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Cross-task spillovers in workplace teams: Motivation vs. learning

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Abstract

We study an experimental setting designed to measure non-strategic behavioural spillovers and elucidate their mechanisms. In our setup a principal can observe the individual efforts of two agents in one task but can only observe team effort in another. We vary the availability of piece rate, tournament, team piece rate, and fixed wage contracts for the individually observable task while holding fixed the use of a team pay contract for the task where only team output is observable. We find tournament incentives unexpectedly induce high voluntary effort in the unobservable task, but that this is exclusively driven by cross-task advantageous learning overriding its deleterious effects on pro-social motivation. We therefore see our study as integrating diverse findings into a coherent explanation: Competitive incentives crowd out pro-social motivation, team incentives promote pro-social motivation, but setting a high effort precedent may be more important when employees perceive tasks as related.

1. Introduction

This paper addresses the question of how incentives should be deployed within organizations to motivate team members who must perform multiple tasks. We start from the observation that much work within organizations takes place in *teams*. Because of productivity spillovers, imperfect attribution, or incomplete contracts, it may often be difficult to induce full effort from self-interested agents within the team. Other tasks may be individually contractible,

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however. Here a wider range of incentives, such as individual piece rates and rank-order tournaments may be used, in addition to team piece rates or fixed wages. Environments where workers complete multiple tasks, often in teams, are becoming increasingly prevalent in modern workplace organisations (Lindbeck and Snower 2000a). Principals may face constraints in incentivizing optimal effort even when a rich set of contracts is available due to spill-overs onto the non-contractible task. One well-known instance is the "multi-tasking" problem, in which agents may substitute effort away from non-remunerated tasks for strategic reasons (Holmström and Milgrom 1991, Fehr and Schmidt 2004, Lindbeck and Snower 2000b). Apart from these strategic cross-task externalities, managers may want to ensure that the incentives they use on some tasks do not demotivate workers on other tasks. Such non-strategic externalities have been the focus of psychologists and behavioural economists (Deci and Ryan 1980, Bowles and Polonía-Reyes 2012).

Our study seeks to isolate and examine non-strategic spillovers. In particular, we study a two-task setting with a principal and two agents in which the optimal effort choice in each task is independent of the effort exerted in the other task. The principal can observe individual efforts in one task but can only observe team effort in the other. We vary between subjects the availability of individual piece rate, rank-order tournament, team piece rate, and fixed wage contracts for the individually observable task while holding fixed the use of a team piece rate contract for the task where only team output is observable. We find that team effort levels are surprisingly highest under the rank-order tournament contracts for individual effort, followed by individual piece rate, then team piece rate, with fixed wage contracts performing worst. We use econometric analysis corroborated with incentivized social value orientations and comprehension questions collected post-game in order to identify the channels of motivational crowding, path dependence, anchoring, and learning as driving factors of the spillovers.

2. Related literature

The contract theory literature has devoted substantial focus to the problem that some tasks may be easier to incentivise than others. The seminal model is that of Holmström and Milgrom (1991). In the classic setup, a principal wants an agent to exert effort along two dimensions but can contract on only one. The selfish agent, who allocates costly effort across both tasks, will neglect the unincentivised component if incentives to exert optimal effort on the contractible component are introduced. The reason is that with a fixed budget of effort, the marginal return to expending effort on the incentivised task rises in comparison. This is termed the "effort distortion" effect. The multi-taking framework is often applied to "quantity/quality" tradeoffs (Hong et al. 2018, for example document this problem in the field).

Principals must rely on the agent's intrinsic motivation to exert effort on the unincentivised component, meaning that the motivational impacts of differing contracts are an important consideration. Fehr and Schmidt (2004) for example, show that allowing principals in a multitasking experiment to offer contractually unenforceable bonuses mitigates the effort distortion effect (disputing the standard theory) relative to piece rate contracts for the contractible task (for which Holmström and Milgrom's predictions are confirmed[1]). Brüggen and Moers (2007) find that a group identity induction with peer monitoring also attenuates effort distortion in the presence of financial incentives. By contrast, Hannan et al. (2013) find that effort distortion in the presence of financial incentives is exacerbated when relative performance feedback is given. See Murad, Stavropoulou, and Cookson (2019) on gender differences in effort distortion.

[1] Effort distortion may also fail to materialise if agents infer that the principal is able to monitor both tasks well when she implements strong incentives. Al-Ubaydli et al. (2015) conduct an experiment exploring this effect.

One factor which may influence intrinsic motivation in poorly contractible tasks is the very incentive scheme used to reward performance on better observed tasks. Behavioural economists have begun to build up a nuanced picture of the motivational crowding impacts of incentives. Incentives which raise performance in their targeted domain but reduce agents' intrinsic willingness to exert effort elsewhere are said to "crowd out" this motivation; incentives which raise performance in their targeted domain *and* raise intrinsic motivation are said to "crowd in". Bowles and Polanía -Reyes (2012) provide a general review of motivational crowding effects.

The role of motivational crowding in multi-task organisational settings is an area of more recent development. Both competition and cooperation feature widely within organisations. The fundamental tension between cooperation and competition (they entail helping and besting others respectively) is likely to generate cognitive dissonance which can be ameliorated by applying the same motive to both contexts.[2] The implication is motivational spillover either from competition to cooperation or vice-versa. Below we review the experimental studies of motivational spillovers by employing a 2x2 taxonomy: whether the activities take place at the same time or in sequence,[3] and whether evidence of motivational crow-out or crowd-in is observed.

Sequential crowd-out

Ter Meer (2014) finds subjects to be more deceptive following a real effort task remunerated by tournament incentives than when they are compensated by piece rate. Buser and Dreber (2016) similarly contrast the effects of piece rate and tournament incentives for a slider task

[2] See Bosworth, Singer, and Snower (2016) for a formal theoretical treatment.
[3] Galizzi and Whitmarsh (2019) provide a review of sequential behavioural spillovers across games.

(Gill and Prowse 2012) on subsequent public goods game contributions. They find that tournament competitors give less, even when prizes are awarded randomly, and that the effect is particularly driven by losers. Beekman, Chung and Levely (2017) observe lower intergroup public goods contributions when groups engage in a preceding Tullock contest. Brandts and Riedl (2017) find lower public goods contributions in pairs of subjects who previously had to compete against each other (e.g. two buyers or two sellers) in a previous market game. Grosch, Ibañez, and Viceisza (2017) replicate the Buser and Dreber design in a field setting and show that their crowd-out result is contingent on competition creating high payoff inequality. Grosch and Rau (2017). Dimant and Hyndman (2019) document negative effects of competition on altruism, trust, and reciprocity.

Sequential crowd-in

Cason, Savikhin, and Sheremeta (2012) find that play in the median effort game positively influences subsequent play in the minimum effort game, but only when played sequentially and in that order. Arechar, Kouchaki, and Rand (2018) find that cooperation increases in Prisoner's Dilemma games with low continuation probability when they follow PD games with high continuation probability but that cooperation is not negatively affected when high continuation probability PD games follow low continuation probability games.[4] Similarly Liu et al. (in press) observe higher cooperation when Prisoner's Dilemmas follow games which implement a Pareto optimum in dominant strategies.

[4] Duffy and Fehr (2018) however find no carry-over from indefinitely-repeated Stag hunts to Prisoner's Dilemmas.

Simultaneous crowd-out

Cason and Gangadharan (2013) show that contributions to a threshold public good are lower when players simultaneously compete on the seller side of a double-auction market.

Simultaneous crowd-in

Savikhin and Sheremeta (2013) contrast simultaneous vs. independent play of a lottery contest and a public goods game. They find that cooperation is unaffected by the lottery but that inefficient bidding for lottery tickets is reduced when subjects contribute to a public goods. Engl, Riedl, and Weber (2018) find that institutions designed to enforce contribution to a public good (credible punishments) have positive effects on contributions to public goods which do not have the institutions. Krieg and Samek (2017) show a similar finding for conditional monetary contribution bonuses, but non-monetary rewards and punishments, while effective in increasing contributions in the game where they apply, crowd out contributions in the game where they do not.

Organising findings: motivation vs. domain specificity and learning

The results from experiments in organizational task spillovers are difficult to integrate. We have seen that order effects matter, and the nature of the two tasks being compared seems to play a role. These factors are expected to be particularly important where players do not implement ex-ante preferred strategies[5] but rather learn as they play (Bednar and Page 2018). Bednar et al. (2012) provide evidence that subjects carry over strategies from simpler strategic environments when choosing in strategically more complex games. Controlling for subject

[5] Duffy and Smith (2014) find that subjects are less strategic when under cognitive load for example. See also Liu et al.

learning and maintaining as similar a presentation across games as possible is therefore a promising avenue for making sense of motivational spillover effects.

Our paper employs two techniques from the literature. Firstly, we explicitly estimate a directional learning model[6] (Selten and Stoecker 1986). This theory posits that subjects adjust their strategy in a particular direction if prior adjustments in that direction resulted in increased payoffs. Anderson, Goeree, and Holt (2004) show that the long-run result of such learning is a quantal response equilibrium (McKelvey and Palfrey 2005). Nax and Perc (2015) argue that directional learning is well-suited to explain the dynamics of public goods game behaviour.

We also elicit subjects' awareness of the strategies which maximise their individual and joint payoffs respectively. This method has been used to explain public goods contributions by Fosgaard and co-authors (2014, 2017), who argue that contributions are only context-sensitive for those who lack understanding.[7]

3. Experimental design

In each treatment of the experiment subjects are matched into groups of three. Two participants in each group are assigned the role of "employee" while the third is assigned the role of "employer". The composition of the groups and individuals' roles within the group remain fixed for the 10-round duration of the experiment. Within each group, the agents must independently choose how many units of effort (with induced effort costs) to expend on two

[6] Other learning models exist. See e.g. reinforcement learning (Erev and Roth 1998) or experience-weighted attraction (Camerer and Ho, 1999).

[7] Though Drouvelis and Grosskopf (2016) show that contributions are sensitive to induced emotions among respondents who passed comprehension questions and Bartke, Bosworth, Snower, and Chierchia (2019) show contributions to be more variable among high- than low-comprehension subjects.

tasks each round. The tasks are decided simultaneously on the same screen. The employer does not make an active decision, but her payoff depends on the effort exerted on the two tasks by both agents. After each round, the total effort levels put into each task is revealed to the participants. For Task 1, the individual efforts of the two employees are observable to the employer, and therefore a number of contracts are possible. For Task 2 however, the employer only ever learns the sum of the effort put in by the two employees and is therefore unable to use remuneration policies which depend on the individual employees' efforts. Employees are made aware of the information structure. Task 2 is remunerated using a team piece rate incentive scheme in all treatments.

Employees may put in any number of units of effort from 0 to 10. Each unit of effort has a constant marginal cost *c* to the employee, and benefits the employer by a constant marginal amount *b*. Since we are interested in purely behavioural spillovers, there is no strategic reason to substitute effort between the tasks. Putting effort into Task 1 does not change the number of units of effort available to be put into Task 2 or their marginal cost, and vice-versa. Only one of the two tasks, randomly selected from one of the 10 rounds, counts for payment, but subjects are told they will not learn which round or task is selected until the end of the experiment.

We implement four distinct remuneration schemes for Task 1 across the different treatments in a between-subjects design. These are an individual piece rate, a team piece rate, a fixed-prize tournament, and a fixed wage payment. We henceforth refer to each treatment by the name of the incentive scheme used to remunerate Task 1. The parameters implemented under each remuneration scheme were selected such that the distribution of payoffs when both employees put in the full (efficient) amount of effort is equal across treatments. The specifics of each scheme are elaborated on below:

Individual piece rate

All subjects start each round with an endowment of €10. The employer is obliged to pay €1.50 for each unit of effort input by a particular employee. The employer earns a revenue of b = €2.10 from each unit produced, entailing a profit of €0.60 per unit of effort exerted. The employer's payoff can therefore be expressed

$$\Pi_m = €10 + €0.60(e_{11} + e_{12})$$

where e_{11} represents employee 1's Task 1 effort and e_{12} represents employee 2's Task 1 effort. Employees face a marginal cost of c = €1.00 for each unit of effort they put in. Correspondingly, employee i's payoff from effort level $e_i \in \{0,1, \ldots ,10\}$ may be expressed

$$\Pi_i = €10 + €0.50 \cdot e_i.$$

Team piece rate

All subjects start each round with an endowment of €10. The employer is obliged to pay each employee €0.75 for any unit of effort input by either employee. The employer earns a revenue of b = €2.10 from each unit produced, entailing a profit of €0.60 per unit of effort exerted. The employer's payoff can therefore be expressed

$$\Pi_m = €10 + €0.60(e_{11} + e_{12})$$

where e_{11} represents employee 1's Task 1 effort and e_{12} represents employee 2's Task 1 effort. Employees face a marginal cost of c = €1.00 for each unit of effort they put in. Correspondingly, employee i's payoff from effort level $e_i \in \{0,1, \ldots ,10\}$ may be expressed

$$\Pi_i = €10 - €0.25 \cdot e_i + €0.75 \cdot e_{-i}$$

where e_{-i} represents the other employee's effort.

Tournament

The employer starts each round with an endowment of €40, of which €30 is earmarked as payment for the employees. Each employee starts the round with an endowment of €10. The employer is obliged to pay a prize of €30 to whichever employee puts in a higher amount of effort than the other employee. If both employees put in the same amount of effort, they split the prize and receive €15 each. The employer earns a revenue of b = €0.60 from each unit of effort exerted. The employer's payoff can therefore be expressed

$$\Pi_m = €10 + €0.60(e_{11} + e_{12})$$

where e_{11} represents employee 1's Task 1 effort and e_{12} represents employee 2's Task 1 effort. Employees face a marginal cost of c = €1.00 for each unit of effort they put in. Correspondingly, employee i's payoff from effort level $e_i \in \{0,1, \dots ,10\}$ may be expressed

$$\Pi_i = \begin{cases} €40 - e_i & e_i > e_{-i} \\ €25 - e_i & e_i = e_{-i} \\ €10 - e_i & e_i < e_{-i} \end{cases}$$

where e_{-i} represents the other employee's effort.

Fixed wage

The employer starts each round with an endowment of €40, of which €30 is earmarked as payment for the employees. Each employee starts the round with an endowment of €10. The employer is obliged to pay a wage of €15 to each employee, regardless of how much effort either exerts. The employer earns a revenue of b = €0.60 from each unit of effort exerted. The employer's payoff can therefore be expressed

$$\Pi_m = €10 + €0.60(e_{11} + e_{12})$$

where e_{11} represents employee 1's Task 1 effort and e_{12} represents employee 2's Task 1 effort. Employees face a marginal cost of c = €1.00 for each unit of effort they put in. Correspondingly, employee i's payoff from effort level $e_i \in \{0,1,\ldots,10\}$ may be expressed

$$\Pi_i = €25 - e_i.$$

Task 2

For all four treatments of the principal-agent game, the two employees simultaneously entered their decision for Task 2 on the same screen (see Fig. 1). Task 2 was remunerated using the same team piece-rate policy in all treatments. This means that Task 2 had the same payoffs as the team piece-rate treatment of Task 1, save for the distinction that the employer never observed the individual efforts for Task 2 (individual efforts were observed but not contracted upon in the team piece rate treatment of Task 1). All subjects start each round with an endowment of €10. The employer is obliged to pay each employee €0.75 for any unit of effort input by either employee. The employer earns a revenue of b = €2.10 from each unit produced, entailing a profit of €0.60 per unit of effort exerted. The employer's payoff can therefore be expressed

$$\Pi_m = €10 + €0.60(e_{11} + e_{12})$$

where e_{11} represents employee 1's Task 1 effort and e_{12} represents employee 2's Task 1 effort. Employees face a marginal cost of c = €1.00 for each unit of effort they put in. Correspondingly, employee i's payoff from effort level $e_i \in \{0,1,\ldots,10\}$ may be expressed

$$\Pi_i = €10 - €0.25 \cdot e_i + €0.75 \cdot e_{-i}$$

where e_{-i} represents the other employee's effort.

[Fig. 1 here]

Following the effort decisions in each round, both employees as well as the employer are asked to guess the level of effort that the other employee put into each task (or, in the case of the employer, what the average effort level on each task was). Subjects were remunerated €2 if their guess was precisely correct and €0 otherwise. Only one of the two tasks, randomly selected from one of the 10 rounds, counts for payment of beliefs, but subjects are told they will not learn which round or task is selected until the end of the experiment. The task and round selected for payment of the beliefs was different from that selected for payment of the decision. This means that if Task 1 was selected for payment of a particular round, then the beliefs for Task 2 of a different round was selected for payment of the beliefs. After each round, the payoffs and actions of the other agent were revealed to each employee, and the profits, individual Task-1 efforts, and the total Task 2 effort were revealed to the employer (see Fig. 2).

Once the 10 rounds of the principal-agent situation were finished, subjects were distributed instructions for a number of shorter tasks. Immediately following the end of the principal-agent game, we asked 4 incentivized comprehension questions. Subjects needed to identify both the own-payoff maximizing action as well as the action which maximized joint payoffs, for each of the two respective tasks[8]. Participants were remunerated with €0.50 for each correct answer.

Following the incentivized comprehension quiz, we re-grouped subjects into pairs. No subject was paired with either of their group members from the principal-agent game. Each subject in the pair was presented with 26 binary dictator games in a randomly determined sequence (Fig. 3 illustrates). The full list of binary decisions may be found in the appendix. Out of each pair, one subject's decisions for one of the 26 dictator games was implemented and paid out to both participants.

After the sequence of binary dictator games, we implemented a variant of Krupka and Weber (2013)'s norm elicitation procedure. Specifically, subjects were re-grouped into the original triads of the principal-agent game and asked which level of effort, for Task 1 and Task 2 respectively, they thought both employees should have put in. If all members of the group coordinated on the same response for a particular task, they each received €1 per task where they coordinated answers. Subjects did not receive payments if no unanimous effort level was stated.

Finally, subjects were distributed pen-and-paper questionnaires which collected demographic information. Subjects were paid privately during completion of these questionnaires.

[Fig. 2 here]

[Fig. 3 here]

[8] In some sessions we added the (irrelevant) qualifier "if the other employee put in 5 units of effort" to the questions. In some sessions this qualifier was omitted from the comprehension questions. The question wording was balanced across treatments.

4. Hypotheses

As a benchmark, we first elucidate the subgame-perfect Nash equilibria for each of the remuneration schemes. Because subgame-perfect Nash equilibrium can sometimes poorly predict results of finitely repeated games when played in the laboratory, we also draw on prior empirical results to inform our hypotheses.

Under the individual piece rate incentives, each employee nets €0.50 for each unit of effort chosen. Therefore, both her individual payoff and the payoff to the employer are maximized when she puts in the full 10 units of effort. Incentive compatible piece rates tend to elicit the predicted Nash equilibrium level of effort in experiments (Bull et al. 1987, Anderhub, et al. 2002).

Under team piece rate incentives, each employee loses €0.25 per unit of effort contributed – though each unit of effort also benefits the employer by €0.60 and the other employee by €0.75. Hence, the subgame-perfect Nash equilibrium is for employees to put in 0 units of effort. This remuneration scheme is structurally equivalent to a linear public goods game, since there is a positive externality to the other employee, and the employees' joint payoffs would be maximized by joint full effort. Laboratory results of finitely repeated linear public goods games with partner matching often feature contribution levels which start at around half of subjects' endowments and decline as play progresses (Ledyard, 1995; Chaudhuri, 2011). Furthermore, players who develop reputations as conditional cooperators generally tend to earn higher payoffs than free riders (e.g. Selten and Stoecker 1986, Andreoni and Miller 1993), as they elicit greater contributions from their counterparts (see Kreps and Wilson 1982 for a theoretical justification).

The tournament incentive scheme has been discussed extensively in the labour economic literature (Lazear and Rosen 1982). Tournaments provide very strong incentives for exerting full effort. For any effort level $e_{-i} < 10$ exerted by the other employee, employee i's payoff is maximized by exerting effort level $e_i = e_{-i} + 1$, since this secures i the €30 prize, while minimizing the cost exerted to obtain it. The only mutual best response is for both employees to put in the full level of effort $e = 10$. In experimental examinations of rank-order tournaments with fixed prizes, effort tends to converge to the subgame-perfect Nash equilibrium, and variance is low when subjects have symmetric effort costs (Bull et al. 1987, Nalbantian and Schotter 1997, Harbring and Irlenbusch 2003). Collusion in tournaments tends to be very low when communication is not possible, and much less than the level of cooperation under team incentives (van Dijk et al. 2001, Harbring 2006).

Finally, the fixed wage scheme provides the weakest incentives to put in the efficient level of effort. This is because the employees' payoffs are monotonically decreasing in the amount of effort put in, *and* there is no payoff externality between them. The subgame-perfect Nash equilibrium is for both employees to put in zero effort. While several experiments have demonstrated the ability of fixed wages which have been *voluntarily* given by the employer to induce levels of effort substantially higher than equilibrium (Fehr et al. 1993, Gneezy and List, 2006, Maximiano et al. 2007), the variant we use features no employer decision-making. This means that the closest empirical counterpart to our fixed wage treatment are dictator games with multiple dictators and one recipient, where giving is generally very low (Dana et al. 2007, Panchanathan et al. 2013).

Hypothesis 1: Task 1 effort is highest in the individual piece rate and tournament treatments, in which employees quickly converge to full effort. Effort is lower under team piece rate remuneration of Task 1, *and declines as rounds progress, but substantially higher than zero. Task 1 effort is lowest under fixed wages.*

Based on the sparse literature on motivation carry-over and theoretical work we predict that Task 2 effort will vary distinctly across the different remuneration treatments employed for Task 1. We suppose that the differing incentives to cooperate or compete in Task 1 will encourage the development of particular strategy profiles which may lead to differential Task 2 behaviour. Our theoretical framework is that of Bosworth et al. (2016). More frequent exposure to cooperative incentives should lead to the development of pro-social strategic types, whereas greater exposure to competitive incentives should highly discourage the development of pro-social strategic types.

The team piece rate remuneration of Task 1 is a very favourable environment for reciprocal cooperation. Conditional cooperators make higher payoffs than consistent free riders when enough of them are present. Since Task 2 has the same incentives, subjects should be very likely to develop these reciprocally cooperative strategies[9].

The individual piece rate and fixed wage remuneration of Task 1 neither directly encourage nor discourage reciprocal cooperation. Under either of these incentive schemes, one employee's payoff is completely independent of the other employee's chosen level of effort. The employer's payoff depends on own effort under both however, meaning that inequality concerns may prompt different strategies. Under individual piece rates, reducing inequality is consistent with putting in below-equilibrium effort levels, since effort benefits the employer more than the employee. Under fixed wages however, the subgame-perfect Nash equilibrium

[9] Employees also have the opportunity to punish low Task 2 effort by reducing their effort in both Tasks 1 and 2 of the team piece rate treatment. Schmidt and Schnitzer (1995) argue similarly that the unavailability of enforceable contracts strengthens repeated-game incentives in relational contracts.

features higher payoffs for the employee than the employer, meaning inequality-concerned employees should put in greater than equilibrium effort.

The tournament remuneration of Task 1 is most discouraging of reciprocal cooperation. Cooperative types should earn worse payoffs under competitive incentives because demonstrating to the other employee that one is willing to collude lets that player know exactly how much she needs to shirk in order to claim the whole €30 prize for herself. Since the strategy of reciprocal cooperation in Task 1 would be disadvantageous, we suppose that fewer subjects under this treatment will end up developing this strategy for Task 2, as there would be cognitive dissonance between the competitive and cooperative strategies suitable for Tasks 1 and 2, respectively.

Hypothesis 2: Task 2 effort is highest in the team piece rate treatment. Effort is lower under the individual piece rate and fixed wage treatments. Task 2 effort is lowest in the tournament treatment.

5. Results

Over the course of November 2016 – March 2017, five sessions of each treatment were run in the economics laboratory of Kiel University. Subjects were recruited from the general subject pool of the university, and mostly comprised undergraduate students at the University. A total of 318 subjects participated, of which 148 were male and 169 were female (one subject did not specify either). Each earned an average payment of €31.08 for their participation, which lasted about an hour for all activities in the lab.

Fig. 4 shows the mean Task 1 effort levels broken down by treatment. Both the individual piece rate and tournament incentive schemes induce high levels of effort (8.83 and 9.08 units of effort on average), with most subjects converging to the subgame-perfect Nash equilibrium rather quickly. In the team piece rate treatment, we replicate the common result from public goods experiments that contributions start at around half of subjects' endowments and decline slightly as rounds progress. On average effort was 5.33 units. Finally, subjects under fixed wages put in the lowest levels of effort, at 1.16 units on average, with most subjects converging quickly to the subgame-perfect Nash equilibrium level of no effort.

[Fig. 4 here]

Fig. 5 shows the comparable graph for the evolution of average effort in Task 2 across rounds. All treatments reproduce the general pattern that was seen under the team piece rate remuneration of Task 1. Effort levels start very clustered together, but converge to the same ordering as the Task 1 efforts, with Task 2 effort in the individual piece rate treatment and Tournament treatments being highest (each at 5.78 units of effort contributed), followed by the team piece rate treatment at 5.16 and the lowest effort in the fixed wage treatment with 4.99. Using a Cuzick test for trends across series, we can reject at $p < .01$ a random ordering of Task 2 effort across treatments in favour of the ordering $e_{2Ipr} \approx e_{2Tour} > e_{2Tpr} > e_{2Fw}$.

[Fig. 5 here]

The data therefore supports Hypothesis 1 quite robustly but does not support Hypothesis 2 in the aggregate. We find these results not altogether surprising, as they are perfectly consistent with a model in which subjects' Task 1 effort, or the Task 1 effort of their group members, constitutes an anchor for their decisions regarding how much effort to expend on Task 2. One mechanism may be that subjects have limited cognitive capacities and bundle the two tasks under the same mental model. A number of theories predict such behaviour, such as the case-based reasoning model of Gilboa and Schmeidler (2001). A combination of conditionally cooperative preferences (Fischbacher et al. 2001) and belief bundling (Jehiel 2005) may generate similar results[10]. In order to better understand the dynamics behind these results, and to piece apart the effects of anchoring and preference spill-over, we use two approaches. Firstly, we examine the results of those subjects who correctly identify both the self-interested payoff maximising and joint payoff maximising choices. We then move on to an econometric specification in which choices in the unobservable Task 2 are explained as a function of cross-task learning, social preferences elicited by the dictator game exercise, and beliefs regarding partner effort.

Figures 6 and 7 elucidate the treatment effects for subjects displaying full comprehension according to the incentivised post-game strategy questions. There are only 86 such subjects (out of a total of 318), and they are unevenly spread across the four treatments (28 in the individual piece rate condition, 24 in the team piece rate condition, 15 in the tournament condition and 19 in the fixed wage condition). The econometric specification below is therefore preferable for disentangling any treatment / comprehension confounds. We can see from Fig. 6 that, in comparison with Fig. 4, choices on Task 1 follow almost exactly the same pattern as in the full sample. Fully-comprehending subjects converge to the full-effort prediction sooner under individual piece rates and tournament incentives, and are likelier to put in low effort in the final period under team incentives (this makes sense strategically, see Selten and Stoecker 1986), but nevertheless contribute around 6 units of effort[11] under team incentives, while

[10] These two explanations may be distinguished by whether the anchoring effect operates entirely through beliefs regarding the effort of the other employee, or whether one's own decision on Task 1 exerts an independent effect. In Jehiel's theory, subjects expect others to have similar effort on Task 1 and Task 2. If their preferences depend on the other's effort then they will behave similarly across tasks as well. Two testable implications are 1) that beliefs explain the entirety of any anchoring effects, and 2) that there is no anchoring for purely self-interested workers.

[11] These findings are in line with those of Fosgaard et al. (2014).

converging to zero effort under fixed wages. Figure 7 on the other hand displays a comparatively clearer pattern among the full comprehension subjects than is apparent from the full sample results in Fig. 5. Here we still see relatively high Task 2 effort contributions from subjects in the individual piece rate condition, which are almost matched by those under team piece rates in the final two periods. Much different are the results for subjects experiencing tournament incentives. Those subjects fully grasping the competitive nature of the tournament incentives are substantially less likely to cooperate when their effort is unobservable in Task 2.

[Fig. 6 here]

[Fig. 7 here]

The results from comparing the full sample with fully-comprehending subjects suggest that there are at least two potential mechanisms driving spillovers across the experimental tasks, which in the case of tournament incentives seem to offset each other. On the one hand, tournament incentives and individual piece rates are very effective at rapidly inducing full effort on Task 1, and this may lead subjects (esp. low comprehension subjects) to employ similar high-effort strategies in the more ambiguous Task 2. On the other hand, tournament incentives, but not individual piece rate incentives may discourage subjects' intrinsic motivation to cooperate when they otherwise would have.

Preliminary evidence for this explanation can be gleaned from Fig. 8. Recall that following the principal agent game and comprehension questions subjects played a series of binary dictator games with another individual not from their principal-agent group. We have categorised all subjects into one of three behavioural social preference type classifications on the basis of this activity. The first type, which we call 'Selfish' are those individuals who always chose the allocation which maximised their own payoff. This type comprises 25-30% of the overall sample. The second, and by far most numerous type we denote as 'Inequality-averse'. These individuals made at least one choice which minimised advantageous inequality and was not selfish, *and* never made a choice which maximised advantageous inequality and was not selfish. This type comprises 55-60% of the sample. The final type we term 'Spiteful'. These individuals made at least one non-selfish choice which maximised advantageous inequality or minimised disadvantageous inequality and *never* made a choice which minimised advantageous inequality. This taxonomy fits all subjects and is standard in the literature (Engelmann and Strobel 2004).

We can see from Fig. 8 that the individual piece rate features the greatest number of Selfish types (36%, contrast with 22% in the team piece rate treatment), the team piece rate treatment features the greatest number of Inequality-averse (66%, contrast with 53% under tournament incentives), and the tournament treatment features the greatest number of Spiteful types (22%, contrast with just 8% under individual piece rates). The fixed wage treatment features intermediate levels of all three types. A Fisher's exact test reveals the type distribution to vary significantly across the three treatments of individual piece rate, team piece rate, and tournament ($p < .07$), but the picture is muddied when all four treatments are contrasted ($p > .17$). Furthermore, Wilcoxon rank-sum tests show that Selfish types are more numerous in the individual piece rate treatment compared with the other three ($p < .08$), Inequality-averse types are more numerous in the team piece rate than the other three treatments ($p < .10$) and Spiteful types are more numerous in the tournament compared to the other three treatments ($p < .05$).[12]

[12] It should be noted that we can also reject at $p < .08$ an equivalent number of Spiteful types under individual piece rates as under team piece rates, tournaments, and fixed wages (i.e. Spiteful types are least numerous under individual piece rates).

In order to disentangle the contrasting effects of motivational crowding, cross-task learning, differential comprehension, and beliefs (important for conditional contributors, see e.g. Fischbacher et al. 2001, Fischbacher and Gächter 2010), we employ a regression framework based on that of Eckel and Grossman (2005). Eckel and Grossman posit a model wherein public goods contribution behaviour features both an initial value (β_1) as well as a trend (β_2) to which contributions converge. For Task 2 effort e_{it}^2 in round t by individual i in treatment j then, the equation

$$e_{it}^2 = \beta_{1j}(1/t) + \beta_{2j}(t-1)/t + \delta' X_{it} + u_{it}$$

models contribution behaviour, where X_{it} is a vector of control variables and u_{it} a residual. Eckel and Grossman argue that the above equation should be estimated by panel GLS methods, which we follow. In all our specifications we control for all potential response patterns to the comprehension questions, interacted with treatment dummies.

Results are shown in Table 1, here the trend coefficient β_2 for the treatments team piece rate, tournament and fixed wage are shown relative to the individual piece rate treatment as the base category. The initial intercepts β_{1j} are not reported, nor are the comprehension by treatment dummies. The first model estimates just the difference in trends across treatments. We see that the individual piece rate treatment does best, with the tournament treatment roughly one unit of effort less, followed by the team piece rate treatment at 1.78 fewer units of effort and the fixed wage treatment having trend effort 2.47 Euros lower. This regression reproduces the broad pattern seen in Figs. 5 and 7, though controls very flexibly for subject comprehension.

[Fig. 8 here]

Model 2 augments the specification of Model 1 with a cross-task directional learning term, $(\pi_{t-1}^{1} - \pi_{t-2}^{1}) \cdot (e_{t-1}^{1} - e_{t-2}^{1})$, i.e. the product of the previous two periods' change in Task 1 effort with the resulting change in Task 1 payoffs. Intuitively, if a subject moved her Task 1 choice in a direction which was profitable, she will effect a similar directional change in her Task 2 effort. If the change in Task 1 effort resulted in a lower payoff, we conversely predict that her Task 2 effort will shift in the opposite direction. The coefficient on the directional learning term is 0.14, and highly significant ($p < .01$). This means that directional learning in Task 1 is a good predictor of Task 2 effort, though since it is less than 1, a successful unit of effort change in Task 1 would need to have resulted in a 1/.14 = €7 payoff increment to lead to an on-average change in Task 2 effort change by the same amount. Also of interest are the impacts on the treatment trend coefficients. The value of the coefficient for team piece rate is virtually unchanged at €1.77 (compare €1.78) whereas it appears that cross-task learning accounts for some of the impact of tournament and fixed wage incentives on voluntary Task 2 effort.

Model 3 further augments the specification of Model 2 with the incentivised beliefs regarding the Task 2 effort of the other employee. As expected, this term is highly significant and close to 1 (0.874), indicating a large degree of conditional cooperation. We now see that the directional learning term is reduced by nearly two thirds to 0.05, though is still marginally significant – suggesting that much of the effect of the cross-task learning may be operating through expectations about the other employee's behaviour. The addition of belief controls also substantially attenuates the treatment trend coefficients, with tournament and individual piece rate differences now insignificant (i.e. these are explained by cross task learning, comprehension and beliefs).

[Table 1 here]

Model 4 augments the base specification of Model 1 with the social preference types seen in Fig. 8. As expected, Inequality-averse types put in a significantly higher effort, by €1.24, compared to Selfish types, and Spiteful types on average put in €0.35 fewer than Selfish types, though this difference (likely owing to the scarcity of this type) is not statistically significant. What is important is that the coefficients on the treatment trends remain relatively unchanged for team piece rates and fixed wages, but are attenuated from -0.94 to -0.52 for tournament incentives. We might interpret this as suggesting that some of the non-learning-related effects of the tournament incentive scheme operate by changing subjects' motives (towards greater spitefulness and less inequality aversion). Oddly, the greater inequality aversion seen in the team piece rate treatment does not seem to mediate any effort contribution differences, as the treatment trend coefficient remains -1.66. The addition of the directional learning term in Model 5 corroborates this, as absent countervailing learning and motivational changes there is very little difference in the trends between tournament and individual piece rate incentives (-0.197). Model 6 provides further corroboration, and suggests that part of the motivational change effected by the tournament treatment operates by changing subjects' beliefs about their other employee's effort.

6. Discussion

Our results paint a more nuanced picture than has been seen in the literature thus far. The classical multitasking problem highlights the potential for strategic effort substitution to well-contracted and remunerated activities (Holmström and Milgrom, Fehr and Schmidt). The behavioural economics literature suggests that overly competitive incentives may crowd out intrinsic motivation (e.g. Buser and Dreber, Dimant and Hyndman). Both of these stylised patterns suggest not to use competitive incentives in a multi-task organisational setting. We cannot deny that both these effects are important considerations when designing organisational incentives. We find that on balance however, competitive incentives do not do too much worse than individual incentives, and in fact encourage no less effort on either task than pure team-based incentives. These effects likely stem from the extremely similar nature and simultaneous completion of both tasks. Our findings are in line with those of Krieg and Samek (2017) and Engl et al. (2018), who find that public goods enforcement institutions create a lock-in effect that sets a precedent even for games where they do not apply. Those papers which find crowd-out from competitive incentives (Buser & Dreber, Ter Meer, Beekman et al., Dimant & Hyndman) rather study qualitatively different games which are separated in time. It is unlikely that the precedent of high effort carries over in these cases. Indeed our social preference type elicitation (dictator game decisions) corroborates this sequential crowd out literature.

We therefore see our study as integrating diverse findings into a coherent explanation: Competitive incentives crowd out pro-social motivation, team incentives promote pro-social motivation, but setting a high effort precedent may be more important when employees perceive tasks as related. It is up to managers in real-world organisations to judge which conditions apply in their context, as well as to shape employees' perceptions (perhaps by framing) in order to ensure the desired results of a given incentive scheme. We also see our findings as a call for more research into which features, either in terms of strategic similarity, visual presentation, descriptive language, and temporal separation, cause greater or lesser perceived similarity in subjects' minds and modulate the learning and motivational externalities across situations.

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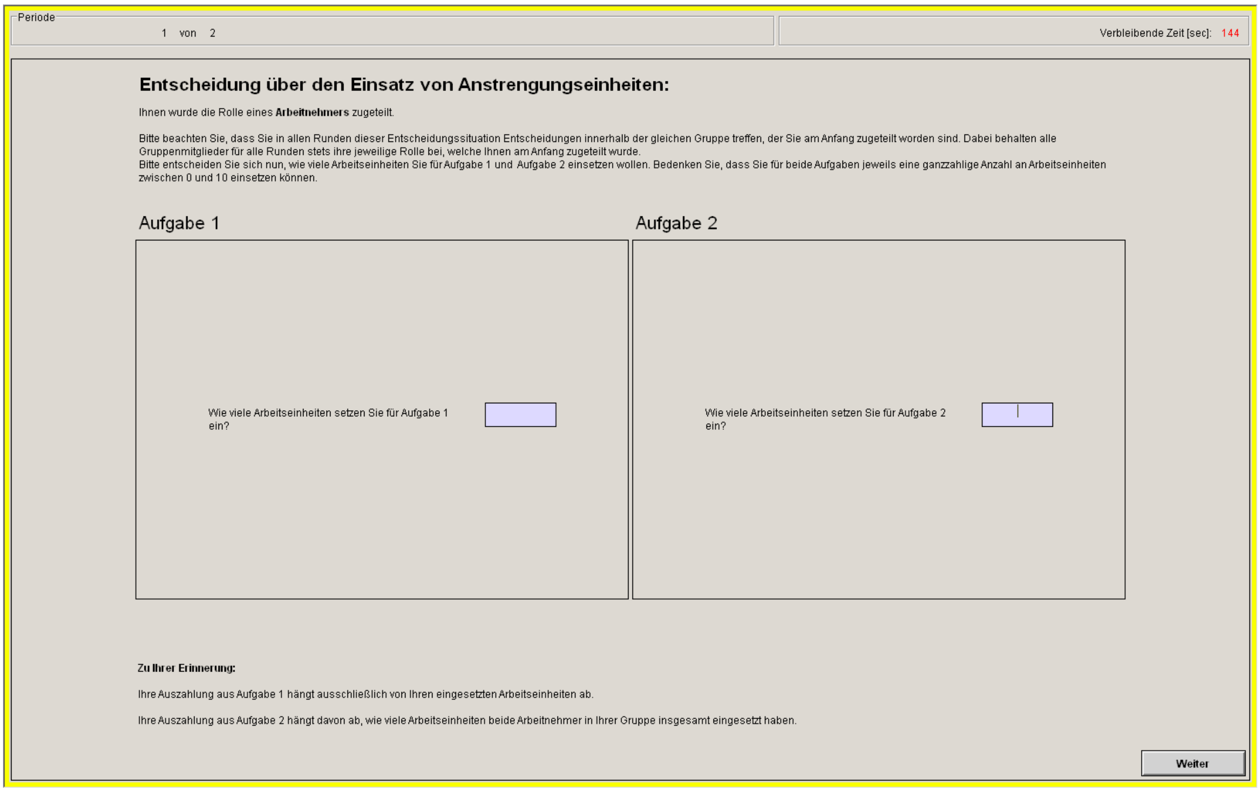

Fig. 1 The decision screen

Fig. 2 Feedback following the decision

Fig. 3 The dictator games

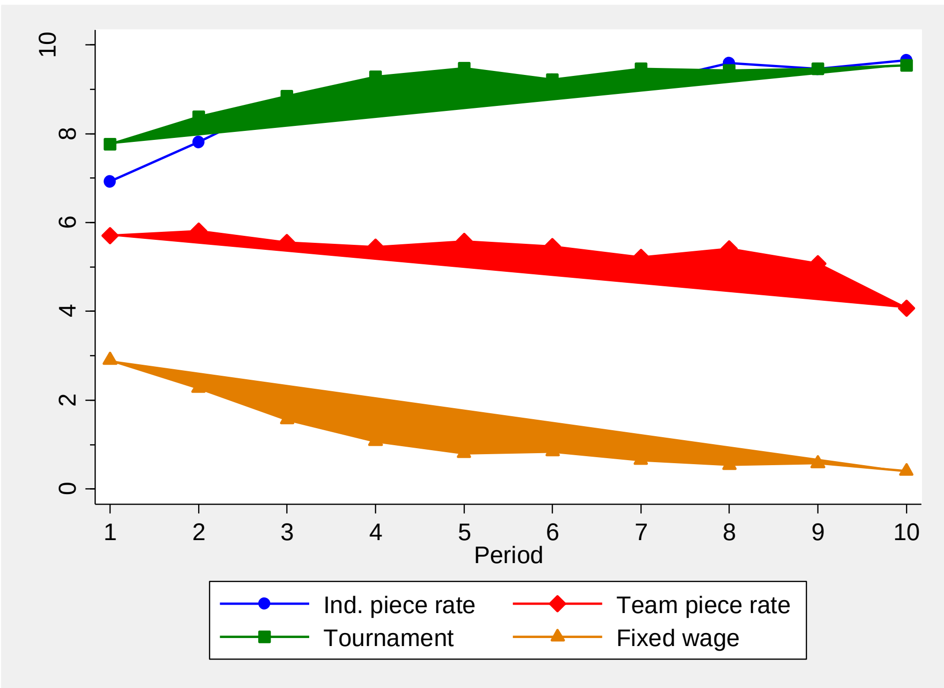

Fig. 4 Task 1 effort

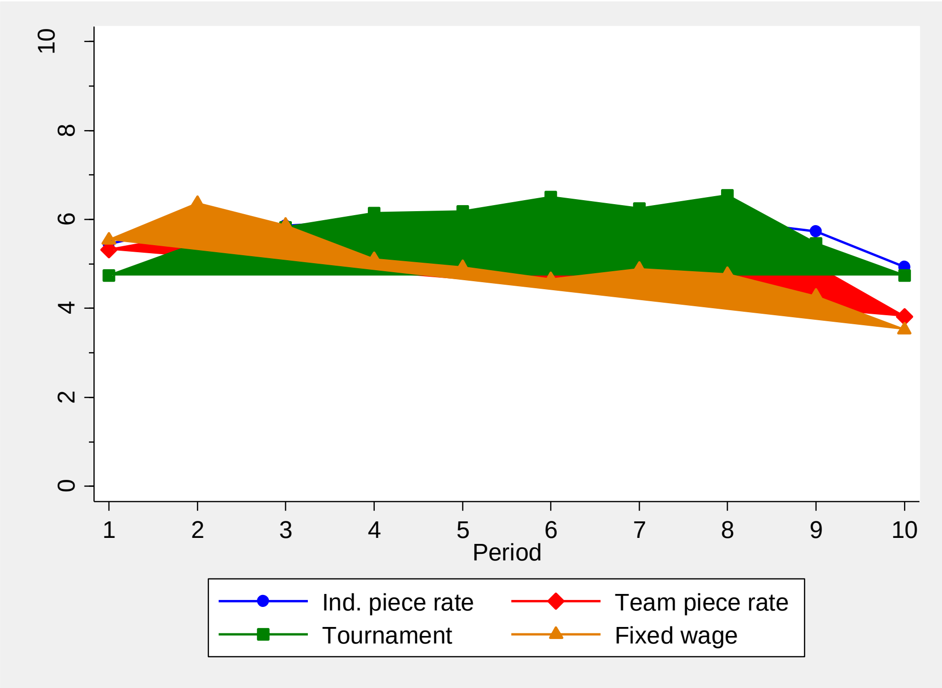

Fig. 5 Task 2 effort

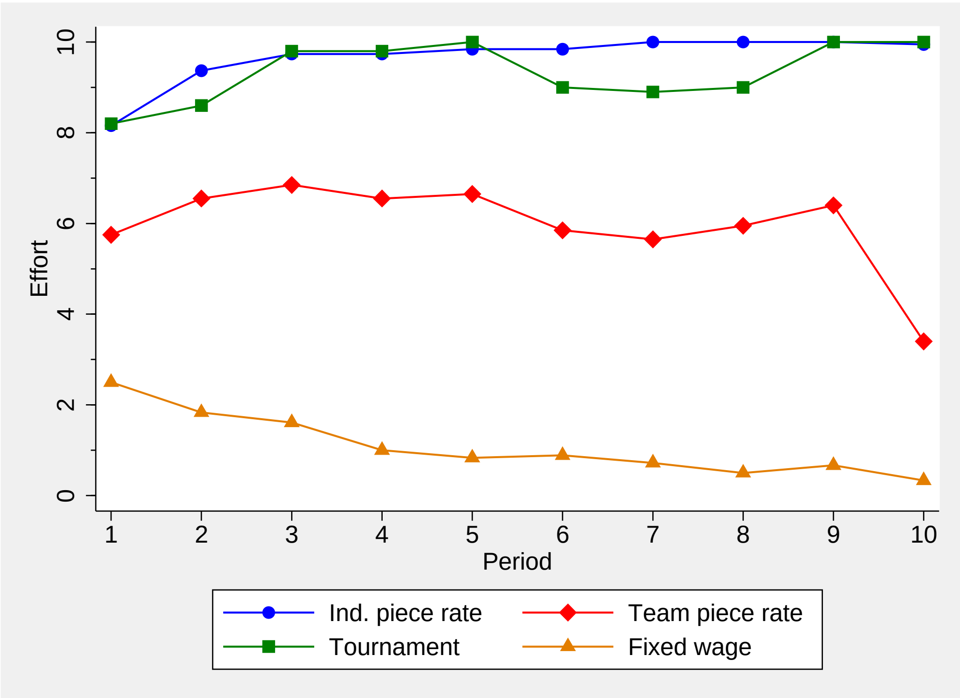

Fig. 6 Task 1 effort of full-comprehension subjects

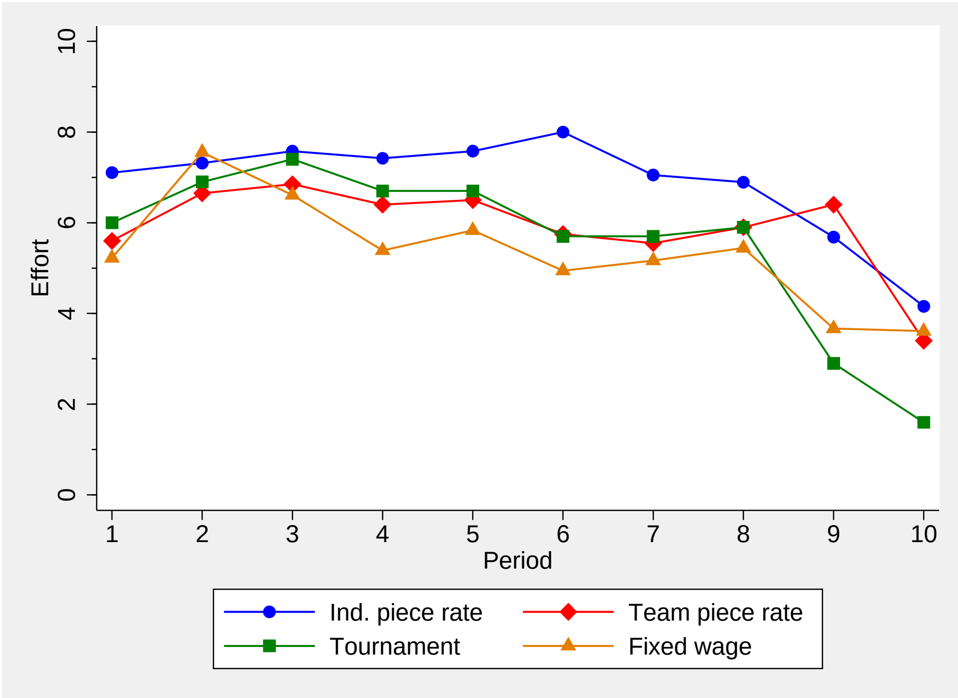

Fig. 7 Task 2 effort of full-comprehension subjects

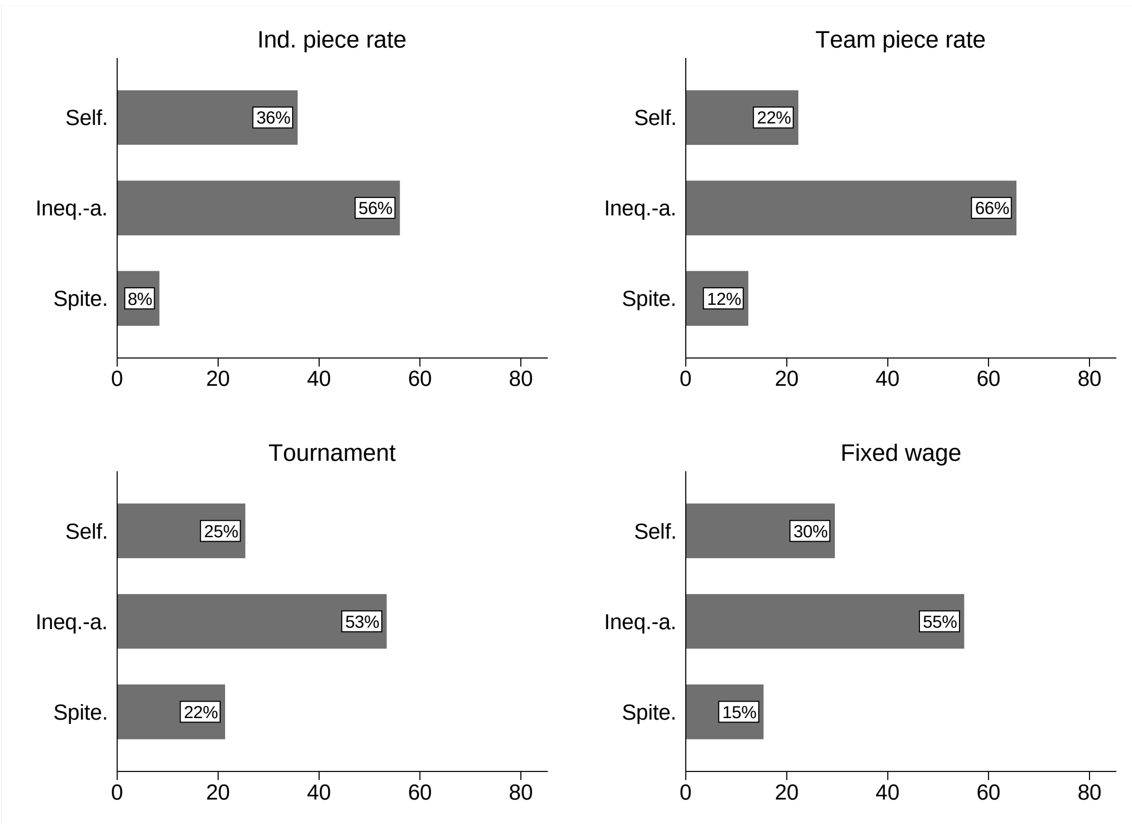

Fig. 8 Social preference types

MODEL	1	2	3	4	5	6
Team piece rate	-1.78***	-1.77***	-.596**	-1.66***	-1.68***	-.331
	(.420)	(.443	(.275)	(.391)	(.391)	(.258)
Tournament	-.938*	-1.27**	-.107	-.517	-.197	-.074
	(.551)	(.589)	(.281)	(.563)	(.571)	(.259)
Fixed wage	-2.47***	-2.95***	-.497**	-2.24***	-2.75***	-.572***
	(.330)	(.402)	(.206)	(.364)	(.422)	(.211)
$(\pi_{t-1}^1 - \pi_{t-2}^1) \cdot (e_{t-1}^1 - e_{t-2}^1)$		.141***	.050*		.141***	.067*
		(.041)	(.029)		(.042)	(.035)
Anticipated Task 2 effort			.874***			.852***
			(.012)			(.013)
Ineq.-a.				1.24***	1.43***	.666***
				(.208)	(.204)	(.106)
Spite.				-.349	-.590**	-.106
				(.253)	(.261)	(.136)

+ unreported comprehension × treatment controls

Table 1 Panel GLS regressions

Appendix

A1. Binary dictator game allocations

	Alternative A		Alternative B	
Choice*	Payoff to self	Payoff to other	Payoff to self	Payoff to other
1	€3.00	€2.00	€2.00	€2.00
2	€2.00	€3.00	€2.00	€2.00
3	€3.00	€3.00	€3.00	€2.00
4	€3.00	€3.00	€2.00	€3.00
5	€3.00	€1.00	€2.00	€2.00
6	€1.00	€3.00	€2.00	€2.00
7	€3.60	€2.60	€2.00	€2.00
8	€2.60	€3.60	€2.00	€2.00
9	€3.00	€1.00	€1.60	€1.60
10	€3.00	€1.00	€2.40	€2.40
11	€1.00	€3.00	€1.60	€1.60
12	€1.00	€3.00	€2.40	€2.40
13	€3.60	€2.60	€2.40	€2.40
14	€3.60	€2.60	€1.60	€1.60
15	€2.60	€3.60	€2.40	€2.40
16	€2.60	€3.60	€1.60	€1.60
17	€3.00	€2.40	€2.00	€0.40
18	€3.00	€2.40	€2.00	€1.80
19	€3.00	€3.00	€2.00	€0.40
20	€3.00	€3.00	€2.00	€1.80
21	€2.40	€4.00	€2.60	€2.00
22	€4.00	€2.40	€2.00	€2.60
23	€2.40	€3.00	€0.40	€2.00
24	€2.40	€3.00	€1.80	€2.00
25	€3.00	€3.00	€0.40	€2.00
26	€3.00	€3.00	€1.80	€2.00

*These were presented to each subject in a randomly determined order.