The sophistication of conditional cooperators: Evidence from public goods games*

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Abstract

We extend the study of behavioural types in voluntary contribution games, adapting the elicitation method of Fischbacher et al. (2001) to a broader range of economic and strategic incentives. Our results in the standard VCM game align with previous findings in many respects; in particular, we identify one-quarter of participants as a distinctive group of "strong" conditional cooperators. We provide an explanation for the behaviour of this group by tracking their contribution strategies as the financial incentives of the game vary. We find that conditional cooperators follow a sophisticated rule, matching contributions only when doing so leads to an overall welfare improvement. This favours an account of conditional cooperation based on social norm compliance, rather than confusion, inequity aversion, or warm-glow giving.

Keywords: public goods, conditional cooperation, sophistication, experiment.

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1 Introduction

Many public goods and worthy activities are financed or supported in whole or in part by voluntary contributions. As has been observed at least since Sugden (1984), in many situations these voluntary contributions cannot easily be rationalised entirely in terms of the benefits which accrue directly to the contributors. Among the possible explanations for such behaviour, Fischbacher et al. (2001) and a series of subsequent studies, including Fischbacher and Gächter (2010) and Fischbacher et al. (2012), have provided evidence for an account that at least some voluntary contributors are motivated by a principle of *conditional cooperation*. Fallucchi et al. (2019) show that, in a survey of studies using Fischbacher et al. (2001)'s methodology, 38.8% of participants are classified in a group of strong conditional cooperators, who are characterised by matching the average contributions of others exactly, or almost exactly, one-for-one. If this is a valid measurement of the prevalence of this strong form of conditional cooperation in the field, conditional cooperation potentially would go a long way towards explaining a willingness to make voluntary contributions, especially in small to medium sized groups.

In this paper, we extend the "p-experiment" methodology of Fischbacher et al. (2001) to identify among competing accounts for why people choose strong conditional cooperation strategies in the laboratory, when faced with a voluntary contributions game in a small group. We thereby provide a more robust measurement of the prevalence of conditional cooperation as an expression of a person's genuine preferences. The key to this identification is to incorporate environments in which following the one-for-one matching rule is Pareto-improving for the group only for some, but not all, anticipated contributions by the rest of the group. Our central finding is that most people who are identified as strong conditional cooperators in the environment using the baseline parameters of Fischbacher et al. (2001) also match contributions one-for-one in other voluntary contributions environments, but *only when* it is Pareto-improving to do so. Our data are evidence that a majority of people who report strongly conditionally cooperative contribution strategies are expressing a genuine and informed response to the incentive system.

Indeed, an informed and sophisticated person could have good reasons to adopt the contribution strategy of one-for-one matching which characterises strong conditional cooperation. For a person with a generally prosocial attitude, one-for-one matching picks out a unique way to respond positively to the contributions of others; because it is in principle broadly applicable, "try to do as others do" could be a useful rule for navigating the many requests for time and treasure people encounter in the groups they are involved in. However, these same properties could be a reason why one-for-one matching is *not* an informed and sophisticated response. One-for-one matching might be observed because people may be confused or misunderstand the incentives in the experiment (see, e.g., Bayer et al., 2013; Burton-Chellew et al., 2016), or may be transferring rules of thumb inappropriately from day-to-day life into the elicitation without regards to the financial incentives. If many people who match one-for-one turn out to be in this latter category, the proportion of genuine strong conditional cooperators would be much smaller, and furthermore methods based on ideas similar to the p-experiment would be less reliable.

Previous studies with the p-experiment elicitation have used a payoff specification which is linear in the contributions of each member of the group. This produces an environment in which the contribution amount that maximises a person's own earnings is always zero, and, conversely, any nonzero contribution is always prosocial in that it increases the total earnings of the group. We measure the contribution strategies of each person across a total of four environments, augmenting the linear one with three in which the own-earnings maximising contribution is in the interior of the strategy space. In those three environments, contributions below the own-earnings level are Pareto-inefficient. These features allow us to identify from among the competing explanations for strong conditional cooperation. Because a majority of people who match one-for-one in the linear environment avoid Pareto-inefficient contribution levels in the other environments, we rule out confusion or naïveté as explanations for most strong conditional cooperators. With data from across four environments, we are also able to constrain further which theoretical models of individual behaviour are consistent with our observations; a model of social cooperation norm compliance provides the best explanation.

The environments in which the own-maximising contribution is positive are useful for technical reasons, but these also incorporate some of the richness of public goods settings in the field. Consider the situation when a parent or guardian receives an invitation at the start of a school year, listing the planned trips and events for their child's class for the year, and asking them to consider volunteering as a chaperone for at least some. There is a public goods element in such a situation: the presence of chaperones benefits the entire class – not to mention the teachers! – and in general, the more chaperones the better. A parent might agree to volunteer for some events out of purely personal interest, to enjoy the opportunity to spend time with their child. However, if parents all volunteer only out of self-interest, the outcome will be inefficient, as parents would neglect the positive externalities from their volunteering.

Depending on the details of the situation, there may be further strategic dimensions. A parent might perceive, from their perspective, that contributions are strategic substitutes. If other parents are likely to volunteer frequently, a parent may not feel the need to volunteer as much, because there will already be adequate coverage; while if others are unlikely to volunteer, a parent might want to volunteer more frequently to ensure trips can go ahead. Alternatively, a parent might have reasons to think of contributions as strategic complements; for example, if they get social enjoyment out of interacting with other parents during a trip or event, then the more other parents who will be there, the more attractive volunteering becomes. Note that these conceptions of strategic substitutes or complements remain based entirely on the parent's own preferences; they are separate from the consideration that for any fixed level of volunteering by others, volunteering in excess of the amount optimal considering only self-interest is welfare-enhancing for the whole group.

Our three additional environments comprise one in which the own-earnings-maximising contribution is independent of the contributions of others (cf. Keser, 1996; Sefton and Steinberg, 1996), one in which contributions are strategic substitutes, and one in which they are strategic complements. These two settings mirror the quantity and price oligopolies, as studied by Potters and Suetens (2009), but in a public good frame. To our knowledge, we are the first to study individual behaviour in public good experiments in two strategic settings where externalities are generated by the investment choice in the private good.[1] These allow us to test whether we continue to observe strong conditional cooperation in settings in which own-earnings-maximisation would lead to nontrivial strategic interaction. We find that most strong conditional cooperators match one-for-one when doing so increases total group earnings, and follow the (non-constant) own-earnings-maximising reaction function when one-for-one matching would prescribe a contribution leading to a Pareto-dominated outcome. Therefore, among this group identified as strong conditional cooperators, we observe *both* an understanding of the strategic structure of the game *and* a desire to conditionally cooperate expressed within the *same* contribution strategy.

The remainder of the paper is structured as follows. In Section 2 we introduce the economic environments and mechanisms used in the experiment, and discuss two theories of behavioural types. In Section 3 we describe the experimental design and the choice architecture. In Section 4 we state the hypotheses which motivate the data analysis and results of Section 5. We conclude in Section 6 with a discussion.

2 Theory

2.1 A public goods environment with linear-quadratic earnings

There are N players, $i = 1, \ldots, N$, whom we refer to collectively as the *group*. Each player i has an endowment $\omega > 0$ of a resource, which we call *tokens*, which she can allocate between a *private account* and a contribution $0 \leq g_i \leq \omega$ towards a public good, which we call the *project*. The total amount contributed towards the project by the group is $G \equiv \sum_{j=1}^{N} g_j$, with $G_{-i} = \sum_{j \neq i} g_j$ denoting the total contributions of players other than i. Given player i's contribution g_i and contributions to the project by other players G_{-i}, the monetary payoff of player i is given by a function $\Pi_i(g_i, G_{-i})$.

[1] We are aware of one other paper, by Lappalainen (2018), where there is complementarity in the public-good production technology.

In our experiment monetary payoffs are determined using functions of the form

$$\Pi_i(g_i, G_{-i}; \beta_1, \beta_2, \lambda) = (\beta_1 - \lambda G_{-i})(\omega - g_i) - \beta_2(\omega - g_i)^2 + 0.4\,[G_{-i} + g_i]\,, \tag{1}$$

where $\beta_1 > 0$ and $\beta_2 \geq 0$.[2] We hold constant the *marginal per-capita return* (MPCR) from contributions to the project at 0.4. By varying β_1, β_2, and λ, we can manipulate the location and slope of the reaction function, given G_{-i}, for a player who wants to maximise her monetary earnings.[3]

When $\beta_2 = \lambda = 0$, we have

$$\Pi_i(g_i, G_{-i}; \beta_1, 0, 0) = \beta_1(\omega - g_i) + 0.4\,[G_{-i} + g_i]\,, \tag{2}$$

which is the payoff function for a standard VCM game with linear and additively separable payoffs. The earnings-maximising reaction function for player i is to allocate all tokens to her private consumption,

$$\tilde{g}_i(G_{-i}) = 0. \tag{3}$$

Note that $\frac{\partial^2 \Pi_i(g_i;G_{-i})}{\partial g_i^2} = -2\beta_2$. When $\beta_2 > 0$, earnings are strictly concave in the number of tokens allocated to the project, and the reaction function for player i to maximise her own earnings is

$$\tilde{g}_i(G_{-i}) = \omega - \frac{\beta_1 - \lambda G_{-i} - 0.4}{2\beta_2}, \tag{4}$$

when the $\tilde{g}_i(G_{-i})$ so defined is in $[0, \omega]$. The parameter λ captures the degree of complementarity or substitutability of contributions, and therefore the slope of the reaction function. When $\lambda = 0$ in (4), the reaction function is constant, as in the specification used by Keser (1996) and Sefton and Steinberg (1996).[4] When $\lambda > 0$, player i wants to contribute more tokens to the project when others are making larger contributions, whereas when $\lambda < 0$ she wants to contribute fewer tokens to the project when others' contributions are higher.[5]

In our experiment tokens are discrete. In passing to the discretised action space, which we call $\mathcal{A}_{\mathbb{Z}}$, we observe that the strict concavity (when $\beta_2 > 0$) of $\Pi_i(g_i, G_{-i})$ with respect to the contribu-

[2]Potters and Suetens (2009) used a similar quadratic specification in an experiment with repeated interaction between fixed pairs.

[3]Our baseline analysis is done under the assumption of that all players have utility equal to their own monetary earnings. Unless otherwise noted, terms such as "reaction function" or "dominant strategy" refer to this case. In the sequel we discuss some of the implications of changing or relaxing this assumption.

[4]Other studies using a quadratic specification with an interior earnings-maximising dominant strategy are Willinger and Ziegelmeyer (1999), and Gronberg et al. (2012).

[5]Other approaches have been used to generate interior equilibria. Andreoni (1993) used a Cobb-Douglas payoff specification; Cason and Gangadharan (2015) a piecewise-linear specification; and Chan et al. (2002) a quadratic specification with a different structure than ours.

tion to the project ensures that, when the reaction function given by (4) is not a whole number, the earnings-maximising contribution in the discrete setting is either the integer immediately above or below. In the exposition of our experimental parameterisation we focus on this discretised case.

Allocation decisions are made in two stages, using an extensive form game introduced by Fischbacher et al. (2001) as the *p-experiment game*. In Stage 1, players $i = 1, \ldots, N-1$ simultaneously and independently choose their contributions g_i. Then in Stage 2, the remaining player $i = N$ learns the average contribution of those $N-1$ players, rounded to the nearest integer, which we refer to as $\overline{G}$; she then decides her contribution. Therefore, the strategy spaces for players $i = 1, \ldots, N-1$ are the same as the action space, $\mathcal{S}_i = \mathcal{A}_{\mathbb{Z}}$. For player N, the strategy space is $\mathcal{S}_N = \{s : \{0, \ldots, \omega\} \rightarrow \mathcal{A}_{\mathbb{Z}}\}$. The rounding involved in determining $\overline{G}$ makes this game formally a game of imperfect information; each level of $\overline{G}$ is an information set. We refer to the component of the action of players $i = 1, \ldots, N-1$ specifying the contribution to the project as the *unconditional contributions* u_i, and the strategy in $\mathcal{S}_N$ specifying the contribution to the project as the *contribution strategy* $c(\cdot)$.

For each game, we identify the set of rationalisable strategies (for players whose objective function is to maximise their own earnings), and the set of perfect Bayesian equilibria in pure strategies. We refer to an equilibrium as symmetric when the unconditional contributions u_i are the same for all $i = 1, \ldots, N-1$.

2.2 Experimental parameterisation

Groups in our experiments consisted of $N = 4$ players. Participants made decisions in four games. In each game participants had an endowment of $\omega = 20$ tokens. Earnings in our baseline game, LINEAR (Γ^L), were determined the same way as in Fischbacher et al. (2001), Fischbacher and Gächter (2010), and Fischbacher et al. (2012),[6]

$$\Pi_i^L(g_i, G_{-i}) \equiv \Pi_i(g_i, G_{-i}; 1, 0, 0) = (\omega - g_i) + 0.4\left[G_{-i} + g_i\right],$$

That is, the value of each token allocated by player i to her private account was £1.00, irrespective of how many tokens she allocated or the decisions of others in the group.

We compare participants' decisions in Γ^L with their decisions in three games in which $\beta_2 = .03$. The parameters for each game generate a reaction function for the Stage 2 player which is in the interior of the action space for all values of $u_1 + u_2 + u_3$, and, importantly, the earnings-maximising response for the Stage 2 player is the same for all values of $u_1 + u_2 + u_3$ consistent with each information set $\overline{G}$. Therefore the loss of precision in information about the play of others due to the rounding of average contributions is not strategically relevant for the best response of

[6] All earnings are expressed in GBP.

the Stage 2 player. In Appendix A we discuss our choice of parameters and provide a complete analysis of the equilibria of each game for own-earnings-maximising players.

In DOMINANT (Γ^D) earnings are determined by

$$\Pi_i^D(g_i, G_{-i}) \equiv \Pi_i(g_i, G_{-i}; 1.18, 0.03, 0) = 1.18(\omega - g_i) - 0.03(\omega - g_i)^2 + 0.4\left[G_{-i} + g_i\right].$$

This game can be solved by iterated elimination of strictly dominated strategies. The Stage 2 player has a strictly dominant strategy $c^{\star D}(\overline{G}) = 7$ for all $\overline{G}$. Given this, a contribution of $u_i^{\star D} = 7$ is strictly dominant for each player i.

In SUBSTITUTES (Γ^S) earnings are determined by

$$\begin{aligned} \Pi_i^S(g_i, G_{-i}) &\equiv \\ \Pi_i\left(g_i, G_{-i}; 1.06, 0.03, -\frac{.02}{3}\right) &= \left(1.06 + \frac{.02}{3}G_{-i}\right)(\omega - g_i) - 0.03(\omega - g_i)^2 + 0.4\left[G_{-i} + g_i\right].\end{aligned}$$

The Stage 2 player has a strictly dominant strategy, which is a nonincreasing strategy $c^{\star S}(\overline{G})$ with $c^{\star S}(0) = 9$ and $c^{\star S}(20) = 4$. The rationalisable unconditional contributions are $3 \leq u_i^S \leq 7$ for $i = 1, 2, 3$. There is a unique symmetric equilibrium with $u_1^{\star S} = u_2^{\star S} = u_3^{\star S} = 7$, with $c^{\star S}(7) = 7$ on the equilibrium path, and asymmetric equilibria with $u_1^{\star S} + u_2^{\star S} + u_3^{\star S} = 13$, with $c^{\star S}(4) = 8$ on the equilibrium path.

In COMPLEMENTS (Γ^C), earnings are determined by

$$\begin{aligned} \Pi_i^C(g_i, G_{-i}) &\equiv \\ \Pi_i\left(g_i, G_{-i}; 1.34, .03, +\frac{.02}{3}\right) &= \left(1.34 - \frac{.02}{3}G_{-i}\right)(\omega - g_i) - .03(\omega - g_i)^2 + 0.4\left[G_{-i} + g_i\right].\end{aligned}$$

The stage 2 player has a strictly dominant strategy, which is a nondecreasing strategy $c^{\star C}(\overline{G})$ with $c^{\star C}(0) = 4$ and $c^{\star C}(20) = 11$. The rationalisable unconditional contributions are $7 \leq u_i^C \leq 10$ for $i = 1, 2, 3$. There is a unique symmetric equilibrium with $u_1^{\star C} = u_2^{\star C} = u_3^{\star C} = 7$, with $c^{\star C}(7) = 7$ on the equilibrium path, and asymmetric equilibria with $u_1^{\star C} + u_2^{\star C} + u_3^{\star C} = 29$, with $c^{\star C}(10) = 8$ on the equilibrium path.

For any fixed G_{-i}, the group's total earnings are always maximised when player i contributes all of her tokens to the project. Furthermore, for games $\gamma \in \{D, S, C\}$, any contribution $g < c^{\star\gamma}(\overline{G})$ by the Stage 2 player is Pareto-dominated by a contribution of $c^{\star\gamma}(\overline{G})$. There are no such *conditionally Pareto-dominated* contribution levels in LINEAR.

2.3 Theories of types in the linear p-experiment game

The p-experiment game is typically combined with the strategy method, which enables elicitation of the full strategy of the player making her allocation in Stage 2. The contribution components of these strategies have been used as the basis for identifying different types of behaviour across participants.

Fallucchi et al. (2019) found that in previous studies using the p-experiment game with linear payoffs, there were 397 distinct contribution strategies chosen by the 551 participants in the sample. Only two of these were followed *exactly* by more than a small number of participants: (1) free-riding (FR), which corresponds to the contribution strategy $c(\overline{G}) = 0$ for all $\overline{G}$, and (2) exact one-for-one matching (OFO), which corresponds to $c(\overline{G}) = \overline{G}$ for all $\overline{G}$. Of the remaining 395 contribution strategies, 381 of them were chosen by exactly one of the 551 participants.

Because of this prevalence of similar-but-not-identical contribution strategies, methods for classifying different strategies into a small number of types have been proposed. There is inherently an element of judgement in dividing the heterogeneous contribution strategies into a small number of types. We therefore consider two type schemata, which we will use jointly to help summarise the contribution strategy data. Each contribution strategy will therefore have a "type" in each schema; which schema is being referenced will be clear from the context.

Fischbacher et al. (2001) proposed a schema (which we call FGF) which classifies strategies into four types. Free-riders (FR) contribute exactly zero in all contingencies, $c(\overline{G}) = 0$. Conditional cooperators (CC) increase their contributions based on higher contributions by others. Formally, participant i is a conditional cooperator if the Spearman's ρ correlation coefficient between the vector $[0, 1, \dots, \omega]$ of possible average contributions and the participant's contribution strategy $[c(0), c(1), \dots, c(\omega)]$ is significantly positive with p-value less than some threshold (typically 0.001, which is the value we use in this paper). Hump-shaped (HS) contributors are identified by visually classifying contribution strategies in which $c(0)$ and $c(\omega)$ are zero or small, but $c(\overline{G})$ is larger for some intermediate information sets $0 < \overline{G} < \omega$. Any contribution strategy not matching one of the above criteria is placed in a residual type.[7]

Fallucchi et al. (2019) re-visit data from six p-experiment studies, and use cluster analysis to propose there are five "stereotypical" strategies: own-maximisers (OWN, $\hat{c}^{OWN}(\overline{G}) = 0$), weak conditional cooperators (WCC, $\hat{c}^{WCC}(\overline{G}) = \frac{1}{2}\overline{G}$), strong conditional cooperators (SCC, $\hat{c}^{SCC}(\overline{G}) = \overline{G}$), unconditional high contributors (UNH, $\hat{c}^{UNH}(\overline{G}) = \omega$), and mid-range contributors (MID, $\hat{c}^{MID}(\overline{G}) = \frac{1}{2}\omega$). We use this observation to construct a second schema (which we call

[7] Thöni and Volk (2018) have proposed a refinement to the FGF schema which focuses on improving the distinction between CC and HS. Using their version of the schema would not affect our results, because strong conditional cooperators are CC under both versions, and because we do not observe contribution strategies which have a hump-shaped form in the data we report.

FLT).[8] We define the distance between two contribution strategies c and c' using the Manhattan distance,

$$d(c, c') = \sum_{\overline{G}=0}^{\omega} \left| c(\overline{G}) - c'(\overline{G}) \right|. \tag{5}$$

Letting $c^{(j)}$ denote the contribution strategy of a given participant j, the type of the strategy in this schema, $T^{FLT}(c^{(j)})$, and by extension the participant, is determined by the stereotypical strategy to which $c^{(j)}$ is closest,

$$T^{FLT}(c^{(j)}) = \underset{t \in \{OWN, WCC, SCC, UNH, MID\}}{\arg\min} d(c^{(j)}, \hat{c}^t). \tag{6}$$

3 Experimental design

3.1 Payoff structure treatments

Participants were assigned at random into groups of four. The member identifiers of the group were the four suits of a standard deck of cards (clubs, diamonds, hearts, and spades). The standard icons for these suits were used extensively in the instructions as well as the decision screens. Each participant's instructions were customised based on their suit identification. For example, the instructions for a participant with the identifier clubs (♣) consistently used phrasing like "your ID (♣)" and "the other members of your group (♢♡♠)."[9]

Participants were asked to make their decisions in each of the four games without any feedback on the choices of others or outcomes of any of the games. The games were presented in one of four orderings, which differed across sessions. Games 1 and 3 were always LINEAR and DOMINANT, in either order, and Games 2 and 4 where always COMPLEMENTS and SUBSTITUTES, again in either order.

3.2 Timing of moves

The decisions in each game were elicited using the p-experiment protocol created by Fischbacher et al. (2001).

[8] Fallucchi et al. (2019) use the output of their cluster analysis to assign types. A feature of using cluster analysis is that types are defined endogenously based on the full dataset presented to the algorithm, and therefore the classification of strategies on the "border" between types may change as new data are included. The deterministic version presented here is based on their observation that these stereotypical behaviours, which have simple intuitive behaviours, emerge robustly as the centres of mass of types even when resampling the data.

[9] Complete instructions are available as a separate Appendix. The instructions illustrate a number of other practical details of how the experiments were implemented which we omit here.

Figure 1: Screenshot of the allocation panel, used by participants to indicate decisions in the experiment. Left: The panel at the start of a decision. Right: The panel with an allocation selected, with 6 tokens allocated to the project and 14 to the private account.

3.2.1 Step 1: Explain the earnings structure

For each game, the first screen explained to participants how their token allocation would affect their earnings and those of others in their group. This was explained both in a brief prose description, and using a table; the contents of the screens for each of the games are included in a separate Appendix.

We presented the decision-making task in terms of allocating twenty individually-numbered tokens to either the project or the private account. The structure of the earnings function (1) allowed us to express the earnings consequences of the allocation of each individual token. Because the MPCR was held constant at £0.40 for all tokens in all games, the consequence of allocating any token to the project was shown as "40p each." The four games varied the consequence of allocating different tokens to the private account. By convention, token #1 was the token which generated the smallest return when allocated to the private account, and token #20 the token which generated the largest return.

3.2.2 Step 2: The Stage 1 allocation

We elicited decisions using the graphical device shown in Figure 1, which we referred to as the *allocation panel*. The participant allocated a token to the project by clicking on the box to the left of that token. Similarly, the participant allocated a token to the private account by clicking on the box to the right of that token. When a participant clicked to allocate token i, the device automatically allocated all tokens with numbers below i to the project, and all tokens with numbers above i to the private account.[10] Participants were able to adjust their allocations as many times as they wished before confirming. Colour-coding was used to indicate the currently-selected allocation; tokens allocated to the project were shown in yellow and those to the private account were shown in orange.

The allocation panel incorporated information about the consequences of an allocation directly into the graphical instrument used to express the choice.[11] Each token was individually labeled with the consequence of allocating that token to the project. The project column included the identifiers of all four group members and each consequence in this column included the word "each." The private account column included only the identifier of the participant making the decision.

3.2.3 Step 3: The Stage 2 allocation

Figure 2 displays the choice architecture for the Stage 2 allocation strategy, which required the specification of 21 decisions. We referred to each possible realisation of the average Stage 1 allocation to the project as a *scenario*. The allocation panels for three scenarios were available on the screen at any time, with a tabbed interface available to navigate among scenarios. A panel at the right of the screen summarised the allocations made by the participant so far. Allocations could be made in any order and changed as often as the participant liked, before confirming the decisions with the button at the bottom-right of the screen.[12]

3.2.4 Step 4: Determination of earnings

One of the four games was selected at random to determine the earnings for the session. At the time participants made their decisions, they did not know which game would be selected, nor whether they would make their decisions in Stage 1 or Stage 2.

[10]Therefore the allocation panel did enforce efficiency in that, whenever k tokens were allocated to the project, they were always the k tokens worth the least to the participant in their private account.

[11]Gronberg et al. (2012) also used a device for making earnings-maximising responses straightforward to discover, but their architecture did not directly represent the social benefits of contributing to the project.

[12]In contrast, Fischbacher et al. (2001) elicit this using an array of 21 text boxes referred to as the "contribution table." In our instructions we simply refer to Stage 1 and Stage 2 choices.

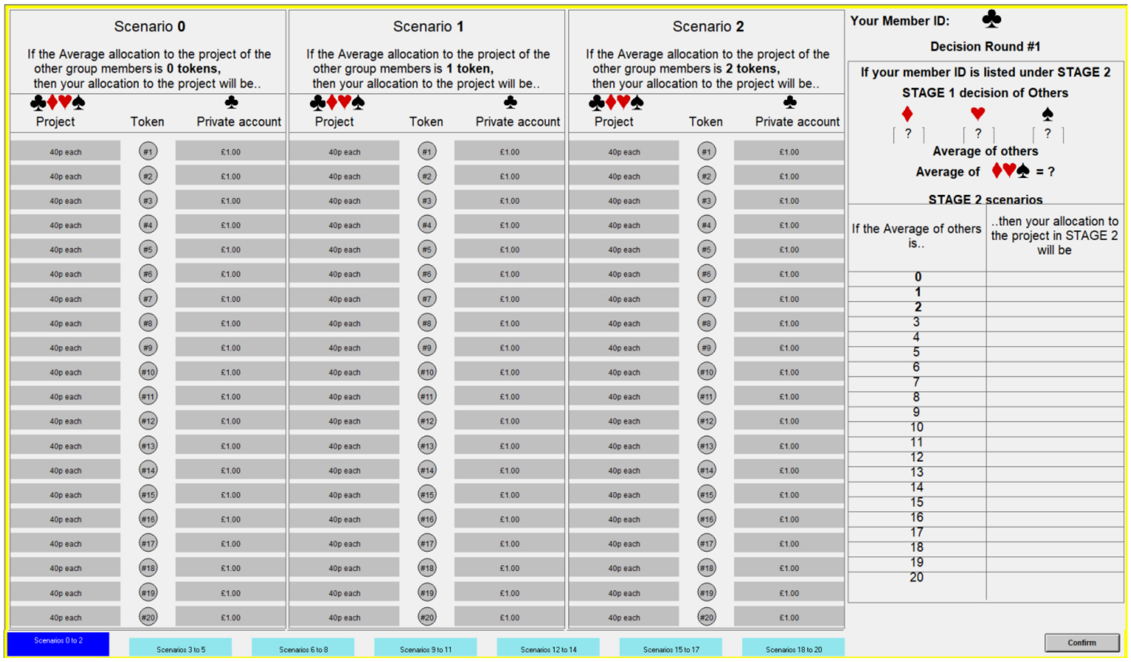


Figure 2: Indication of Stage 2 allocation strategy decisions. Three scenarios were available on the screen at a time. Navigation across scenarios was available using tabs at the bottom of the screen. A panel at the right summarised the allocation decisions made so far.

3.3 Experimental sessions

We conducted a total of 8 sessions at the laboratory of the Centre for Behavioural and Experimental Social Science (CBESS) at University of East Anglia, in April and May, 2016. We recruited 148 participants from the standing participant pool, maintained using the hRoot system. (Bock et al., 2014) The experiment was programmed using zTree (Fischbacher, 2007). Sessions lasted on average 75 minutes, including instructions and control questions, and participants earned on average £23.39 with an interquartile range of £5.34.[13]

4 Hypotheses

4.1 Identifying the motivation of behavioural types

Our principal research question is to identify whether the behaviour of people classified as strong conditional cooperators are motivated by an informed response to the incentives of the environment. The main data of interest therefore are the Stage 2 contribution strategies, and we structure our main hypotheses around these.

In our experiment LINEAR is a systematic replication of previous studies using the p-experiment

[13]For comparison, the living wage in the United Kingdom at the time of the experiments was £8.25 per hour.

protocol. We retain approximate parity in the financial incentives themselves. However, to ensure transparent communication of the the financial incentives across all games, we structure the choice differently than Fischbacher et al. (2001) and others, using an allocation[14] of distinct tokens, where each token is labeled with the earnings consequences resulting from being allocated to the private account or the project.[15] The way the choice is framed or explained can affect the decisions people make in voluntary contributions games. (e.g. Brandts and Schwieren, 2009; Dufwenberg et al., 2011; Cubitt et al., 2011; Cox et al., 2013; Cox, 2015; Khadjavi and Lange, 2015; Kingsley, 2015; Cox et al., 2018). For comparability with previously-published results, we must first confirm that the features of our design do not change the Stage 2 contribution strategies in LINEAR; or, to put it another way, that the distribution of contribution strategies obtained in the linear setting is robust.

Hypothesis 1. *The proportions of types of contribution strategies in* LINEAR *will be the same in our experiment as in previously-reported experiments.*

Fallucchi et al. (2019) identified the two most common types of contribution strategies in p-experiment studies in the linear setting: strong conditional cooperators (38.8%) are the largest group, followed by own-maximisers (25.8%), who in the linear case choose to contribute exactly or almost always zero. Contributing zero tokens at all information sets in Stage 2 always maximises a person's own earnings and, insofar as it is not controversial that in many experiments many people make choices in a way that is consistent with own-earnings maximisation, it is a reasonable presumption that own-maximisers in LINEAR are motivated by recognising which strategy maximises their own earnings, and they act on this.

Hypothesis 2. *Participants who are identified as own-maximisers in* LINEAR *will exhibit own-earnings-maximisation across all games; that is, they will use contribution strategies given by the version of (4) restricted to discrete integer choices.*

In contrast, different accounts have been given for the behaviour of strong conditional co-operators. Participants might match the contributions of others one-for-one because they do not understand the economics of the game as given by the financial incentives, or because they are ignoring those incentives in favour of a rule of thumb transferred from a different context. In each of DOMINANT, SUBSTITUTES, and COMPLEMENTS, following a one-for-one rule of thumb when others contribute below the Nash level would lead to conditionally Pareto-dominated contributions.

[14]In constrast, many VCM experiments, including those of Fischbacher et al. (2001); Fischbacher and Gächter (2010); Fischbacher et al. (2012) to which we compare our results, ask participants to specify only the contribution to the group project, and usually ask them to do so by typing a number into a box.

[15]Our choice architecture is thus similar to one which has been used in field studies with primary school children (see e.g. Harbaugh and Krause, 2000; Hermes et al., 2019) to provide an easier understanding of the payoff consequences of choices in the linear public good game.

If strong conditional cooperators were to match one-for-one for contributions lower than the Nash level, this would implicate confusion or heuristic transfer.

Hypothesis 3. *Participants who are identified as strong conditional cooperators in* LINEAR *will follow the same rule of thumb of (approximate) one-for-one matching across all games; this will result in conditionally Pareto-dominated choices in some contingencies.*

4.2 Unconditional contributions

In the p-experiment protocol, the unconditional contributions in Stage 1 serve primarily to establish the incentive-compatibility of the contribution strategies in Stage 2, because each Stage 2 information set may be realised with positive probability depending on the unconditional contributions the other players in the group make. Nevertheless the Stage 1 contributions are of interest in their own right, as they are incentivised choices made in a voluntary contributions setting with nontrivial strategic considerations.

For the same reasons motivating Hypothesis 1, we first check whether we replicate contributions in the baseline linear environment.

Hypothesis 4. *The distribution of unconditional contributions in* LINEAR *will be the same in our experiment as in previously-reported experiments.*

SUBSTITUTES and COMPLEMENTS present an interesting strategic environment for players in Stage 1. This differs from standard simultaneous-choice VCMs because Stage 1 players in the p-experiment should anticipate that raising or lowering their contribution is likely to have an effect on the contribution of the Stage 2 player in these games. Under the assumption of an own-earnings-maximising Stage 2 player, in SUBSTITUTES if a Stage 1 player deviates and lowers their unconditional contribution, it might result in the Stage 2 player increasing theirs, while in COMPLEMENTS if a Stage 1 player deviates and raises their unconditional contribution it might result in a matching increase from the Stage 2 player.[16] Because these games are played only once and without any feedback at all, it is not plausible behaviourally that people would play an equilibrium, whereas it is possible to recognise the opportunity to manipulate strategically the Stage 2 player's response as described. We therefore propose that rationalisability is the appropriate concept to apply to predicting choices in Stage 1.

Hypothesis 5. *Unconditional contributions will be lower in* SUBSTITUTES *than in* DOMINANT *than in* COMPLEMENTS.

[16]In Appendix A we show that the discreteness of the strategy space inherently gives rise to asymmetric equilibria in these games precisely because of this reasoning.

Study	N	FGF		OFO	FLT				
		FR	CC		OWN	WCC	SCC	UNH	MID
Our data	148	22.3	52.7	7.4	32.4	22.3	27.0	2.7	15.5
Fischbacher et al. (2001)	44	29.5	50.0	9.1	43.2	20.5	27.3	2.3	6.8
Fischbacher et al. (2012)	136	14.7	70.6	11.0	35.3	21.3	38.2	2.2	2.9
Fischbacher and Gächter (2010)	140	22.9	52.1	9.3	42.1	20.0	32.9	2.1	2.9

Table 1: Type classifications based on contribution strategies in LINEAR.

5 Results

5.1 Contribution strategies and behavioural types

We benchmark our LINEAR data against the series of studies, which use the p-experimental protocol, by Fischbacher et al. (2001), Fischbacher and Gächter (2010), and Fischbacher et al. (2012) (which we refer to as the "Fischbacher sample").

To get a handle on whether our contribution strategies are similar to those in the Fischbacher sample, we classify behaviour according to the two type schemata, FGF and FLT, introduced in Section 2. In Table 1 we report classifications based on the two approaches.[17] Although matching exactly one-for-one in all 21 information sets is the second most common contribution strategy, it is not a type in its own right in either schema (it is a subset of CC in FGF and SCC in FLT). We therefore report the proportion of these separately as OFO.

Result 1. *The proportions of strategies which exactly or approximately maximise the participant's own earnings, and the proportions of strategies which exactly or approximately match the average contributions of the group, are similar in our data and the Fischbacher sample.*

Support. Contribution strategies which exactly or approximately maximise the participant's earnings appear with similar frequencies. For exact maximisation, we find a proportion of FR similar to the Fischbacher sample (22.3 compared to 20.3, $p = .62$ using the binomial test). Relaxing to approximate maximisation, our proportion of OWN is also similar (32.4 compared to 38.8; $p = .14$).

Exact one-for-one matching occurs at a similar rate (7.4 compared to 10.0, $p = .37$), as does the more relaxed criterion of strong conditional cooperation (27.0 compared to 34.1, $p = .13$).[18] □

[17] We do not report proportions of "hump-shaped" (HS) contributors. Among the 37 participants who do not satisfy the criteria for FR or CC, none exhibit a clearly hump-shaped pattern. The presence of any clearly HS strategies would be evident in the heatmaps in Figure 3 and Figure 8. The absence of HS contribution strategies in our data is a notable difference from most previous studies.

[18] If we consider all types, our type distribution is similar to the Fischbacher sample under the FGF classification (χ^2 test, $p = 0.329$), but differs under the FLT classification (χ^2 test, $p = 0.004$). The differences arise from contribution

Do the types identified by the contribution strategies chosen in LINEAR predict the contribution strategies in games DOMINANT, SUBSTITUTES, and COMPLEMENTS? We focus first on OWN, WCC, and SCC, who together comprise 83.5% of our participants.

To give an initial visual summary of the data, we use the method developed in Fallucchi et al. (2019) and construct heatmaps for the contribution strategies of each type in each game. Let $T(j)$ denote the type classification of a given participant j. The heatmap for a type t is produced by taking the contribution strategies of all participants assigned to that type, and constructing the multiset $\{(\overline{G}, c^{(j)}(\overline{G}))\}_{j:T(j)=t,\overline{G}=0,\ldots,20}$. The frequencies of these ordered pairs are used to generate the heatmap. Cells with darker shades correspond to higher frequencies; the modal behaviour for any given information set $\overline{G}$ can therefore be identified by the darkest cell among the cells in the column corresponding to that information set.

For each type t we also define the medoid strategy $\overline{c}(t)$ as the strategy with the smallest average distance from all the strategies in the type,

$$\overline{c}(t) = \underset{\{c^{(j)}:T(j)=t\}}{\arg\min} \frac{1}{|\{j : T(j) = t\}|} \sum_{k:T(k)=t} d\left(c^{(j)}, c^{(k)}\right). \tag{7}$$

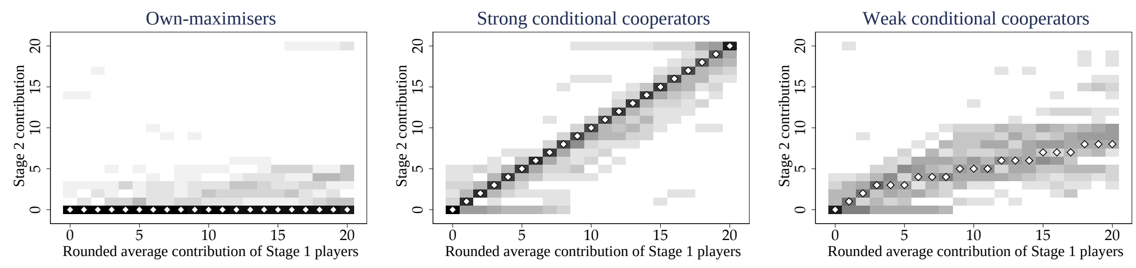
The medoid for type t is always a strategy that was chosen by at least one participant classified as type t. It coincides with the more familiar centroid when the centroid is a member of the set $\{c^{(j)} : T(j) = t\}$. The medoid strategy is one way to express a "most typical" strategy for the type, and is plotted using small white diamonds in the heatmaps.

In Figure 3, we set each participant i's type $T(i)$ as their type determined by their contribution strategy in LINEAR. Then, for each type t and for each game Γ, we take the participants classified as type t and use their contribution strategies in Γ to construct the heatmap for type t in game Γ.

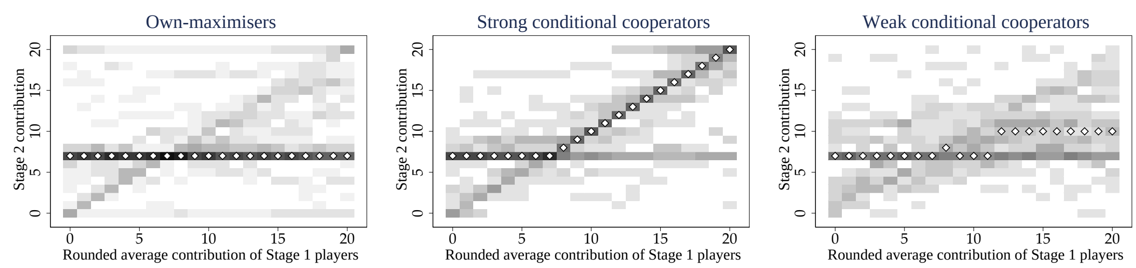
For participants classified as own-maximisers in LINEAR, the medoid contribution strategy in each of the three nonlinear games is to contribute exactly the own-maximising number of tokens in every contingency, except when other participants contribute 20 in SUBSTITUTES. The contributions of own-maximisers are typically at or close to the contribution strategy given by the reaction function (4).

Participants identified as strong conditional cooperators in LINEAR also show a consistent pattern across the other games. The medoid contribution strategies in the nonlinear games match average contributions at or very near one-for-one, but - importantly - *only* when doing so is socially improving. When contemplating possible low levels of contributions by the rest of the group, the medoid contribution strategy of strong conditional cooperators selects the own-earnings-

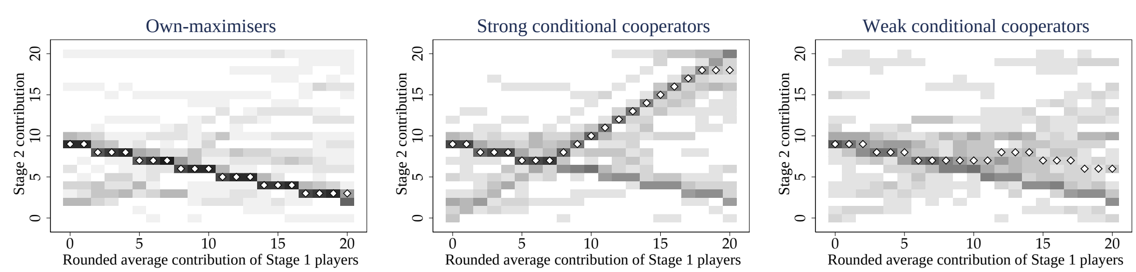
strategies which are HS in the Fischbacher sample, which are classified as OWN, WCC, or SCC in FLT, and the existence in our data of participants who divide tokens more or less equally between the private account and the project, who do not feature in the Fischbacher sample.



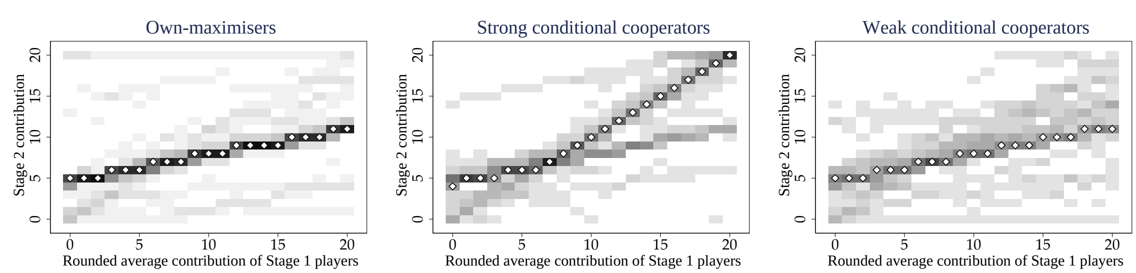
(a) LINEAR



(b) DOMINANT



(c) SUBSTITUTES



(d) COMPLEMENTS

Figure 3: Heatmaps of Stage 2 contributions to the project. Participants are grouped based on the FLT classification of their Stage 2 contribution strategy in LINEAR.

	OWN vs. SCC	SCC vs. WCC	OWN vs. WCC
LINEAR	88.861 (0.005)	70.889 (0.005)	69.877 (0.005)
DOMINANT	40.543 (0.014)	41.294 (0.014)	25.229 (0.259)
COMPLEMENTS	50.173 (0.023)	38.380 (0.021)	20.557 (0.486)
SUBSTITUTES	38.724 (0.021)	33.120 (0.054)	34.292 (0.045)

Table 2: Test statistics for Oja (2010) location test of the difference in the contribution vectors between types. p-values adjusted for multiple testing using the Benjamini-Hochberg False Discovery Rate method are reported in parentheses.

maximising contribution. This is particularly striking in SUBSTITUTES, as this results in a non-monotonic contribution strategy.

Result 2. *The type identifications in* LINEAR *are predictive of behaviour in other games.*

Support. The medoid contribution strategies of OWN and SCC are distinct across all four games, and contribution strategies for both types cluster primarily near the medoid. For OWN, the medoid contribution strategy is almost exactly the own-earnings-maximising reaction function in all games. For SCC, the medoid contribution strategy is almost exactly to follow one-for-one matching above the Nash equilibrium contribution level; below it, the medoid strategy chooses the own-earnings-maximising contribution level, and avoids Pareto-dominated contribution levels.[19] In contrast, the distribution of contribution strategies for WCC is much more dispersed in all games. The medoid contribution strategy for WCC in DOMINANT and SUBSTITUTES prescribes contributing a few more tokens than the own-earnings-maximising amount when responding to group contributions above the Nash level, while in COMPLEMENTS the medoid contribution strategy is exactly the own-earnings-maximising reaction function.

To formalise the discussion, we are testing a hypothesis about whether the distributions of contribution strategies are different among these three groups of participants. Distributions over strategies can be quantified in various ways; we therefore take two approaches to testing for differences in these distributions. Our first approach uses a non-parametric test proposed by Oja (2010) based on spatial signed ranks. The null hypothesis is that the treatment difference between samples is equal to the zero vector. Let $\mathcal{T}$ be the set of types being considered, and n_t be the number of participants in type $t \in \mathcal{T}$. Let R be the vector of centred rank scores, with elements $R_i = \sum_{c^{(j)}} \frac{1}{n} \left(\frac{c^{(i)} - c^{(j)}}{d(c^{(i)}, c^{(j)})} \right)$. The average centred rank score for type t is then $\overline{R}_t = \sum_{i:c^{(i)} \in t} \frac{1}{n_t} R_i$. $\hat{B}$ is the covariance matrix given by RR'. To test the null hypothesis that the true difference in ranks

[19]We say "almost exactly" because both OWN and SCC vary slightly from these descriptions when $\overline{G} = 20$ in SUBSTITUTES, and SCC when $\overline{G} = 0$ in COMPLEMENTS. These are information sets which would be reached with very small probabilities given the empirical distributions of unconditional contributions (see Section 5.3).

is the zero vector, form the test statistic

$$Q^2 = \sum_{t \in \mathcal{T}} n_t \overline{R}_t' \hat{B}^{-1} \overline{R}_t. \tag{8}$$

The limiting distribution of Q^2 is $\chi^2_{(|\mathcal{T}|-1)k}$, where k is the number of dimensions in the data.[20]

We report in Table 2 the results of pairwise comparisons among OWN, SCC, and WCC for each game, adjusting for multiple testing.[21] SCC are different in all games from OWN (all $p \leq 0.015$) and from WCC (all $p \leq 0.045$). WCC, however, are not well-distinguished from OWN in either DOMINANT or COMPLEMENTS; in the latter, as noted the upward-sloping reaction function is also the medoid contribution strategy for WCC. □

The advantage of the analysis above is that it takes the whole contribution strategy as the observation. It allows us to quantify whether strategies are different across types, but not at which information sets $\overline{G}$ they differ. Note, however, that the medoids in Figure 3 in all games below the Nash equilibrium outcome are similar for among OWN, SCC and WCC, while the stereotypical contribution patterns differ across the three types in information sets $\overline{G}$ above the equilibrium level.

Result 3. *The majority of participants in all three main types do not choose conditionally Pareto-dominated contributions.*

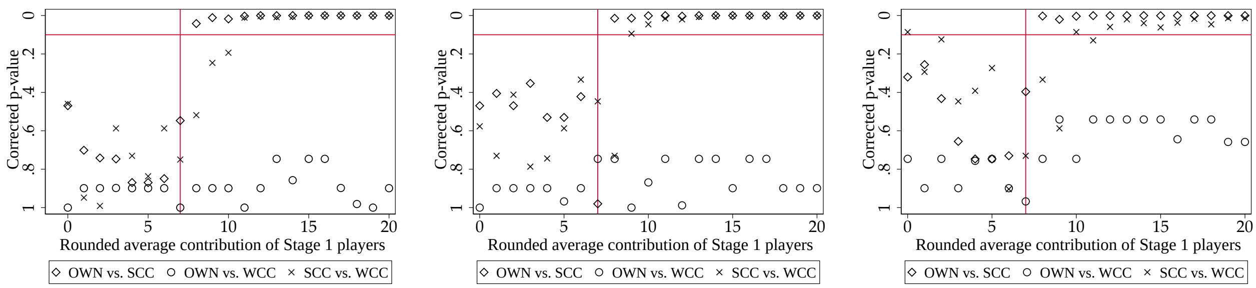
Support. The heatmaps in Figure 3 show there are some instances of inefficient responses below the own-earnings-maximising level. These occur most frequently in the information sets $\overline{G}$ below the equilibrium level. These are accounted for by 8 subjects in COMPLEMENTS, 15 in DOMINANT, and 16 in SUBSTITUTES. Of these, half are classified as WCC, and the others distributed equally between OWN and SCC. We identify only four subjects (3% of the sample) who systematically make Pareto-dominated choices in all the three games; two of these are classified as SCC, one as WCC and one as OWN. The contribution patterns for information sets $\overline{G}$ below the equilibrium level should be similar across types, as already hinted by looking at the heatmaps.

To test for this and for differences between types at any level of the information set, we follow Barr et al. (2018) and perform, for each information set $\overline{G}$, MWW tests comparing the distributions of contributions between each pair of types. We report in Figure 4 the p-values of these tests, corrected for the fact we are performing multiple tests.[22] OWN and SCC are distinguished at all information sets $\overline{G}$ above the symmetric Nash equilibrium level. SCC and WCC are distinguished

[20] Unlike in the univariate case, in the multivariate analysis there are no natural orderings of the data points. See Oja (2010) for an overview of the different rules to rank observations using the Manhattan distance.

[21] Specifically, we apply the Benjamini-Hochberg False Discovery Rate method (Simes, 1986; Benjamini and Hochberg, 1995). We sort the p-values in ascending rank, divide them by the rank and multiply for the number of multiple tests performed.

[22] We report the list of corrected p-values in Table 7 in Appendix B.



(a) DOMINANT (b) COMPLEMENTS (c) SUBSTITUTES

Figure 4: Results of pairwise comparisons of contribution strategies by information set $\overline{G}$. Each point is the p-value of a Mann-Whitney-Wilcoxon test; these are adjusted for multiple testing using the Benjamini-Hochberg False Discovery Rate method. The vertical reference line is at $\overline{G} = 7$, below which differences among the types are not expected. The horizontal reference line is set at $p = 0.10$.

when the contributions of the group exceed the Nash by more than a few tokens; the distinction is weaker in SUBSTITUTES, in which the reaction function is upward-sloping. Conversely, at information sets below the symmetric Nash equilibrium outcome, the contributions of the three types are statistically not distinguishable. □

5.2 Modeling the motivations of strong conditional cooperators

We observe generally consistent behaviour among strong conditional cooperators across all games, as well as a clear distinction of strong conditional cooperators from weak conditional cooperators. The observations of the strong conditional cooperators' contribution strategies across four games places constraints on the possible theoretical explanations for modeling the motivations of these people.

5.2.1 Inequity aversion

Fehr and Schmidt (1999) propose a model of *inequity aversion*, in which a player's utility may be affected by whether the player's monetary earnings are greater or less than the monetary earnings of other players. In our games, inequity in earnings across players is determined entirely by the different earnings players receive from their respective private accounts. Fix an information set $\overline{G}$, and assume the Stage 1 players all contribute $u_i = \overline{G}$. Let $f(g_i, G_{-i})$ represent the earnings to player i from her private account if she contributes g_i tokens to the project, and all other players contribute G_{-i} tokens in total. Note that $\frac{\partial f}{\partial g_i} < 0$. The financial earnings of player N are $\pi_N(g_N; \overline{G}) = f(g_N, (N-1)\overline{G})) + 0.4[(N-1)\overline{G} + g_N]$ and those of a given Stage 1 player i are

$\pi_i(g_N;\overline{G}) = f(\overline{G},(N-2)\overline{G}+g_N)+0.4[(N-1)\overline{G}+g_N]$. The difference in earnings between player N and player i is

$$I(g_N;\overline{G}) \equiv \pi_N(g_N;\overline{G}) - \pi_i(g_N;\overline{G}) = f(g_N,(N-1)\overline{G})) - f(\overline{G},(N-2)\overline{G}+g_N).$$

Following Fehr and Schmidt, the utility of player N is given by

$$U_N(g_N;\overline{G}) = \pi_N(g_N;\overline{G}) - \alpha\left[-I(g_N;\overline{G})\right]^+ - \gamma\left[I(g_N;\overline{G})\right]^-,$$

where $\alpha \geq 0$ represents the sensitivity of the player to disadvantageous inequity, and $\gamma \geq 0$ the sensitivity to advantageous inequity. For each of our games, there exists an interval of information sets $\overline{G}$, including the one which occurs in the symmetric equilibrium, over which interval $I'(g_N;\overline{G}) < 0$.[23] For these information sets,

$$U'_N(g_N;\overline{G}) = \begin{cases} \pi'_N(g_N;\overline{G}) + \alpha I'(g_N;\overline{G}) & \text{if } g_N > \overline{G} \\ \pi'_N(g_N;\overline{G}) - \gamma I'(g_N;\overline{G}) & \text{if } g_N < \overline{G}; \end{cases} \tag{9}$$

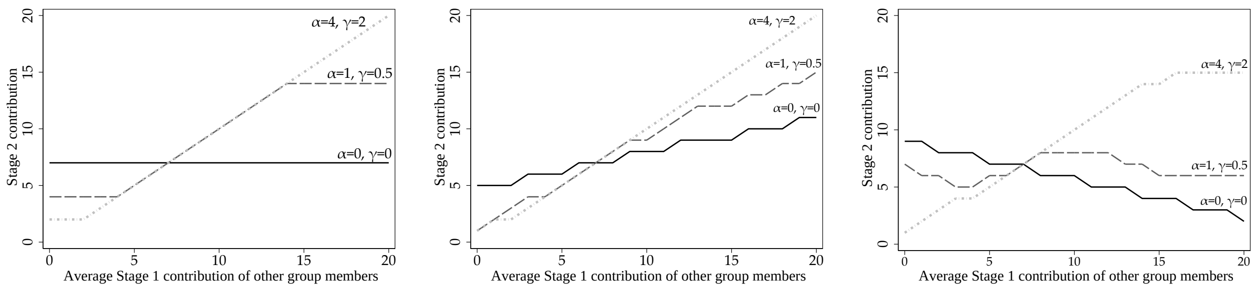
and $g_N = \overline{G}$ is a best response if

$$\gamma I'(\overline{G};\overline{G}) \leq \pi'_N(\overline{G};\overline{G}) \leq -\alpha I'(\overline{G};\overline{G}). \tag{10}$$

Condition (10) holds at the symmetric equilibrium value $u^\star = \overline{G}$ irrespective of α and γ. In our games, monetary earnings are concave in g_N given $\overline{G}$ (strictly for games other than LINEAR), and $\frac{d}{d\overline{G}}c^\star(\overline{G}) < 1$ for all games. Therefore for $\overline{G} > u^\star$, $\pi'_N(\overline{G};\overline{G}) < 0$, and so the left inequality in (10) is relevant; one-for-one matching for information sets $\overline{G} > u^\star$ would be sustained by an aversion to *advantageous* inequity, with progressively larger values of γ required for larger $\overline{G}$. For $\overline{G} < u^\star$, $\pi'_N(\overline{G};\overline{G}) > 0$, and so the right inequality in (10) is relevant; one-for-one matching for information sets $\overline{G} < u^\star$ would be sustained by an aversion to *disadvantageous* inequity. This model would therefore attribute the modal contribution strategy of SCC to significant aversion to advantageous inequity.

We plot in Figure 5 the contribution predictions in the three non-linear games for illustratively selected parameters α and γ. Exact one-for-one matching can indeed be rationalised by inequity aversion – but only if the player is *extremely* sensitive to inequity ($\alpha = 4, \gamma = 2$). These parameters are far away from the assumptions in Fehr and Schmidt (1999), and from the values of these parameters observed in other experimental settings (e.g. Blanco et al., 2011). The minority of strong

[23] $I'(g_N;\overline{G}) < 0$ condition fails to hold only for large $\overline{G}$ in COMPLEMENTS and small $\overline{G}$ in SUBSTITUTES, in which certain tokens result in losses if allocated to the private account.



(a) DOMINANT (b) COMPLEMENTS (c) SUBSTITUTES

Figure 5: Contribution predictions under the Fehr and Schmidt (1999) model in the non-linear games.

conditional cooperators in LINEAR who match one-for-one for $\overline{G} < 7$ in DOMINANT, COMPLEMENTS, and SUBSTITUTES could therefore be confused, or could be extremely inequity averse. However, inequity aversion, even at extreme levels, does not on its own produce the distinctive "hockey stick" shape of the medoid strategy of strong conditional cooperators in DOMINANT nor the V-shape of the medoid strategy in COMPLEMENTS.

5.2.2 Warm glow giving

Andreoni (1989) proposed that players might contribute more to the project than required to maximise their own monetary earnings due to a *warm glow* feeling arising from the act of voluntary contribution itself. Consider player N in information set $\overline{G}$, again assuming symmetry of contributions among Stage 1 players, and suppose her utility depends on her monetary earnings and the number of tokens she contributes, $U(g_N;\overline{G}) = h(\pi(g_N;\overline{G}), g_N)$. If we assume h is differentiable, a standard calculation shows the optimal response $c^{WG}(\overline{G})$ satisfies

$$\pi'(c^{WG}(\overline{G});\overline{G}) = -\frac{\partial h/\partial g}{\partial h/\partial \pi}.$$

The function specifying the monetary earnings in our experiment satisfies $\pi'(g;\overline{G}) - \pi'(\hat{g};\overline{G}) = 2\beta_2(\hat{g} - g)$ for any two contribution amounts g and $\hat{g}$, and therefore, for games with $\beta_2 > 0$,

$$c^{WG}(\overline{G}) - c(\overline{G}) = \frac{1}{2\beta_2} \times \frac{\partial h/\partial g}{\partial h/\partial \pi}. \tag{11}$$

where $c(\overline{G})$ is the contribution strategy for an own-earnings-maximising Stage 2 player.

As $\overline{G}$ increases, so increases the baseline wealth of the Stage 2 player, which derives from the Stage 1 contributions to the projects. The modal contribution strategy for SCC specifies the own-earnings-maximising contribution for $\overline{G}$ up to the symmetric equilibrium level of 7; from (11) this implies that warm glow must be zero (or negligible) for those income levels. To rationalise the one-for-one matching by SCC for $\overline{G} > 7$, (11) indicates that warm glow becomes relevant at those income levels, and indeed becomes relatively more important than monetary income rapidly. It would be a remarkable coincidence not only for so many participants to have preferences such that warm glow kicks in exactly at our equilibrium earnings level, and indeed that this level would occur exactly at our equilibrium as opposed to another group contribution level.[24]

5.2.3 Social cooperation norm compliance

Fehr and Schurtenberger (2018) propose a model which incorporates preferences for complying with a norm, following an idea of Elster (1989). This notion of *social cooperation norm compliance* offers a plausible account for the contribution strategies we observe among strong conditional cooperators. In the case of the conditional contribution decision in the p-experiment, the rounded average contribution $\overline{G}$ of other players might establish such a norm. A player in Stage 2 who gives consideration to social cooperation norm compliance would have utility

$$U_N(g_N, \overline{G}; \rho) = \begin{cases} \Pi_N(g_N, \overline{G}) - \rho \left(g_N - \overline{G}\right)^2 & \text{if } g_N < \overline{G} \\ \Pi_N(g_N, \overline{G}) & \text{if } g_N \geq \overline{G} \end{cases} \tag{12}$$

The parameter $\rho \geq 0$ captures the strength of any psychological costs that the player incurs by contributing *less* than the amount prescribed by the norm set by $\overline{G}$. Denote the best response contribution in game γ for a player with utility of the form (12) as $\tilde{c}^{\gamma}_{\rho}(\overline{G})$. Contributions in excess of the norm do not incur psychological costs or generate additional benefits; therefore, when $c^{\star\gamma}(\overline{G}) \geq \overline{G}$, it follows that $\tilde{c}^{\gamma}_{\rho}(\overline{G}) = c^{\star\gamma}(\overline{G})$. The stylised stereotypical behaviour of strong conditional cooperators, matching average contributions one-for-one when doing so is not conditionally Pareto-dominated, is generated by a sufficiently large value of ρ. In particular, for each game γ, there exists some threshold $\overline{\rho}^{\gamma}$ such that, when $\rho > \overline{\rho}^{\gamma}$, $\tilde{c}^{\gamma}_{\rho}(\overline{G}) = \overline{G}$ for all information sets $\overline{G}$ at which $c^{\star\gamma}(\overline{G}) < \overline{G}$. These threshold values are 0.61 for LINEAR, 0.51 for COMPLEMENTS, 0.76 for DOMINANT, and 0.88 for SUBSTITUTES. If $0 < \rho < \overline{\rho}^{\gamma}$, $\tilde{c}^{\gamma}_{\rho}(\overline{G}) \in \left(0, \overline{G}\right)$ for all information sets $\overline{G}$ at which $c^{\star\gamma}(\overline{G}) < \overline{G}$, corresponding broadly to the behaviour of weak conditional cooperators. The medoid contribution strategies for WCCs across the four environments are best rationalised by (12) with values of ρ between 0.015 and 0.03. These parameters contrast sharply with those which rationalise SCC strategies.

[24]Many contribution strategies classified as WCC are broadly consistent in a qualitative sense with (11) under the reasonable supposition that the glow from giving becomes relatively more important than the value of additional income as the baseline income increases.

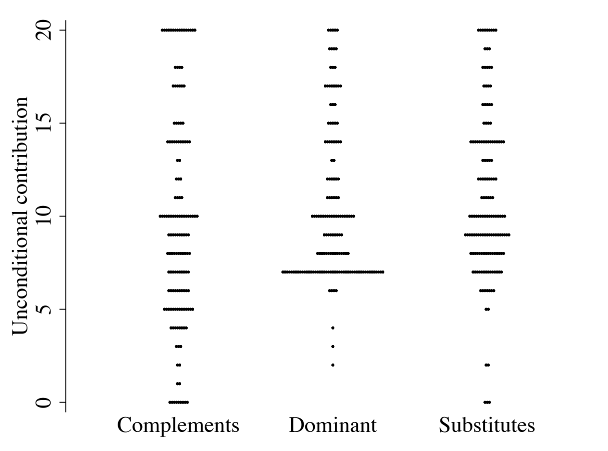


Figure 6: Distributions of unconditional contributions.

	LINEAR	DOMINANT	COMPLEMENTS	SUBSTITUTES
LINEAR	1.00			
DOMINANT	0.38 (<0.001)	1.00		
COMPLEMENTS	0.23 (0.006)	0.38 (<0.001)	1.00	
SUBSTITUTES	0.21 (0.011)	0.43 (<0.001)	0.40 (<0.001)	1.00

Table 3: Spearman rank-order correlation of unconditional contributions across games. Numbers in parentheses are significance levels adjusted for multiple testing using the Benjamini-Hochberg False Discovery Rate method.

	LINEAR	DOMINANT	COMPLEMENTS	SUBSTITUTES
OWN	0.4 (1.2)	8.8 (3.5)	8.8 (6.4)	10.1 (4.4)
WCC	4.2 (3.6)	9.8 (3.7)	8.5 (4.0)	11.1 (3.9)
SCC	6.1 (6.2)	11.1 (4.4)	10.9 (5.8)	11.9 (4.4)
UNH	12.5 (9.6)	14.5 (4.4)	17.3 (3.2)	13.5 (3.3)
MID	7.8 (4.1)	12.1 (4.0)	9.9 (5.2)	11.3 (4.9)
All	4.3 (5.2)	10.3 (4.1)	9.7 (5.7)	11.1 (4.4)

Table 4: Average and standard deviations (in parentheses) of Stage 1 contributions for each game, overall and disaggregated by behavioural type classification.

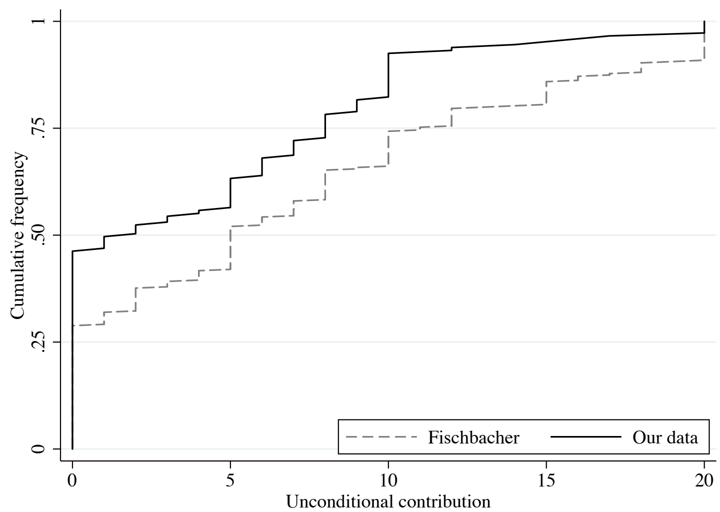


Figure 7: Empirical cumulative frequencies of unconditional contributions in LINEAR compared to the Fischbacher sample.

5.3 Unconditional contributions

Turning to the unconditional contributions in Stage 1, Table 4 provides the average and standard deviation of unconditional contributions by game, for all participants and broken out by each of the behavioural type classifications.

Result 4. *The distribution of unconditional contributions in our data differs from the Fischbacher sample. In our experiment, fewer participants make a positive unconditional contribution, and the overall amounts contributed in Stage 1 are also lower. These differences are consistent at type level.*

Support. Figure 7 plots the empirical cumulative frequencies of Stage 1 contributions in LINEAR, and the same for the Fischbacher sample. Using the Mann-Whitney-Wilcoxon (MWW) test, the distribution of our unconditional contributions differs from the Fischbacher sample ($r = .385$, $p < .001$).[25] The proportion of participants contributing a positive amount is lower in our data ($z = 3.71$, $p < .001$). The increase in zero contributions accounts for much although not all of the lower contributions in our data. Conditional on contributing a positive amount, contributions in our data are also somewhat lower (MWW, $r = .429$, $p = .055$).

Therefore, we observe broadly *similar* Stage 2 contribution strategies in our experiment as in the Fischbacher sample, we observe a very *different* distribution of Stage 1 unconditional contributions. We ask whether the difference in our unconditional contribution data is driven by a certain type or types. Table 5 summarises the distribution of contributions of the main types in Stage 1 for these three studies and our experiment. Stage 1 contributions are lower in our data type-for-type. Of particular note are the Stage 1 contributions for exact free-riders; in our data only 6% (2 of 33) of these participants contribute a positive amount, in contrast to 22% in the Fischbacher sample. Strong conditional cooperators, and in particular the one-for-one subset of them, contribute about half as much in our study as in the Fischbacher sample. □

Among the games with interior best-responses for own-earnings maximisers, Figure 6 plots the distributions of the unconditional contributions. As might be expected from the frequency of zero contributions in LINEAR, in DOMINANT there is a clear mode of contributions at the own-earnings dominant contribution of 7. In COMPLEMENTS we observe a sizeable number of unconditional contributions below the equilibrium of 7, whereas in SUBSTITUTES we observe very few.

Result 5. *In contrast to the ranking of games provided by rationalisability, unconditional contributions are highest in* SUBSTITUTES*, followed by* DOMINANT*, followed by* COMPLEMENTS*. The unconditional contributions of individual participants are positively correlated across games.*

Support. The average unconditional contribution is 9.7 tokens in COMPLEMENTS, 10.3 in DOMINANT, and 11.1 in SUBSTITUTES. 80 (50) participants contribute more (fewer) tokens in SUBSTITUTES than COMPLEMENTS (Wilcoxon matched-pairs test, $p = .003$). Contributions in DOMINANT are in between: 75 (48) participants contribute more (fewer) tokens in SUBSTITUTES than DOMINANT ($p = .091$), and 75 (54) contribute more (fewer) tokens in DOMINANT than COMPLEMENTS ($p = .040$). Overall, 37.1% of participants contribute at least as many tokens in SUBSTITUTES than DOMINANT and at least as many tokens in DOMINANT than COMPLEMENTS, while 20.0% of participants exhibit the reverse order.

Individual participants are systematically more or less generous in contributing to the project across games. Table 3 reports the Spearman rank-order correlations of participants' unconditional

[25]For MWW tests we report the test statistic in terms of the effect size r, which is defined as the probability a randomly-selected observation in the first-named sample is greater than a randomly-selected observation in the second-named sample, with ties broken equiprobably.

			All participants		Positive contributions only			
Type	Sample	N	Median	Mean	% Positive	N	Median	Mean
FR	Our data	33	0.0	0.1	6%	2	1.5	1.5
	Fischbacher	65	0.0	1.8	22%	14	5.5	8.4
OFO	Our data	11	0.0	2.9	36%	4	8.5	8.0
	Fischbacher	32	7.5	8.6	81%	26	10.0	10.5
CC	Our data	78	5.0	4.8	59%	46	7.5	8.2
	Fischbacher	191	8.0	8.4	82%	157	9.0	9.8
OWN	Our data	48	0.0	0.5	15%	7	3.0	3.1
	Fischbacher	124	0.0	3.2	43%	53	5.0	7.5
WCC	Our data	33	5.0	4.1	67%	22	6.0	6.1
	Fischbacher	65	7.0	7.1	92%	60	8.0	7.8
SCC	Our data	40	5.5	6.1	65%	26	9.0	9.4
	Fischbacher	109	10.0	10.2	89%	97	10.0	11.4

Table 5: Stage 1 contributions by various Stage 2 types.

contributions. The correlations between contributions in each pair of games are systematically positive, ranging from 0.21 between LINEAR and SUBSTITUTES to 0.43 between DOMINANT and SUBSTITUTES. We additionally aggregate unconditional contributions by type in Table 4, which shows that the pattern of contributing more tokens in SUBSTITUTES than in COMPLEMENTS is not driven solely by the behaviour of any one type. □

There are thus two key observations about unconditional contributions in these three games: (1) in all of DOMINANT, SUBSTITUTES, and COMPLEMENTS, average contributions exceed the own-earnings-maximising equilibrium prediction, even among those classified as OWN; (2) the ordering of average contributions is the opposite of what is predicted by rationalisability.

A candidate ex-post explanation for observation (1) is anticipated reciprocity. Our baseline analysis assumed the Stage 2 player maximised her own earnings; however, it is possible, if not probable that at least some players anticipated at least some reciprocity by the Stage 2 players. We extend our theoretical analysis to the case where Stage 1 players are own-maximisers but anticipate that the Stage 2 player follows the medoid SCC strategy of own-earnings-maximising below $\overline{G} = 7$ and matching one-for-one above. (See Appendix A for details.) Under this assumption, the equilibrium outcomes satisfy $u_1^{\star S} + u_2^{\star S} + u_3^{\star S} \in \{13, 26\}$ in SUBSTITUTES, $u_1^{\star D} + u_2^{\star D} + u_3^{\star D} \in \{26, 29\}$ in DOMINANT, and $u_1^{\star C} + u_2^{\star C} + u_3^{\star C} \in \{26, 29, 32\}$ in COMPLEMENTS.

We can offer some circumstantial evidence for anticipated reciprocity by comparing the unconditional contributions of conditionally-cooperative participants between COMPLEMENTS and SUBSTITUTES. Recall that the contribution strategies of strong conditional cooperators are particularly interesting in SUBSTITUTES because they contribute the fewest tokens in response to the information set $\overline{G} = 7$; either decreasing or increasing unconditional contributions from this level leads to an increase in their contributions. In contrast, their contribution strategies are increasing in COMPLEMENTS. We take the set of participants classified as WCC and SCC and consider their unconditional contributions in LINEAR. If we assume that these participants approach their decisions in Stage 1 and Stage 2 in similar ways, we can take their unconditional contribution in LINEAR as a rough proxy for their beliefs about the general expected contribution levels of other participants. A conditional cooperator who believes others will contribute few tokens should contribute more tokens in SUBSTITUTES than in COMPLEMENTS, because they anticipate contributions are likely to be in the region $\overline{G} < 7$ and therefore their preferences for conditional cooperation do not operate. In contrast, a conditional cooperator who believes contributions of others will be high should contribute roughly the same in SUBSTITUTES and COMPLEMENTS, because in that case their preferences for conditional cooperation would encourage them to contribute similar amounts in either game. We divide conditional cooperators into two groups based on whether their unconditional contribution in LINEAR is above or below the median of their type. We find that those who choose unconditional contributions below the median in LINEAR contribute significantly more tokens in SUBSTITUTES than in COMPLEMENTS (11.2 versus 8.5, Wilcoxon matched-pairs test $p = 0.005$). Those with above-median unconditional contributions in LINEAR contribute similar amounts in SUBSTITUTES and COMPLEMENTS (11.9 versus 11.4, $p = 0.541$). Anticipated reciprocity can therefore account for at least some of the unconditional contributions in excess of the own-earnings-maximising equilibrium.

Observation (2) on the relative contribution levels across the three games is more difficult to explain. In our two-stage game, the ordering given by rationalisability captures an intuitive observation. For example, in SUBSTITUTES, lowering one's unconditional contribution may result in the Stage 2 player responding with a higher contribution, making up at least some of the shortfall.[26] Because our game is played in two stages, there are few other experimental studies which are directly comparable. The closest similar result is reported by Mermer et al. (2021), who study a two-player repeated game in which, like us, earnings are determined by a quadratic functional form originally used in Potters and Suetens (2009). Also like us, they compare games with strategic substitutes and strategic complements, and find more cooperation in the first period under substitutes. However, their preferred explanation for their result is that, under their payoff functions, it is less risky to cooperate in their game with substitutes, in the sense that the difference between the

[26]Indeed, the existence of the asymmetric equilibria in our games results from the interaction between this intuition and the discreteness of the experimental game. In the discrete settings, there are contingencies in Stage 1 such that a one-token change in unconditional contributions leads to a countervailing one-token change in the Stage 2 player's response in SUBSTITUTES and COMPLEMENTS. This does not occur in the continuous case, where a one-token change in an unconditional contribution leads, in the own-earnings-maximising equilibrium, to a change of one-ninth of a token by the Stage 2 player.

Type	N	Mean	SE	Quartiles		
Own-maximisers	48	112.9	78.5	57	77	150
Strong conditional cooperators	42	115.0	70.8	62	97	153
Weak conditional cooperators	32	117.5	80.2	63	97	131
Mid-range	22	201.1	113.1	113	162	253
Unconditional high	4	150.3	100.7	79	117	222

Table 6: Time spent, in seconds, by participants answering control questions, by behavioural type.

payoff from cooperation, and the "sucker" payoff of cooperating when the other player does not, is smaller in their substitutes game than in their complements game. This is not the case for our payoff structure: if our payoff functions were used in a standard four-player simultaneous-move VCM, the loss to unrequited cooperation in COMPLEMENTS would be smaller than in SUBSTITUTES. We again note that the ranking of these three games in terms of unconditional contributions is consistent across all behavioural types, and within each game, it is generally the case that OWN contribute less than WCC who in turn contribute less than SCC, which seems reasonable to expect given the Stage 2 contribution strategies typical of those types; therefore the patterns in the data are internally consistent with expectations *except* with respect to the strategic intuition captured by rationalisability.

5.4 Response times to control questions

We have observed that strong conditional cooperators across games choose Stage 2 contribution strategies which appear to follow consistent principles incorporating some sophisticated consideration of the financial incentives of the game. This is suggestive that strong conditional cooperators are making a well-informed and conscious decision in forming their Stage 2 strategies.

To look for further evidence, we look at the time participants spent reviewing and answering the battery of comprehension control questions at the end of the instructions.[27] Table 6 reports descriptive statistics on the distribution of these times, by behavioural type.

Result 6. *Strong conditional cooperators are not different from own-maximisers or weak conditional cooperators in response time to control questions. Own-maximisers, weak and strong conditional cooperators take significantly less time to complete the control questions than mid-range.*

Support. Own-maximisers on average take 112.9 seconds to complete the control questions, strong conditional cooperators 115.0 seconds and weak conditional cooperators 117.5 seconds. The lower and upper quartiles of the distribution of response times are likewise similar between the groups.

[27]Note however, that Bigoni et al. (2016) control for the task comprehension on the level of contribution in a repeated game, finding no correlation.

We cannot reject the null hypothesis of these distributions being the same. (Kruskal-Wallis test, $p = 0.84$)

Mid-range contributors take notably longer to complete the questions, at 201.1 seconds. This differs from the response times of own-maximisers, weak conditional cooperators, and strong conditional cooperators, (MWW, $p = 0.001$; the probability the completion time of a randomly-chosen MID participant is longer than that of a randomly-chosen OWN/WCC/SCC is .76.) □

There are many factors which might feed into how long it takes a participant to complete the control questions. A participant could spend a longer time on the control questions because of one or more incorrect answers, as participants could only continue once they gave a correct response. Participants of different cognitive abilities might need more or less time to process and respond to a question. Some participants with long response times may simply be less engaged with the experimental task.[28] However, in order to complete the control questions in a relatively small length of time, a participant would need to be engaged with the task and provide the correct responses to questions quickly. Our strong conditional cooperators appear to be as well-engaged and understand the task as well as our own-maximisers.[29]

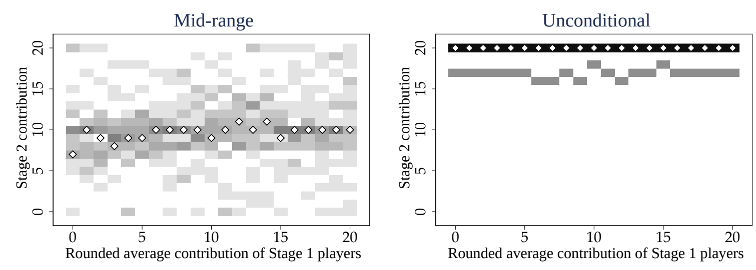
5.5 Mid-range and unconditional high contributors

Only 22 participants are classified as mid-range contributors and 4 as unconditional high contributors. These participants do not show a systematic response to the anticipated contributions of the other members of their group in LINEAR. Recall that the stereotype strategy for mid-range contributors is a constant contribution of 10 tokens irrespective of $\overline{G}$ and the stereotype for unconditional high is full contribution of 20 tokens.

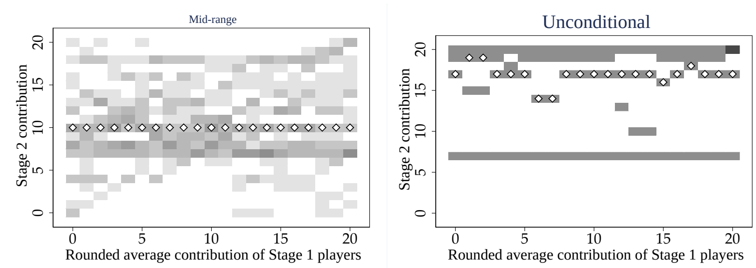
Figure 8 shows the heatmaps of Stage 2 strategies for these types. With only 4 participants classified as unconditional high contributors no meaningful conclusions can be drawn. The much longer control question response times for mid-range types reported in Table 6 suggest further qualitative comment on their behaviour across games. Their longer times to complete the control questions successfully suggests they had a harder time comprehending the experiment, were less engaged with the task, or both.

[28] The distributions of the completion times for all groups have long right tails.

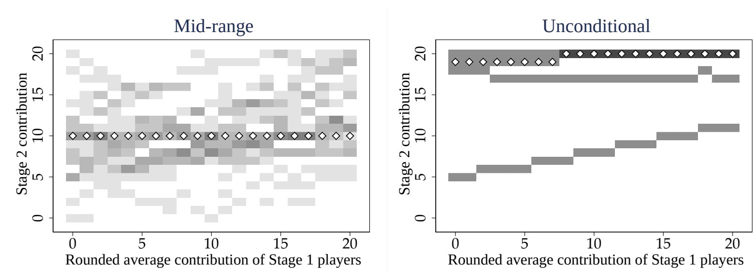
[29] We look at response times to the control questions rather than response times on choices because there are confounds in interpreting the latter. SCC generally take the longest to complete their Stage 2 decisions, while OWN complete Stage 2 more quickly. Fast decision times, however, are consistent both with clarity in one's own responses and with a lack of deliberation. There is a more prosaic reason why SCC take longer to complete Stage 2, which is simply that it takes more mouse movement to input the SCC strategies. It is interesting that the participants who adopt one-for-one strategies do so even though it is more work for them to input it in the software than a constant strategy such as zero contributions in all contingencies.



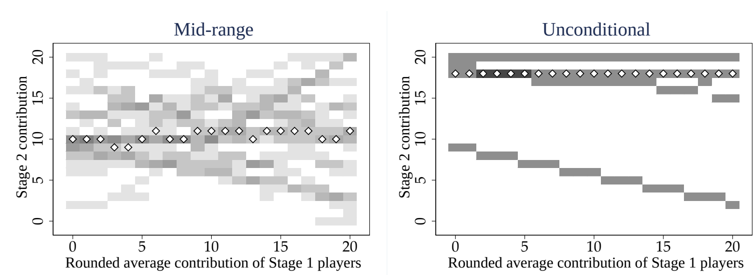
(a) LINEAR



(b) DOMINANT



(c) COMPLEMENTS



(d) SUBSTITUTES

Figure 8: Heatmap of Stage 2 strategies for contribution to the project, for mid-range and unconditional high types, across games

The medoid contribution strategy for mid-range contributors in LINEAR is exactly, or nearly, a contribution of 10 for all $\overline{G}$ for all four games. The contribution strategies do not shift systematically in response to the varying financial incentives across the games. The contributions in these contribution strategies are not uniformly random; contributions closer to 10 tokens are more frequent than those at either the high or low end of the strategy space. This contrasts with the clustering results in Fallucchi et al. (2019), in which the heatmap of the analogous "various" group is roughly uniform for all information sets $\overline{G}$. This may be a response to a lack of confidence in their comprehension of the game, in which a "choose the middle" heuristic may seem the safest option. Alternatively, some may choose a contribution of 10 tokens on the principle of "share and share alike," where sharing is not done in terms of the financial incentives of the game, but instead based on the strategy space of tokens. Our experiment is not designed to identify these or other possible motivations for the mid-range contributor strategies, but we can note that as a group they are not systematically responsive to the economic environment given by the financial incentives. This suggests the instinctive response of participants who are unengaged, confused, uncertain, and/or importing heuristics from other settings is to split the token endowment more or less equally between the private account and the project; and not, in contrast to Hypothesis 3, reflexively to match the contributions of others one-for-one.

6 Discussion

We investigate the robustness of pro-social behaviour in VCM games by eliciting the behaviour of the same participants in games with different economic and strategic structures. In the game with linear payoffs we find proportions of participants who adopt contribution strategies at or near the two most common stereotypes, exact free-riding and exact one-for-one matching, which are comparable to previous studies, even though we introduce a novel choice architecture designed to present financial incentives transparently across all our environments. The contribution strategies in the linear game are strongly predictive of the contribution strategies specified in the additional environments we investigate. Taken together, type classifications based on contribution strategies are fairly robust to how the decisions are elicited, and have predictive value for how participants will choose in the other, related voluntary contributions environments we study.

Our results support the distinction between strong and weak forms of conditional cooperation, as proposed in Fallucchi et al. (2019). Strong conditional cooperators, who match the average contributions of others at or near a rate of one-for-one, generally avoid choosing conditionally Pareto-dominated contribution levels. This provides evidence in favour of the account that, at least for many strong conditional cooperators, the adoption of one-for-one matching is informed by the financial incentives of the experiment. Within the same strategy, strong conditional cooperators demonstrate through their responses in some contingencies that they can identify the response which maximises their own earnings, while in other contingencies they choose larger contributions, which improve the earnings of the group at a cost to themselves. Among existing theoretical approaches, this integration of financial incentives and other considerations is best captured by a model of social contribution norm compliance. This model is distinguished from an explanation based solely to due to conformity (Bardsley and Sausgruber, 2005) in its inclusion of financial incentives; in our interpretation, the social norm of matching is applied only when it does not lead to inefficient outcomes. Other standard models, such as warm glow giving or inequity aversion, would require assumptions on parameters which are either knife-edge or inconsistent with received results from experiments in other types of environments.

By applying the conditional contribution procedure in the p-experiment protocol to other environments, we also learn more about the properties of the procedure itself. Zizzo (2010) raises the possibility that the conditional contribution procedure creates a demand effect, by suggesting that contributions *should* depend on the actions of others. Participants would therefore be more likely to specify a contribution strategy which is responsive to the information about the contributions $\overline{G}$ of others, even though the financial incentives of the game would indicate otherwise for participants seeking to maximise their own earnings. We include two environments, SUBSTITUTES and COMPLEMENTS, in which participants who want to maximise their own earnings should indeed respond by changing their contributions in response to $\overline{G}$. Strong conditional cooperators choose a systematically different way of conditioning their responses, which rules out experimenter demand as an explanation for one-for-one matching.

The economically significant difference in our data compared to previous experiments using the p-experiment protocol is that we observer lower unconditional contributions in LINEAR. Under the assumption that participants choose unconditional contributions according to their beliefs about the choices of others while using a strategy similar to their stated contribution strategy, lower unconditional contributions by conditional cooperators (of either type) would imply more pessimistic beliefs about the anticipated contributions of others (Kölle et al., 2014).[30] However, unconditional contributions by own-maximisers are also lower; indeed almost all participants who are exact free-riders in their contribution strategy also specify an unconditional contribution of zero. So beliefs alone cannot explain the lower unconditional contributions in our data.

One explanation for the discrepancy in previous p-experiment studies in which free-riders nevertheless contribute positive amounts in Stage 1 is the use of the strategy method itself. In Stage 2 of the p-experiment, participants are asked to think through the possible contingencies of $\overline{G}$ that might arise, and how they would respond; such contingency-by-contingency reasoning might lead

[30]We did not attempt to measure beliefs in this experiment. The protocol is already complex for a participant to digest, even with our choice architecture and concrete phrasing of many parts of the instructions.

own-earnings-maximising participants to realise that, in LINEAR, free riding always maximises earnings. In contrast, the elicitation of the Stage 1 unconditional contributions does not offer the opportunity to walk through such best-response reasoning.[31] In p-experiment studies, the elicitation of the Stage 2 contribution strategy occurs after the Stage 1 unconditional contribution, so any experience from strategy-method thinking in Stage 2 comes too late to inform Stage 1 decisions. This would account for the discrepancy among own-earnings-maximisers contributing zero across the board in Stage 2 while making positive contributions in Stage 1. In our choice architecture, the tokens are individually-labeled with their earnings consequences, a feature we intended precisely to make the own-earnings-maximising choice transparent. Because own-earnings-maximisers receive this cue in Stage 1 in our design, their Stage 1 and Stage 2 decisions tend to be more consistent.

Based on the re-analysis of Fallucchi et al. (2019) and the data in this paper, about 30% of participants choose strongly conditionally cooperative contribution strategies in a linear VCM game. We show that the contribution strategies a majority of these participants adopt in other games points to them understanding the financial incentives they face in the games, and reacting to those in a sophisticated way. These strong conditional cooperators match the average contributions of others when - and only when - doing so is efficiency enhancing. The "only when" in the previous statement allows us to rule out confusion, misunderstanding, or a lack of engagement with the experimental task as an explanation for this behaviour. Most strong conditional cooperators are expressing a sophisticated response to the social dilemmas posed by the voluntary contributions environment.

[31] Anyone who has taught introductory game theory will know from experience that the contingency-by-contingency reasoning to generate a reaction function does not come naturally to most students!

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A Experimental games: Design and perfect Bayesian equilibrium analysis

In this section we analyse the four p-experiment games, under the assumption that all players maximise their own earnings. We show that for each game the Stage 2 player has a unique best response strategy. Given this, we can identify the set of unconditional contributions which are rationalisable for the Stage 1 players, and characterise the set of perfect Bayesian equilibria.

We number the three Stage 1 players as $i = 1, 2, 3$, and the Stage 2 player as $i = 4$. For LINEAR and DOMINANT the analysis is straightforward, as the allocation which maximises earnings does not depend on the allocations of other players. In LINEAR, the contribution which maximises earnings is 0, irrespective of what other players do, and therefore the Stage 2 player's equilibrium contribution strategy is $c^{\star L}(\overline{G}) = 0$ for all $\overline{G} \in \{0, \ldots, 20\}$, and for the Stage 1 players, the equilibrium unconditional contributions are $u_1^{\star L} = u_2^{\star L} = u_3^{\star L} = 0$. In DOMINANT, the contribution which maximises earnings is 7, and therefore the Stage 2 player's equilibrium contribution strategy is $c^{\star D}(\overline{G}) = 7$ for all $\overline{G} \in \{0, \ldots, 20\}$, and for the Stage 1 players, the equilibrium unconditional contributions are $u_1^{\star D} = u_2^{\star D} = u_3^{\star D} = 7$.

In turning to the analysis of SUBSTITUTES and COMPLEMENTS, our design of these games incorporated several considerations. As a starting point, we chose parameters such that the equilibria of the simultaneous-move VCM with payoff functions Π^S and Π^C would have a unique symmetric equilibrium with all players contributing 7, which coincides with the unique equilibrium in DOMINANT. The p-experiment game is a two-stage game, however. If our games were played with payoff functions Π^S and Π^C but with continuous action spaces and perfect information about the actions of the Stage 1 players, there would be a unique equilibrium in each game following the usual Stackelberg-type logic. In SUBSTITUTES, Stage 1 players would have an incentive to reduce contributions below 7, anticipating that the Stage 2 player would respond with a higher contribution; in COMPLEMENTS, the Stage 1 players would have an incentive to increase contributions above 7, anticipating that the Stage 2 player would respond with a higher contribution.

This intuition applies to our games, but is complicated by the discreteness of the action space and especially the imperfect information resulting from the rounding of the average contributions of the Stage 1 players. The latter creates a discontinuity in the reaction function for the Stage 2 player; it is this discontinuity that results in multiple equilibria in games with this structure (and not just for our chosen parameters). There are Stackelberg-type equilibria, which for our parameters involve asymmetric contributions among the Stage 1 players, where the asymmetry is a consequence of the discreteness of action spaces. Meanwhile, the unique symmetric equilibrium of the game corresponds to the equilibrium of the simultaneous-move version, and therefore to the dominant strategies in DOMINANT. This equilibrium survives because any of the Stage 1 player would have to decrease (in SUBSTITUTES) or increase (in COMPLEMENTS) their contribution by multiple tokens in order to change the response of the Stage 2 player, and such a unilateral deviation is unprofitable.

Another important design feature is that the best response for the Stage 2 player is constant for all G_{-i} consistent with each information set $\overline{G}$. This is a consequence of the discreteness of the action space, and is useful both theoretically and practically. Theoretically, it means that beliefs at each information set are not important for computing the reaction functions, and therefore the Stage 2 player has a dominant strategy response. This is important because the Stage 2 contribution strategies are the focus of our experiment. In LINEAR, the rounding of average Stage 1 contributions is not problematic for the baseline case of own-earnings-maximising players, but is important practically because it cuts down the number of choices participants need to specify in their contribution strategies. Our parameter choices allow us to extend the p-experiment design to our payoff structure, while not losing any information which is strategically relevant to an own-earnings-maximising player in Stage 2.

The multiplicity of equilibria is a consequence of having discrete action spaces, the rounding of the average contributions to report to the Stage 2 player, and having a systematic pattern for how the value of tokens allocated to the private account change. Multiplicity could in principle be eliminated by manipulating the formula for the value of tokens in the private account to destroy one of the classes of equilibria, but at the cost of not having an easily-explainable rule for how these values are determined. Our design retains the nice properties that the symmetric equilibrium contributions are the same across SUBSTITUTES, DOMINANT, and COMPLEMENTS, and further that the iteratively rationalisable unconditional contributions are weakly orderable, with contributions in SUBSTITUTES no more than in DOMINANT, and contributions in DOMINANT no more than in COMPLEMENTS.

We now turn to the detailed analysis of SUBSTITUTES and COMPLEMENTS.

A.1 Analysis of SUBSTITUTES

We begin with the Stage 2 player's decision. For any fixed G_{-4}, player 4's earnings are strictly concave in her contribution. Therefore, if two contributions (g_4, x_4) and $(g_4 - 1, x_4 + 1)$, which are adjacent in $\mathcal{A}_{\mathbb{Z}}$, result in the same earnings, they must jointly be the two (and only two) earnings-maximising contributions. We can therefore characterise the best response of player 4 by identifying the values of G_{-4} at which she is indifferent between adjacent contributions.

$$\begin{aligned}\Pi_4^S(g_4, G_{-4}) - \Pi_4^S(g_4 - 1, G_{-4}) &= -\left(1.06 + \frac{.02}{3}G_{-4}\right) + .03\,(2(20 - g_4) + 1) + 0.40 \\ &= -.63 + .06(20 - g_4) - \frac{.02}{3}G_{-4}. \end{aligned} \tag{13}$$

Setting this equal to zero, we see that player 4 is indifferent between g_4 and $g_4 - 1$ if and only if $\hat{G}_{-4} = 9(9.5 - g_4)$. If $G_{-4} < \hat{G}_{-4}$, she strictly prefers g_4 to $g_4 - 1$, and if $G_{-4} > \hat{G}_{-4}$, she strictly prefers $g_4 - 1$ to g_4. Note that there are no solutions where g_4 and $\hat{G}_{-4}$ are both integers. Therefore the best response is strict for all G_{-4}, and g_4 is a best response to G_{-4} if and only if $25\frac{2}{3} - 3g_4 \leq \frac{G_{-4}}{3} \leq 28\frac{1}{3} - 3g_4$. If this inequality is satisfied for some G_{-4} such that $\frac{G_{-4}}{3}$ is an integer, it is also satisfied for $G_{-4} - 1$ and $G_{-4} + 1$ for the same g_4. Therefore, for all information sets $\overline{G}$, the best response is constant over all total contributions G_{-4} for which $\frac{G_{-4}}{3}$ rounds to $\overline{G}$. The beliefs that player 4 might have over the values G_{-4} which are consistent with information set $\overline{G}$ do not affect the best response. The unique rationalisable contribution strategy $c^{\star S}(\overline{G})$, and the contribution strategy in any perfect Bayesian equilibrium, is therefore

$c^{\star S}(\overline{G})$	2	3	4	5	6	7	8	9
G_{-4}	59-60	50-58	41-49	32-40	23-31	14-22	5-13	0-4
$\overline{G}$	20	17-19	14-16	11-13	8-10	5-7	2-4	0-1

Turning to the Stage 1 players, the discrete jumps in the contribution strategy $c^{\star S}(\overline{G})$ complicate the analysis. It is most straightforward to tabulate the best response function by direct calculation. Player 1's reaction function is given by

$u_2 + u_3$	$\tilde{u}_1^S$	$u_2 + u_3$	$\tilde{u}_1^S$	$u_2 + u_3$	$\tilde{u}_1^S$	$u_2 + u_3$	$\tilde{u}_1^S$
0	8						
1	8	11	7	21	6	31	5
2	8	12	7	22	6	32	5
3	8	13	7	23	6	33	5
4	8	14	7	24	6	34	5
5	8	15	7	25	6	35	5
6	7	16	6	26	5	36	4
7	6	17	5	27	4	37	3
8	5	18	4	28	3	38	2
9	4	19	3	29	2	39	1
10	3	20	2	30	1	40	0

By symmetry the best responses of the other players are identical up to the appropriate permutation of the indices. In many contingencies, the optimal response for a player is to reduce their contribution by exactly the number of tokens required to trigger a one-token increase by the Stage 2 player. For example, consider a situation in which player 1 believes that $u_2 + u_3 = 18$. Consider any $5 \leq u_1 \leq 13$; this results in $23 \leq G_{-4} \leq 31$ and the Stage 2 player responds with a contribution of 6 at these information sets. Among these, $u_1 = 6$ would result in the highest earnings for player 1. However, if instead player 1 contributes $u_1 = 4$, then $G_{-4} = 32$ and the Stage 2 player responds instead with a contribution of 7 tokens. Player 1's earnings from $u_1 = 4$ are higher than from $u_1 = 6$; there is a net loss of 0.40 from there being one fewer token contributed overall to the project, but player 1 is more than compensated by his private account tokens being more valuable due to the Stage 2 player's larger contribution.

To identify the rationalisable strategies for the Stage 1 players, without loss of generality assume $u_1^\star \leq u_2^\star \leq u_3^\star$. Because $u_3^\star \leq 8$, $u_2^\star + u_3^\star \leq 16$, and so $3 \leq u_1^\star$. This implies $u_1^\star + u_2^\star \geq 6$, and so $u_3^\star \leq 7$. Therefore, $6 \leq u_2^\star + u_3^\star \leq 14$, and the rationalisable strategies are $3 \leq u_i^\star \leq 7$.

The remaining pure strategy profiles $(u_1^\star, u_2^\star, u_3^\star)$ in which $u_1^\star \leq u_2^\star \leq u_3^\star$ and $u_1^\star$ is a best response to $u_2^\star + u_3^\star$ are $(7, 7, 7)$ and $\{(3, 3, 7), (3, 4, 6), (3, 5, 5), (4, 4, 5)\}$. By inspection, the first is the unique symmetric equilibrium, in which total unconditional contributions are $G_{-4} = 21$, and the Stage 2 player responds on the equilibrium path with a contribution of 7. The second set are asymmetric equilibria, in which total unconditional contributions are $G_{-4} = 13$, and the Stage 2 player responds on the equilibrium path with a contribution of 8.

A.2 Analysis of COMPLEMENTS

We begin with the Stage 2 player's decision. For any fixed G_{-4}, player 4's earnings are strictly concave in her contribution. Therefore, if two contributions g_4 and $g_i - 4$, which are adjacent in $\mathcal{A}_{\mathbb{Z}}$, result in the same earnings, they must jointly be the two (and only two) earnings-maximising contributions. We can therefore characterise the best response of player 4 by identifying the values of G_{-4} at which she is indifferent between adjacent contributions.

$$\begin{aligned}
\Pi_i^C(g_4, G_{-4}) - \Pi_i^C(g_4 - 1, G_{-4}) &= -\left(1.34 - \frac{.02}{3}G_{-4}\right) + .03\,(2(20 - g_4) + 1) + 0.40 \\
&= -.91 + .06(20 - g_4) + \frac{.02}{3}G_{-4}. \qquad (14)
\end{aligned}$$

Setting this equal to zero, we see that player 4 is indifferent between g_4 and $g_4 - 1$ if and only if $\hat{G}_{-4} = 9\left(g_4 - 4\frac{5}{6}\right)$. If $G_{-4} > \hat{G}_{-4}$, she strictly prefers g_4 to $g_4 - 1$, and if $G_{-4} < \hat{G}_{-4}$, she strictly prefers $g_4 - 1$ to g_4. Note that there are no solutions where g_4 and $\hat{G}_4$ are both integers. Therefore, the best response is strict for all G_{-4}, and (g_4, x_4) is a best response to G_{-4} if and only if $3g_4 - 14\frac{1}{3} \leq \frac{G_{-4}}{3} \leq 3g_4 - 11\frac{2}{3}$. If this inequality is satisfied for some G_{-4} such that $\frac{G_{-4}}{3}$ is an integer, it is also satisfied for $G_{-4} - 1$ and $G_{-4} + 1$ for the game g_4. Therefore, for all information sets $\overline{G}$, the best response is constant over all total contributions G_{-4} for which $\frac{G_{-4}}{3}$ rounds to $\overline{G}$. The beliefs that player 4 might have over the values G_{-4} which are consistent with information set $\overline{G}$ do not affect the best response. The unique rationalisable contribution strategy $c^{\star C}(\overline{G})$, and the contribution strategy in any perfect Bayesian equilibrium, is therefore

$c^{\star C}(\overline{G})$	11	10	9	8	7	6	5	4
G_{-4}	56-60	47-57	38-46	29-37	20-28	11-19	2-10	0-1
$\overline{G}$	20-19	16-18	13-15	10-12	7-9	4-6	1-3	0

Turning to the Stage 1 players, again it is most straightforward to tabulate the best response function by direct calculation. Player 1's reaction function is given by

$u_2 + u_3$	$\tilde{u}_1^C$	$u_2 + u_3$	$\tilde{u}_1^C$	$u_2 + u_3$	$\tilde{u}_1^C$	$u_2 + u_3$	$\tilde{u}_1^C$
0	5						
1	5	11	9	21	8	31	9
2	5	12	8	22	8	32	9
3	8	13	7	23	8	33	9
4	7	14	7	24	8	34	9
5	6	15	7	25	8	35	12
6	6	16	7	26	8	36	11
7	6	17	7	27	11	37	10
8	6	18	7	28	10	38	10
9	6	19	10	29	9	39	10
10	6	20	9	30	9	40	10

By symmetry the best responses of the other players are identical up to the appropriate permutation of the indices. The intuition for the jumps in the reaction function is parallel to SUBSTITUTES, except in COMPLEMENTS Stage 1 players may find it profitable to contribute just enough tokens to ensure an additional token contribution by the Stage 2 player.

To identify the rationalisable strategies for the Stage 1 players, without loss of generality assume $u_1^\star \leq u_2^\star \leq u_3^\star$. Because $u_2^\star \geq 5$, $u_2^\star + u_3^\star \geq 10$, and so $6 \leq u_1^\star$. This implies $u_2^\star + u_3^\star \geq 12$. Therefore, the rationalisable strategies are $7 \leq u_i^\star \leq 10$.

We consider remaining pure strategy profiles $(u_1^\star, u_2^\star, u_3^\star)$ in which $u_1^\star \leq u_2^\star \leq u_3^\star$ in increasing lexicographic order. The profile $(7, 7, 7)$ is a symmetric equilibrium, in which the total unconditional contributions are $G_{-4} = 21$, and the Stage 2 player responds on the equilibrium path with a contribution of 7. In order for $u_3^\star \geq 8$, $u_1^\star + u_2^\star \geq 19$, so the next profile to consider is $(9, 9, 10)$, at which player 3 is not best-responding. The profile $(9, 10, 10)$ is an asymmetric equilibrium, in which the total unconditional contributions are $G_{-4} = 29$, and the Stage 2 player responds on the equilibrium path with a contribution of 8.

A.3 Extension to the case where the Stage 2 player is SCC

As an extension, we characterise the set of rationalisable strategies and the pure-strategy perfect Bayesian equilibria under the assumption that Stage 1 players maximise their own earnings, while the Stage 2 player is a strong conditional cooperator.

First, observe that in LINEAR the equilibrium unconditional contributions remain $u_1^{\star L} = u_2^{\star L} = u_3^{\star L} = 0$ even if the Stage 2 player follows the strategy $\hat{c}^{SCC}(\overline{G}) = \overline{G}$. Without loss of generality, consider player 1; we claim that for any given u_2 and u_3, player 1's earnings are strictly decreasing in u_1. To see this, suppose player 1 increases their contribution from some level u_1 to u_1+1. Either this results in no change in the Stage 2 player's contribution, in which case player 1's earnings decrease by 0.60; or, it results in the Stage 2 player contributing an additional token, in which case player 1's earnings decrease by 0.20. Therefore, $u_i = 0$ remains a strictly dominant strategy for all Stage 1 players $i = 1, 2, 3$.

Based on our experimental results, for games $\gamma \in \{D, S, C\}$ we define the Stage 2 player's SCC strategy as

$$c^{SCC,\gamma}(\overline{G}) = \begin{cases} c^{\star\gamma}(\overline{G}) & \text{if } \overline{G} \leq 7 \\ \overline{G} & \text{if } \overline{G} > 7. \end{cases}$$

We then proceed to compute the reaction functions for the Stage 1 players under the assumption the Stage 2 player uses strategy $c^{SCC,\gamma}$. The method for enumerating the rationalisable strategies and equilibrium unconditional contribution profiles is the same as used in the previous subsections; we present an abbreviated summary for compactness.

For SUBSTITUTES, the reaction function for player 1 is

$u_2 + u_3$	$\tilde{u}_1^S$	$u_2 + u_3$	$\tilde{u}_1^S$	$u_2 + u_3$	$\tilde{u}_1^S$	$u_2 + u_3$	$\tilde{u}_1^S$
0	8						
1	8	11	7	21	8	31	7
2	8	12	7	22	7	32	6
3	8	13	10	23	9	33	8
4	8	14	9	24	8	34	7
5	8	15	8	25	7	35	6
6	7	16	10	26	9	36	5
7	6	17	9	27	8	37	8
8	5	18	8	28	7	38	7
9	4	19	7	29	6	39	6
10	3	20	9	30	8	40	7

The rationalisable strategies are $3 \leq u_i^\star \leq 10$. The equilibria with $G_{-4} = 13$ previously identified remain equilibria in this modified setting. However, the symmetric profile $(7,7,7)$ is no longer an equilibrium. Instead, there is a family of equilibria at profiles $(7,9,10)$, $(8,8,10)$, and $(8,9,9)$, with $G_{-4} = 26$, to which the Stage 2 player responds on the equilibrium path with a contribution of 9.

For COMPLEMENTS, the reaction function for player 1 is

u_2+u_3	$\tilde{u}_1^C$	u_2+u_3	$\tilde{u}_1^C$	u_2+u_3	$\tilde{u}_1^C$	u_2+u_3	$\tilde{u}_1^C$
0	5						
1	5	11	9	21	11	31	10
2	5	12	8	22	10	32	12
3	8	13	7	23	9	33	11
4	7	14	9	24	11	34	13
5	6	15	8	25	10	35	12
6	6	16	10	26	9	36	11
7	6	17	9	27	11	37	13
8	6	18	8	28	10	38	12
9	6	19	10	29	12	39	14
10	6	20	9	30	11	40	13

The rationalisable strategies are $8 \le x_i^\star \le 11$. The symmetric profile $(7,7,7)$ is no longer an equilibrium. There exist equilibria at $(8,8,10)$ and $(8,9,9)$, with $G_{-4} = 26$ and a Stage 2 contribution of 9; at $(9,10,10)$, with $G_{-4} = 29$ and a Stage 2 contribution of 10; and at $(10,11,11)$, with $G_{-4} = 32$ and a Stage 2 contribution of 11.

For DOMINANT, the reaction function for player 1 is

u_2+u_3	$\tilde{u}_1^D$	u_2+u_3	$\tilde{u}_1^D$	u_2+u_3	$\tilde{u}_1^D$	u_2+u_3	$\tilde{u}_1^D$
0	7						
1	7	11	7	21	8	31	10
2	7	12	7	22	10	32	9
3	7	13	10	23	9	33	8
4	7	14	9	24	8	34	10
5	7	15	8	25	10	35	9
6	7	16	10	26	9	36	8
7	7	17	9	27	8	37	10
8	7	18	8	28	10	38	9
9	7	19	10	29	9	39	8
10	7	20	9	30	8	40	10

The rationalisable strategies are $8 \leq u_i^\star \leq 10$. The symmetric profile $(7, 7, 7)$ is no longer an equilibrium. There exist equilibria at $(8, 8, 10)$ and $(8, 9, 9)$, with $G_{-4} = 26$ and a Stage 2 contribution of 9; and at $(9, 10, 10)$, with $G_{-4} = 29$ and a Stage 2 contribution of 10.

B Adjusted p-values of the multiple pairwise comparisons

	Dominant			Complements			Substitutes		
$\overline{G}$	OWN vs. SCC	SCC vs. WCC	OWN vs. WCC	OWN vs. SCC	SCC vs. WCC	OWN vs. WCC	OWN vs. SCC	SCC vs. WCC	OWN vs. WCC
≤ 7	>0.469	>0.460	>0.898	>0.405	>0.333	>0.746	>0.255	>0.086	>0.746
8	<0.001	0.518		0.014	0.730		0.003	0.333	
9	0.011	0.246		0.014	0.094		0.020	0.587	
10	0.018	0.194		0.001	0.046		0.004	0.086	
11	0.003	0.011		<0.001	0.015		<0.001	0.072	
12	<0.001	0.003		0.003	0.020		<0.001	0.059	
13	<0.001	0.009		<0.001	0.007		<0.001	0.020	
14	<0.001	0.006	>0.746	<0.001	0.002	>0.746	<0.001	0.039	>0.541
15	<0.001	0.001		<0.001	0.001		0.001	0.062	
16	<0.001	<0.001		<0.001	0.001		<0.001	0.037	
17	<0.001	<0.001		<0.001	0.001		<0.001	0.017	
18	<0.001	<0.001		<0.001	<0.001		<0.001	0.046	
19	<0.001	<0.001		<0.001	<0.001		0.001	0.014	
20	<0.001	<0.001		<0.001	<0.001		<0.001	0.014	

Table 7: Pairwise comparisons of contribution strategies by information set $\overline{G}$. Each cell is the p-value of a Mann-Whitney-Wilcoxon test; these are adjusted for multiple testing using the Benjamini-Hochberg False Discovery Rate method. $\overline{G}$ at or below the Bayes-Nash contribution level are grouped, as no difference is expected in these contingencies.

C Stage 2 contributions by $\overline{G}$

These tables present the raw data used to make the heatmaps in Figure 3. In each table, the columns represent the information sets $\overline{G}$. Each row corresponds to one conditional contribution amount c. These tables aggregate over all Stage 2 contribution strategies of players classified as the indicated type.

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0
5	0	0	0	1	0	1	0	0	1	1	1	1	0	0	1	3	3	3	1	1	4
4	0	0	0	0	0	0	1	0	1	1	0	0	1	2	2	2	1	1	5	5	4
3	1	1	1	1	3	1	2	2	1	2	2	2	4	4	3	2	2	3	3	1	1
2	1	0	2	1	0	1	2	2	1	2	4	3	3	3	3	3	4	2	1	2	0
1	0	2	0	3	3	5	2	2	3	3	2	2	2	1	1	1	1	2	3	4	4
0	45	44	44	42	42	40	40	41	41	38	39	40	37	37	37	37	36	36	34	34	33

LINEAR: Own-maximisers ($N = 48$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	2	2	2	7	8	26
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	18	6
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	19	6	5
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	20	4	3	2
16	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	3	20	5	4	1	1
15	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3	22	7	5	1	2	0
14	0	0	0	0	0	0	0	0	0	0	0	0	1	2	22	6	3	2	0	1	0
13	0	0	0	0	0	0	0	0	0	0	0	0	2	23	4	2	2	1	2	0	0
12	0	0	0	0	0	0	0	0	0	0	0	3	23	4	2	1	1	1	0	0	0
11	0	0	0	0	0	0	0	1	0	0	2	21	4	2	4	1	1	0	0	0	0
10	0	0	0	0	0	0	0	0	0	2	21	5	3	4	2	1	0	0	1	1	0
9	0	0	0	0	0	0	0	0	2	20	9	5	4	2	2	0	0	0	0	0	0
8	0	0	0	0	0	0	0	2	21	10	2	1	1	1	0	0	0	0	0	0	0
7	0	0	0	0	1	1	1	22	7	1	1	2	0	0	0	0	0	0	0	0	0
6	0	0	0	1	0	3	24	7	2	1	2	0	1	0	0	0	0	0	0	0	0
5	1	1	2	1	5	23	7	2	2	3	0	1	0	0	0	0	0	0	0	0	0
4	1	1	0	4	22	5	3	1	1	1	1	0	0	0	0	0	0	0	0	0	0
3	2	2	4	22	5	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	1	4	25	5	2	1	1	1	1	0	0	0	0	0	0	0	1	1	0	0	0
1	2	24	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0
0	33	8	9	6	5	5	4	3	2	0	0	0	0	0	0	0	0	0	0	0	0

LINEAR: Strong conditional cooperators ($N = 40$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
17	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
13	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	2	1	1
11	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
10	0	0	0	0	0	0	0	0	1	2	2	2	4	3	3	5	4	3	4	5	7
9	0	0	1	0	0	0	0	1	0	3	3	3	2	5	3	2	3	6	8	7	7
8	0	0	0	0	0	0	1	0	4	3	3	5	5	2	6	7	7	5	5	6	6
7	0	0	0	0	0	2	0	4	1	3	2	2	3	4	5	3	2	4	3	4	1
6	0	0	0	0	2	1	5	5	5	4	8	4	9	8	6	9	7	3	0	0	0
5	0	0	0	2	2	9	8	4	3	7	6	9	2	5	5	3	3	4	4	4	2
4	1	1	2	4	9	2	8	7	11	5	6	6	6	4	3	2	1	2	2	1	2
3	2	4	6	14	7	7	1	4	2	4	1	1	0	0	1	1	2	1	1	0	1
2	4	4	12	3	5	4	5	3	2	0	0	0	1	0	0	0	1	3	0	0	0
1	4	13	2	4	2	3	0	0	0	2	1	1	0	1	0	0	0	0	0	0	0
0	22	10	10	6	6	5	5	5	4	0	0	0	0	0	0	0	0	0	0	0	0

LINEAR: Weak conditional cooperators ($N = 33$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	3	2	2	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	3	8
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	3	0
18	1	0	0	2	1	0	0	0	0	0	0	1	0	0	1	1	1	2	2	1	1
17	0	1	0	0	0	0	1	1	2	2	2	1	2	2	1	0	1	2	2	1	1
16	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	3	2	3	4	2
15	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	3	3	4	2	1	1
14	0	0	1	0	1	1	0	0	0	0	0	0	1	2	5	2	2	0	2	0	2
13	0	1	0	0	0	0	0	0	1	1	0	1	1	3	1	2	0	0	1	2	0
12	0	0	0	0	1	1	1	1	0	1	2	2	3	3	2	2	1	1	3	2	2
11	0	0	1	1	0	0	0	0	0	1	2	5	4	2	2	0	2	1	0	1	0
10	0	0	0	0	0	0	3	2	2	1	4	0	2	1	1	2	2	2	0	0	0
9	0	0	0	0	0	2	0	2	1	4	2	4	2	2	1	1	1	1	0	1	1
8	3	3	5	2	4	1	1	1	6	8	5	5	4	4	5	4	2	3	4	3	3
7	25	28	25	29	27	28	30	36	32	25	26	23	25	23	24	23	24	23	21	21	21
6	3	1	2	2	1	3	6	1	0	2	2	2	0	2	0	0	0	0	0	0	1
5	1	1	2	2	5	7	0	1	0	1	1	2	2	1	2	0	0	0	1	1	0
4	1	1	0	2	6	1	2	0	1	0	0	0	0	1	0	2	2	1	0	2	2
3	1	0	2	5	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0
2	0	2	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
1	1	6	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0
0	8	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	2	2	2	2	2

DOMINANT: Own-maximisers ($N = 48$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	0	0	0	0	0	2	2	2	3	4	4	9	9	19
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	2	12	5
18	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	2	14	6	2
17	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	4	4	17	4	1	3
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	15	1	2	2	1
15	0	1	0	1	0	0	0	0	0	0	0	0	1	2	4	17	1	2	0	2	0
14	0	1	0	0	0	0	1	0	0	1	1	1	3	4	17	3	3	3	1	0	0
13	0	0	0	0	0	0	1	1	1	0	2	3	3	17	1	1	1	0	0	0	0
12	0	0	1	0	1	0	0	0	1	2	1	3	17	1	1	1	0	1	0	0	0
11	0	1	1	1	0	1	1	1	1	1	1	16	0	0	2	1	1	1	0	0	0
10	1	0	0	0	1	1	0	1	0	5	18	2	3	2	1	0	0	0	0	2	0
9	1	1	3	4	2	4	4	5	6	16	2	3	1	1	1	0	0	0	0	0	2
8	2	3	1	3	5	2	2	2	14	2	1	1	1	0	0	3	3	1	1	0	0
7	21	20	21	18	18	19	20	25	13	9	10	8	6	7	7	4	5	5	6	6	6
6	1	1	1	0	0	2	7	2	0	1	0	0	0	0	0	1	1	1	1	0	0
5	1	0	0	2	4	7	2	1	2	0	2	1	1	1	1	0	0	0	0	0	1
4	0	1	0	1	6	1	1	1	1	1	0	0	0	0	1	1	0	0	0	0	0
3	2	1	3	8	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	1	3	6	1	1	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	0
1	1	4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
0	9	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

DOMINANT: Strong conditional cooperators ($N = 40$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	1	0	0	0	1
19	1	0	0	1	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	1
18	0	0	0	0	0	0	0	1	1	1	0	0	1	0	0	0	0	1	0	1	1
17	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	3	2	2
16	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	1	1	1	3	2	2
15	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	3	4	3	0	1	1
14	0	0	0	0	0	0	1	1	0	0	0	0	2	2	4	2	1	1	3	3	2
13	0	1	1	0	0	0	1	2	2	1	2	2	1	4	1	0	1	1	1	0	0
12	1	0	0	1	1	0	2	2	1	1	1	2	2	2	2	3	2	2	2	1	1
11	2	2	2	2	3	5	1	1	1	2	1	3	5	6	5	5	3	5	2	3	3
10	2	1	1	0	0	2	1	1	1	2	4	2	3	3	3	2	3	1	1	2	4
9	2	2	2	3	1	2	2	1	3	6	4	6	4	3	2	2	3	3	4	2	2
8	1	0	2	0	3	0	2	2	5	3	5	3	1	2	2	5	5	2	2	1	2
7	12	14	11	12	12	14	13	12	11	11	10	9	10	9	10	7	7	10	9	8	7
6	0	0	0	6	3	0	2	3	3	2	2	4	2	1	0	1	0	0	1	3	0
5	0	1	2	1	1	5	2	3	3	1	2	1	1	1	1	0	1	0	0	0	2
4	2	2	4	2	5	1	3	1	1	2	0	0	0	0	0	0	1	0	0	1	1
3	2	3	4	4	1	3	2	2	0	0	0	1	1	0	1	0	0	1	1	0	1
2	2	4	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
1	3	2	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	3	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0

DOMINANT: Weak conditional cooperators ($N = 33$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	3
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
18	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0	0
17	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	2	2	2	2	3
16	0	1	0	0	1	1	1	0	0	0	0	0	1	1	1	1	1	0	0	1	0
15	0	0	1	2	1	0	1	0	0	0	0	0	0	0	1	1	0	2	1	1	1
14	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	2	0	1	0	1
13	1	0	0	0	0	0	0	0	0	0	0	0	2	2	0	1	1	1	0	0	0
12	0	0	1	0	0	0	0	0	0	1	0	2	1	1	2	2	1	1	2	4	4
11	0	0	0	0	0	0	0	0	1	0	3	2	1	0	1	1	3	4	28	33	32
10	0	0	0	0	0	1	0	2	1	2	1	1	3	3	4	24	31	30	7	0	0
9	0	0	0	0	1	0	1	0	1	2	3	3	26	34	32	11	2	2	0	0	1
8	0	0	0	1	1	1	2	4	6	27	33	32	9	1	1	0	0	0	0	0	0
7	0	0	1	0	2	5	22	33	31	11	2	2	0	0	0	0	0	0	1	0	0
6	0	3	1	24	31	30	15	3	2	0	0	0	0	0	0	0	0	0	0	0	0
5	26	33	34	12	4	3	1	0	0	0	1	0	0	0	0	0	0	1	0	1	1
4	11	1	1	1	2	1	0	0	0	1	1	1	1	1	1	2	2	2	2	2	1
3	1	1	2	4	2	2	2	1	1	0	0	0	1	0	2	1	1	0	0	0	0
2	0	2	3	1	0	0	1	1	0	0	0	2	2	2	0	0	0	0	0	0	0
1	3	4	2	1	1	1	0	1	2	2	2	1	0	1	1	1	1	1	1	1	1
0	4	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0

COMPLEMENTS: Own-maximisers ($N = 48$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4	4	7	8	24
19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	2	0	1	3	17	5
18	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	2	5	17	2	0
17	0	0	0	0	0	0	0	1	1	2	1	1	1	0	1	1	2	14	2	2	1
16	0	0	0	0	1	1	1	0	0	0	0	1	0	0	2	3	13	2	1	1	0
15	0	1	1	1	0	0	0	0	0	0	0	0	0	2	3	16	6	1	1	0	0
14	1	0	0	0	0	0	0	0	0	0	1	0	2	3	13	3	0	1	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	1	3	15	2	0	1	1	1	1	0
12	0	0	0	0	0	0	0	0	0	1	1	2	17	3	2	1	0	0	0	0	1
11	0	0	0	0	0	0	0	0	0	1	3	15	1	0	1	1	2	2	3	7	7
10	0	0	0	0	0	0	0	0	2	2	15	4	0	0	1	6	8	7	4	0	1
9	0	0	0	0	0	0	0	1	3	18	3	1	5	13	11	3	0	0	0	0	0
8	1	0	1	0	0	2	4	5	17	6	11	11	8	0	0	0	0	0	0	0	0
7	1	1	1	4	5	5	13	27	13	6	0	0	0	0	0	1	0	0	0	0	0
6	2	3	3	11	21	20	17	3	1	2	2	1	0	0	1	0	1	1	1	1	1
5	15	23	21	11	2	7	2	0	1	0	0	0	0	2	1	1	1	1	0	0	0
4	8	0	0	5	7	2	1	1	0	1	1	1	2	0	0	0	0	0	0	0	0
3	2	2	5	5	3	3	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
2	2	3	5	2	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	2	6	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
0	6	1	2	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0

COMPLEMENTS: Strong conditional cooperators ($N = 40$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	2	1	0	1
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	2	2
18	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	1
17	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	3	2
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	4	1	0	1
15	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	2	0	2	2	1
14	1	0	1	0	0	1	0	1	1	0	0	1	2	2	3	2	2	2	1	3	5
13	0	0	1	1	1	1	1	1	0	1	1	0	2	3	4	3	2	3	4	2	2
12	2	1	0	1	1	1	1	1	2	2	2	2	2	2	2	0	3	3	2	3	2
11	0	1	0	1	0	0	0	0	2	0	1	2	2	2	3	3	4	2	8	10	9
10	0	0	1	0	0	1	2	3	1	4	4	5	4	6	4	8	9	10	4	1	2
9	0	0	0	0	0	1	2	2	4	4	6	5	9	11	10	5	0	0	2	1	0
8	0	0	1	2	3	2	3	4	6	11	12	12	6	0	0	0	1	1	0	1	0
7	0	2	3	4	4	6	13	17	13	5	1	0	0	1	1	2	0	0	0	0	1
6	4	4	3	7	13	12	7	0	1	1	0	0	2	1	0	0	0	0	0	0	1
5	11	13	13	7	3	2	0	0	0	1	1	1	0	1	2	1	1	3	1	2	1
4	7	3	1	5	4	3	1	1	1	1	0	1	1	1	1	1	1	0	2	0	1
3	1	2	3	2	0	0	2	2	1	1	2	1	0	0	1	1	2	0	0	0	0
2	1	1	2	1	2	2	0	0	0	1	0	1	1	1	0	0	0	1	0	1	0
1	2	4	3	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
0	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

COMPLEMENTS: Weak conditional cooperators ($N = 33$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
18	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	1
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0
16	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	3	2	2
15	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0	1
14	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	1	1	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	2	2	2	1	1	0
12	0	0	0	1	1	1	1	0	0	1	2	0	2	2	1	0	0	0	2	2	2
11	0	0	1	0	0	0	0	1	2	1	0	0	1	0	0	0	0	0	0	0	0
10	5	4	3	1	1	1	2	2	2	1	2	4	1	1	1	2	2	2	1	1	1
9	29	30	7	4	1	2	0	1	0	1	3	0	0	0	0	0	0	0	1	2	2
8	0	0	23	28	31	9	6	2	2	4	2	2	4	3	3	2	2	2	1	1	1
7	0	1	0	1	1	23	28	33	10	4	1	1	2	2	2	3	4	3	2	1	1
6	2	0	1	0	1	1	2	2	25	29	31	6	1	1	0	1	1	1	2	2	2
5	0	1	0	3	3	1	2	0	0	0	0	26	29	30	6	2	0	0	1	0	0
4	3	3	4	2	2	5	1	0	0	1	1	1	1	1	27	28	30	7	4	3	1
3	1	2	4	4	5	2	3	5	5	1	1	1	2	2	1	0	1	24	27	29	10
2	6	5	3	2	0	0	0	0	0	1	2	2	2	1	1	2	1	1	0	0	21
1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	1	1	1	1

SUBSTITUTES: Own-maximisers ($N = 48$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	3	3	5	5	13
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	9	2
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	10	3	2
17	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	11	2	1	1
16	0	0	0	0	1	1	1	1	1	0	0	0	1	0	0	3	13	2	3	4	3
15	0	0	0	0	0	0	0	0	0	1	1	2	0	0	1	11	2	3	1	0	1
14	0	0	0	0	0	0	0	0	0	0	1	0	0	1	13	2	3	2	0	1	1
13	0	1	1	0	0	0	0	0	0	1	0	0	2	14	1	3	1	1	1	1	1
12	1	0	0	0	1	1	0	0	1	0	0	1	14	2	2	0	0	0	1	0	1
11	0	0	1	1	0	0	0	1	0	1	3	15	0	1	3	0	0	0	1	1	0
10	4	3	1	2	1	1	4	2	2	4	16	4	2	2	1	2	2	2	0	0	0
9	20	21	7	3	3	2	4	3	5	15	0	1	1	2	0	0	0	0	0	0	0
8	0	1	16	20	21	7	2	5	16	2	3	3	3	1	2	0	0	1	1	0	0
7	1	1	1	1	0	18	21	23	3	0	1	0	2	3	1	0	0	0	0	0	0
6	0	1	0	0	3	1	6	2	10	13	14	4	2	1	2	0	0	0	0	1	2
5	2	1	1	2	1	4	1	2	0	1	0	9	11	10	2	3	3	1	1	1	0
4	0	0	1	3	6	1	0	0	0	0	0	0	0	1	10	11	11	3	2	2	2
3	1	1	2	4	0	1	0	0	0	1	1	1	1	0	0	0	0	8	10	10	2
2	6	5	8	1	2	2	1	1	1	1	0	0	0	0	0	0	0	1	1	0	8
1	2	5	1	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
0	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	1

SUBSTITUTES: Strong conditional cooperators ($N = 40$)

	$\overline{G}$																				
c	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
20	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0
19	1	1	1	1	1	1	1	0	0	0	0	0	1	1	1	1	1	1	2	2	2
18	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0
17	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	1	0	2
15	2	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	2	1
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	1	0
13	0	0	0	0	0	0	0	0	0	0	0	1	1	1	2	0	0	2	1	1	2
12	1	1	0	0	0	0	3	3	3	1	1	1	1	1	1	2	1	1	2	2	1
11	2	0	0	1	1	2	0	0	0	0	0	1	1	1	0	2	1	1	0	0	0
10	5	5	5	3	2	1	1	2	4	3	5	3	4	5	4	1	2	1	4	4	5
9	15	13	8	5	7	7	4	2	1	4	3	3	0	1	3	3	2	2	2	2	0
8	1	3	9	12	13	5	3	3	1	4	3	3	3	3	4	1	3	3	1	0	1
7	1	1	2	3	1	8	13	14	10	7	4	4	7	4	3	3	2	2	1	2	1
6	0	1	0	0	2	2	2	4	10	10	13	5	3	4	3	3	1	2	2	1	3
5	0	1	1	1	0	1	3	1	1	0	1	10	9	9	2	3	3	2	2	1	0
4	1	1	1	2	3	1	2	1	1	1	1	0	2	1	9	9	10	3	2	3	1
3	1	1	2	2	1	2	1	1	1	0	1	0	0	2	0	0	2	8	9	9	3
2	0	0	0	0	1	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	9
1	1	2	2	2	1	1	0	0	0	0	0	0	0	0	1	1	1	2	1	2	0
0	2	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	2

SUBSTITUTES: Weak conditional cooperators ($N = 33$)