17
0.37	0.41	-0.01	0.29	0.17	0.30	-0.01
0.55	0.56	0.46	0.46	0.61	0.66	0.25

	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Before reconsideration	0.33	0.00	0.00	N/A	0.16	0.31	0.43	0.43	0.40	0.25
After reconsideration	0.49	0.00	0.67	N/A	0.83	0.81	0.73	0.73	0.88	0.84

B11	B12	B13	B14	B15	B16
0.52	0.30	0.08	0.06	-0.02	0.43
0.81	0.83	0.42	0.37	0.71	0.83

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Before reconsideration	0.60	0.00	0.37	0.00	0.55	0.09	-0.01	0.05	0.08	0.22
After reconsideration	0.60	0.00	0.37	0.00	0.55	0.09	-0.01	0.05	0.08	0.22

	D1	D2	D3	D4	D5	D6	D7	D8	D9
Before reconsideration	0.06	0.11	0.14	0.81	0.51	0.43	0.50	0.51	0.24
After reconsideration	0.07	0.95	0.17	0.85	0.79	0.66	0.85	0.57	0.35

	E1	E2	E3	E4	E5	E6	E7	E8
Before reconsideration	0.41	0.36	0.10	0.08	0.33	0.11	0.00	0.66
After reconsideration	0.65	0.68	0.28	0.98	0.33	0.11	0.00	0.86

C.4. Regression Results

The followings tables include regression results when using each code dummy as independent variables. Not only GLS but also Tobit regressions were performed since non-negligible number of observations are censored. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Dependent Variable: Contribution to the Group Account in Period *t*

	Random effects GLS regressions with standard errors clustered by group						Random effects Tobit regressions					
	(1) Team-No		(2) Team-Yes		(3) All data		(1) Team-No		(2) Team-Yes		(3) All data	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
A1 dummy	8.13***	2.33	4.38***	0.92	5.17***	1.00	11.03***	1.87	6.29***	0.95	7.63***	0.90
A2 dummy	-3.39***	0.79	-3.49***	0.73	-3.46***	0.58	-6.21***	1.37	-3.82***	0.78	-4.92***	0.72
A3 dummy	2.81***	0.70	0.67	0.92	1.41**	0.70	3.82***	1.27	1.22*	0.73	2.06***	0.67
A4 dummy	-1.37*	0.76	-0.46	1.19	-1.30*	0.67	-1.59	1.23	0.29	1.32	-1.25	0.90
A5 dummy	3.02***	0.52	2.24***	0.70	2.62***	0.44	4.18***	0.94	3.02***	1.03	3.67***	0.69
A6 dummy	0.30	0.93	0.25	0.76	0.25	0.64	0.22	0.93	0.81	1.03	0.42	0.67
A7 dummy	-4.41***	0.98	-4.11***	0.82	-4.51***	0.83	-8.06***	0.96	-4.76***	1.25	-7.19***	0.72
A8 dummy	0.49	0.61	0.56	0.37	0.33	0.37	0.97	0.65	0.89	0.62	0.87*	0.45
A9 dummy	3.36***	1.16	3.79***	1.00	3.31***	0.77	5.39***	1.50	6.54***	1.47	5.73***	1.06
A11 dummy	1.60	1.11	1.42	1.00	1.19*	0.61	2.18	1.39	2.22*	1.13	1.91**	0.91
A12 dummy	1.53*	0.87	1.12	0.80	1.26**	0.59	1.89	1.31	1.59	1.43	1.55	0.96
A13 dummy	---	---	2.04	2.63	---	---	---	---	7.01*	3.88	---	---
A14 dummy	---	---	0.28	0.92	---	---	---	---	1.22	1.32	---	---
A15 dummy	---	---	-0.98	2.02	---	---	---	---	0.00	2.58	---	---
A16 dummy	---	---	-1.37**	0.62	---	---	---	---	-0.88	1.62	---	---
D2 dummy	---	---	-0.06	0.52	---	---	---	---	-0.34	0.78	---	---
D4 dummy	---	---	2.24**	0.93	---	---	---	---	3.07	1.97	---	---
D5 dummy	0.54	0.69	0.64*	0.34	0.38	0.35	0.34	1.26	0.96	0.96	0.41	0.80
D6 dummy	-0.46	0.63	0.36	0.60	-0.70	0.51	-0.73	0.83	1.15	1.40	-0.84	0.67
D7 dummy	-0.15	0.63	-0.17	0.46	-0.28	0.38	-0.28	0.81	-0.32	0.60	-0.44	0.50
D8 dummy	0.92	1.13	1.31**	0.61	1.15*	0.65	1.00	1.87	2.01	1.48	1.61	1.20
E1 dummy	0.55	0.58	-1.32	0.83	-0.29	0.49	1.13	0.97	-1.80*	0.93	-0.13	0.67
E2 dummy	1.58	1.01	-0.12	0.78	0.69	0.64	2.94***	0.94	-0.13	0.82	1.37**	0.63
E4 dummy	0.90***	0.34	0.10	0.34	0.49**	0.24	1.35*	0.75	0.30	0.54	0.83*	0.46
E5 dummy	-2.05**	1.04	---	---	---	---	-3.03*	1.76	---	---	---	---
E6 dummy	-0.06	0.73	---	---	---	---	1.52	3.90	---	---	---	---
E8 dummy	0.05	0.69	-2.32***	0.87	-2.55***	0.93	-30.56	658.17	-5.28**	658.17	-6.96***	2.45
Gender	-1.14	2.13	-0.74	2.90	-1.48	1.73	-0.83	2.35	-0.83	-0.83	-2.56	2.74
Degree	-2.57*	1.44	-5.99**	2.84	-4.29**	1.67	-3.44	2.47	-3.44*	-3.44	-6.27**	2.82
British	1.62	2.04	-4.13*	2.17	-1.45	1.79	0.79	2.64	0.79	0.79	-2.83	2.75
Constant	7.20*	4.02	14.91**	7.56	12.22**	4.73	5.80	4.51	5.80**	5.80	14.84***	5.27
# of obs.	600	---	536	---	1,136	---	600	---	536	---	1136	---
# Left-censored	---	---	---	---	---	---	192	---	67	---	259.00	---
# Right-censored	---	---	---	---	---	---	46	---	137	---	183.00	---

Dependent Variable: Punishment Point given in Stage 2 of Period *t* (Team-Yes treatment only)

	Random effects GLS regressions with standard errors clustered by group		Random effects Tobit regressions	
	Coefficient	S.E.	Coefficient	S.E.
B1 dummy	0.76***	0.29	2.94**	1.24
B3 dummy	0.98**	0.48	0.54	3.85
B4 dummy	---	(omitted)	---	(omitted)
B5 dummy	0.62**	0.28	5.19***	1.21
B6 dummy	1.40*	0.77	4.02***	1.16
B7 dummy	1.38*	0.70	2.76**	1.15
B8 dummy	-0.17	0.17	-0.84	1.23
B9 dummy	-0.21	0.15	-0.26	1.00
B10 dummy	-0.17	0.11	-1.58	1.67
B11 dummy	-0.38**	0.17	-5.22***	1.67
B12 dummy	-0.34***	0.11	-18.80	640.13
B13 dummy	-0.14	0.12	-13.94	2054.27
B15 dummy	-0.09	0.14	-0.69	1.96
B16 dummy	-0.07	0.08	-2.60	2.50
D2 dummy	-0.12*	0.07	-2.32**	1.09
D4 dummy	-0.30***	0.11	-15.76	1581.79
D5 dummy	-0.17***	0.05	-2.16	1.33
D6 dummy	-0.26**	0.11	-3.88***	1.47
D7 dummy	-0.11	0.07	-1.39	0.89
D8 dummy	-0.15***	0.06	-14.23	3452.84
E1 dummy	-0.15	0.25	-0.21	1.01
E2 dummy	-0.18	0.39	1.50	1.08
E4 dummy	0.28***	0.10	2.15***	0.79
E8 dummy	0.25	0.32	-13.62	5435.54
Gender	0.40	0.36	0.82	1.50
Degree	0.49	0.37	4.21***	1.52
British	-0.17	0.13	-1.53	1.40
Constant	-0.28	0.56	-5.67**	2.85
N	563	---	536	---
# Left (Right)-censored	---	---	474 (0)	---

Dependent Variable: Counter-Punishment Points given in Stage 3 of Period *t* (Team-Yes treatment)

	Random effects GLS regressions with standard errors clustered by group		Random Effects Tobit regressions	
	Coefficient	S.E.	Coefficient	S.E.
C1 dummy	0.82***	0.29	2.05**	0.99
C5 dummy	-0.22	0.23	-1.01	1.35
D2 dummy	-0.26	0.26	-0.72	1.06
D4 dummy		(omitted)	---	(omitted)
D5 dummy	-0.14	0.22	-0.76	1.49
D6 dummy	0.24	0.17	0.54	1.03
D7 dummy	-0.12	0.16	-0.85	1.16
D8 dummy		(omitted)	---	(omitted)
E1 dummy	-0.16	0.31	0.02	1.10
E2 dummy	-0.20	0.20	-0.28	1.34
E4 dummy	0.11	0.27	0.79	0.83
Gender	1.11***	0.35	4.06	2.54
Degree	0.44	0.53	2.45	1.95
British	-3.29	2.61	-5.33***	1.96
Constant	1.29	1.98	-4.85	4.63
N	69	---	69	---
# Left (Right)-censored	---	---	47 (0)	---