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ORIGINAL PAPER

Teamwork revisited: social preferences and knowledge acquisition in the field

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Abstract
Combining a lab-in-the-field experiment with field data, we study the effect of social preferences on performance in a modified teamwork setting, where the production of a public good serves as basis for incentivized individual performance, but is not a goal in itself. Examples of such modified team settings are knowledge sharing, peer coaching, and cooperative learning—all highly relevant topics for organizations today. As opposed to a standard public good setting, we find that conditional cooperators and their team partners are not more successful in producing the target output. In contrast, selfish individuals tend to perform better individually, without generating negative externalities for their team partners, as measured by the incentivized individual performance.

Keywords Teamwork · Social preferences · Knowledge sharing · Knowledge building · Cooperative learning · Lab-in-the-field experiment

JEL classifications D90 · M12 · M21

1 Introduction

Teamwork is key for organizations today (Lazear and Shaw 2007; Delarue et al. 2008). From an economic point of view, teamwork is a public good, where individuals jointly manage an asset (the team production) from which all of them benefit, but that requires costly and unobservable individual resources to build or to sustain

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(Alchian and Demsetz 1972; Holmstrom 1982; Rob and Zemsky 2002). Group members' social preferences strongly influence the contributions of individual resources to the public good. Production is more successful when the group includes conditional cooperators—individuals who behave reciprocally—among its members (Fischbacher et al. 2001). This has been shown in the lab, where the common workhorse for these studies is a repeated public good game (Isaac et al. 1984), as well as in the field, where, for instance, groups with a larger share of conditional cooperators are more successful in forest commons management (Rustagi et al. 2010).

Given the findings above, one would be tempted to conclude that firms and organizations relying on teamwork should try to hire as many conditional cooperators as possible. However, in practice, a widespread type of teamwork exists that is not fully captured by the pure public good setting: exchanges among workers with the objective of building and sharing knowledge, that subsequently serves as basis for individual production of a valuable product, but is not directly incentivized itself.

A situation of this kind is the exchange of best practice in firms (Tsai 2001; Szulanski et al. 2016), a crucial factor for generating, and continuously renewing, competitive advantage (Szulanski 1996). Very frequently, organizations encourage workers to exchange success recipes or jointly think about solving problems that they cannot crack on their own. However, such kind of exchanges with the objective of knowledge building and sharing are rarely incentivized as strongly as individual performance, e.g., quantity or quality of the output. The modified team setting also covers documentation, peer coaching, and cross-functional cooperation, all highly relevant aspects of today's corporate life. Our study examines whether conditional cooperators perform better than other social types in this modified team setting.

Our field setting—a challenging mandatory course for mathematics freshmen at a university in Germany—provides an example of the modified team environment, where cooperative learning constitutes a core component of knowledge acquisition (Slavin 1980). This educational standard (Ernest 2010) is communicated to the students by the faculty. The students are therefore required to hand in weekly homework assignments in teams of two. Achieving a minimum of 50% of points on the assignments over the semester is required to gain exam admission, but there are no external incentives to perform beyond this hurdle. The problems are so difficult, that the students cannot obtain the solution on their own. Individual preparation and team discussions are required to obtain satisfactory answers to the problems and, ultimately, to acquire the necessary knowledge for individual performance on the exam. The students are made aware of these facts by the instructor.

Students' social preferences are measured in a public good game (lab-in-the-field), using the standard procedure from Fischbacher et al. (2001).[1] We control for individual ability, time spent on individual preparation and team discussions (students' self-reports). The main outcome variable is the student's individual performance on the exam. In addition, we collect data on students' self-reported satisfaction with the joint work and the team partners' performance.

[1] The translated instructions are documented in "Appendix 1".

There are reasons to expect that conditional cooperators will thrive in the modified team setting as they would in a standard public good game, because they are willing to contribute and to punish defectors. At the same time, it is not guaranteed that higher contributions to the public good always translate into higher individual output (points on the exam in our case). It may happen that conditional cooperators will not select the best strategy to produce the target individual output most efficiently.

We find that conditional cooperators and their team partners are not more successful in the modified setting. In contrast, free riders have a statistically significantly better individual performance on the final exam than other social types, controlling for ability, and do not generate externalities, negative or positive, on their partners' individual performance, as measured by the performance on the final exam compared to the performance of students paired with other social types. In addition, free riders are perceived as more competent by their team partners, controlling for ability. At the same time, we obtain some evidence that free riders may contribute less individual preparation to the joint production of knowledge and therefore show expected free riding behavior. We provide potential explanations for our findings in the discussion section.

2 Related literature

Knowledge is an important organizational resource, providing a competitive advantage for firms in dynamic environments (Spender and Grant 1996). The knowledge base of the firm can be enhanced through the creation of new knowledge and the sharing of existing knowledge among employees (Grant 1996; Wang and Noe 2010). As Quinn et al. (1996) note, knowledge creation and sharing in organizations are interrelated: As one employee shares knowledge with another employee, the receiver gains information, and at the same time poses questions and makes amplifications and modifications, that add knowledge for the original sender. Thus, not surprisingly, firms have invested considerable amounts of financial resources in knowledge management systems intended to help knowledge sharing and creation (Wang and Noe 2010). Prior research has identified contributions to these systems as a public good (Cabrera and Cabrera 2002), because every employee can access the knowledge and its value does not diminish with use.

Considering knowledge sharing among purely self-interested employees, Siemsen et al. (2007) investigate optimal incentive systems to promote individual task-related effort and knowledge sharing in teams using a principal agent model. The authors find that individual and team incentives are complements, because individuals will share knowledge if they believe their coworkers will apply the knowledge (due to individual incentives) which in turn benefits the sharer (due to team incentives).

More closely related to our research that takes into account social preferences, Wang and Noe (2010) review the literature from management, organizational behavior, and applied psychology on knowledge sharing and identify avenues for future research. While prior research has identified important individual characteristics determining the propensity to share knowledge, like exchange ideology

(Lin 2007) and openness to experience (Cabrera et al. 2006), the authors consider the examination of further individual attitudes and personality traits as promising field for further research. We contribute to this literature by investigating how social preferences translate into individual performance in a field setting where knowledge creation and sharing in a team is key.

Additionally, the education literature has paid extensive attention to cooperative learning, which describes the process of putting students in intergroup exchanges as a viable method to increase student achievements (Slavin 1980). Several studies report positive effects such as increased student performance and the favorable development of interpersonal skills (Ciccotello et al. 1997). However, despite the benefits of cooperative learning, some studies report negative effects for some students (see Holt et al. 1997; Lundberg and Lundberg 1992; Robinson 1990). Especially, the free rider problem can turn cooperative learning to a negative experience and decrease overall performance (Joyce 1999), in particular when the team performance is weakly incentivized. Therefore, it is important to gather additional evidence on the impact of social preferences on the outcome of cooperative learning.

The effect of social preferences on contributions in the standard public good setting has been studied extensively, mostly in the lab (Fischbacher et al. 2001; Fischbacher and Gächter 2010; Chaudhuri 2011). A common finding is that groups that count conditional cooperators among their members produce higher contribution levels. There are several reasons for this phenomenon. First, conditional cooperators contribute to the common project, if they perceive that others are contributing as well. Second, conditional cooperators motivate selfish members, who rationally expect contributions from conditional cooperators in return, to participate more in the common project, at least in the first periods of a repeated game. Finally, the effects are amplified when punishment opportunities are given, as conditional cooperators negatively reciprocate free riding, punishing it even at a personal cost (Fehr and Fischbacher 2004).

There is ample evidence that social preferences are related to behavior in real life. Less selfish individuals are more likely to donate to charity (Benz and Meier 2008), and to participate in crowd-sourcing, such as Wikipedia (Algan et al. 2013). Gneezy et al. (2015) find that fishermen who must rely on teamwork due to environmental factors show more pro-social preferences across a range of experimental games than their neighbors who work individually. A detailed overview of the literature on the generalizations of social behavior from the lab to the field, including its limitations, is given in Burks et al. (2016). This study shows that US truck drivers' social preferences are related to their behavior toward their peers, but not toward the experimenters, with whom the truck drivers have fewer social connections.

Conditional cooperation, or reciprocity, is particularly relevant for determining real-world outcomes. For example, cross-country skiers contribute more to the preparation of tracks, if they believe that others do so, too (Heldt 2005). Students' donations to a scholarship correlate with their beliefs about others' donations (Frey and Meier 2004). Reciprocity measured as second-mover behavior in a trust game (trustworthiness) is related to sales people's choice of selling strategy and success (Essl et al. 2018). Finally, according to a large-scale survey with employees in Germany, reciprocity influences tax morale (Frey and Torgler 2007) and effort exerted at work (Dohmen et al. 2009).

3 Study design and data collection

The data was collected during the 2015/2016 winter semester in the course Analysis I at a major university in Germany. The 10 European Credit Transfer and Accumulation System (ECTS) course is mandatory for freshmen, and is the main course in mathematics in the first semester.[2] The course consists of two lectures per week, as well as a weekly tutorial in which take-home assignments are discussed. Class attendance is not compulsory. The typical exam failure rates in mathematics are about 30–50%, with 40–60% of students dropping out of university during the first few semesters. Thus, mathematics is a challenging subject to study, and Analysis I is the first demanding course in mathematics.

To encourage learner-learner exchange, students are given weekly take-home assignments to solve in teams of two. The problem sets are designed to be difficult to the degree that the vast majority of students cannot successfully solve them on their own. Accordingly, the instructor makes students aware of the importance of joint work as a prerequisite for successful exam performance.

Each assignment is graded per team, meaning that the two team members receive the same number of points. At least 50% of points must be obtained to gain exam admission. In the data set, no team failed to receive exam admission by at least the last assignment. We conducted a lab-in-the-field experiment to assess the students' social preferences. In addition, we were given access to pseudo-anonymized data of individual exam grades, team composition, and scores for the homework assignments during the semester.[3] Figure 1 illustrates the timing of events and data collection.

In the first lecture, students took a test of high school math. The grade on this test was used as the measure of mathematical ability. Controlling for ability is important to avoid endogeneity in later analyses, as students with higher ability are more likely to earn better course grades.

In the second lecture, students were instructed by the lecturer to form teams of two. These teams had to turn in the homework assignments together. Due to fairness concerns, and as requested by the instructor, we had to keep the team formation procedure unchanged compared to previous semesters. Thus, we were not allowed to manipulate the formation of the teams. However, the teams formed at the beginning of the semester, and students had to sign up immediately after class with their partner. This reduced the probability that students selected their partners strategically. In

[2] The curriculum for the first semester consists of 31 ECTS, with a total of 19 ECTS in mathematics and 12 ECTS in related subjects.

[3] The students agreed that their student ID number would be matched with their player number, and stored physically at the university where the study was conducted. The key was used only once, at the end of the semester, to match the experimental data with the course data. Furthermore, students were assured that the key would be erased by the end of the study, as was indeed the case.

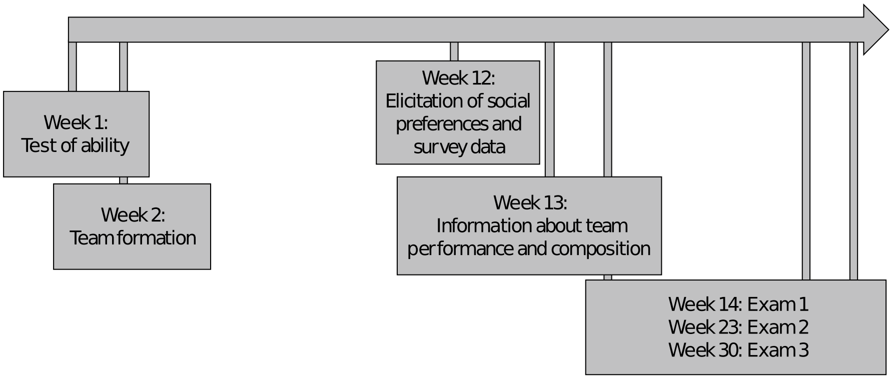

Fig. 1 Timing of the study

the survey, 93% of students stated that they had not known the team partner before the course.

In week 12 of the semester, all students present in the lecture participated in a classroom paper-pen public good experiment that followed the procedure in Fischbacher et al. (2001). In total, 111 students out of the 158 enrolled students (roughly 70%) were present for this lecture and participated in the initial test of ability. All students present chose to participate in the study.[4] Participants decided on an unconditional contribution and a full (conditional) contribution table. Every participant was endowed with €5 (10 points). Integer contributions between 0 and 10 points were allowed. To capture the context of the take-home assignments, experimental groups consisted of two members. The efficiency factor of $\alpha = 0.7$ guaranteed a sufficient balance between individual and collective utility. To minimize social concerns toward their peers, students were informed that their decisions would be matched with those of another student from a different university.[5] After the experiment, students filled out a survey, stating how many hours per week they generally spent on the take-home assignment working individually and in the team, measured in 5-h intervals, and how satisfied they were with the team cooperation and their partners' competence and engagement. In addition, students entered their demographic data, and indicated when they had first met their team partner. Finally, students signed a consent form allowing us to use their pseudo-anonymized data in the study.

There were three exam dates during weeks 14, 23, and 30, respectively. Students were free to register for one of these three dates (in case they failed a try, they could retake one of the subsequent exams), or they could even postpone the exam to the next semester. All tests were designed to be equally difficult. The variables used in the study are summarized in Table 1.

[4] One student refused to share his or her pseudo-anonymized exam data, and one failed to fill out the questionnaire. Both students' answers were excluded from the analysis.

[5] We collected the matched data two weeks later, and organized the payments shortly after.

Table 1 The dependent and independent variables of the study

	Variable	Measure
DV	Individual performance	Points earned on the exam (min. 0; max. 60)
	Self-stated satisfaction with teamwork	Self-stated satisfaction with partner's engagement and competence, and team cooperation in general (min 0; max. 3)
Independent	Ability	Test of mathematical skills in the first lecture
	Social preferences	Experimental measures from public good game
	Individual preparation	Self-reported hours spent on the assignments individually weekly
	Team discussions	Self-reported hours spent on the assignments in the team weekly

A total of 158 students were enrolled in Analysis I. We obtained measurements of social preferences in the lab-in-the-field experiment of 125 individuals. Of those subjects, $N = 111$ were also present when ability was measured.[6] For 85 of these students, we additionally have the experimental measures of their team partner. Both types of observations receive attention in the main analysis. 76 observations contain individual performance, ability, and experimental measures for *both* team members. This enables us to assess the quality of teamwork with the team members' perceived competence and engagement, and overall satisfaction with cooperation, while controlling for ability.

4 A simple model of the modified teamwork setting

Our field setting represents a modified teamwork situation, where the teamwork is not directly and continuously incentivized, but constitutes a basis for later individual performance. As argued in Sects. 1 and 2, this kind of situation is common in organizations. The knowledge acquisition phase (i.e. the work on the problem sets) constitutes a public good situation with *knowledge* generated being the public good. Due to the fact that the problem sets at hand are of significant difficulty and cannot be solved alone, they need to be prepared beforehand and later discussed in the team. There are thus two types of contributions to the public good: individual preparation time and team discussions. Both are non-excludable and non-rivalrous: During the team discussion, students cannot exclude each other either from the results of their individual preparation nor from the results of the discussion itself; insights created during both of the contributions do not diminish when shared and are therefore non-rivalrous.

Note that there is another prominent public good in our setting, which are the solutions to the problem sets. However, given that the incentive structure does not foster continuous contributions to this public good (50%-hurdle to gain exam admission), we do not consider the solutions to the problem sets in our analysis.

[6] Note that lecture attendance is not mandatory.

To illustrate the situation of our study subjects, we assume a simple knowledge acquisition function where knowledge k_i for individual i is a function of i's ability a_i and the effort that i and her team partner j spend on homework assignments. The effort can be invested either in individual preparation, p_i, p_j or in joint team discussions, t_i, t_j. Both types of effort increase the individual's and their partner's knowledge. Team discussions are required, given that due to the high complexity level of the problems, individuals can very rarely solve them fully on their own. Finally, parts of the total available time T that each individual has at his or her disposal can also be spent on leisure, l_i. Thus, an individual's productive effort is given as

$$p_i + t_i = T - l_i. \tag{1}$$

The knowledge acquisition function, thus, looks as follows:

$$k_i = a_i + \alpha(p_i + p_j) + \beta(t_i + t_j) \tag{2}$$

where α and β are the marginal per-capita returns (MPCR) of the individual preparation and team discussion on knowledge production. In common public goods with $n = 2$ individuals, it is usually assumed that $0.5 < \text{MPCR} < 1$, indicating that contributions are collectively efficient but individually detrimental, because the individual has to fully bear the cost of forfeited leisure but only partly benefits from own contributions. In our case, it is possible, that the MPCRs on the two types of contributions differ by individual and team, depending, e.g., on ability, learning style or team dynamics. However, as long $0.5 < \text{MPCR} < 1$ holds for all MPCRs, the model is suited to describe our field setting.

To summarize, collaborative learning is illustrated by a public good game, where the public good is the acquired knowledge and the contribution is problem-solving effort, spent individually or in the team. Though the public good and the individual contributions have different "denominations" (effort vs. knowledge), they are both non-rivalrous and non-excludable, given that no member of the team can be excluded from the solutions and both can use the solutions to build up own knowledge. Finally, the incentivized target output is the individual's performance on the exam, a function of knowledge and other unobservable factors, such as stress resistance, the mood on the day of the exam, etc.

The simple model, of course, has several limitations. First, it ignores possible interactions between effort spent on individual preparation and team discussion, which can be substitutes (as better preparation makes for a more efficient and thus better team discussion) or complements (better prepared individuals have more to talk about, and may choose to solve more problems to create more knowledge that will help them perform on the exam).

Second, the model ignores potential interactions of ability and effort. These again can be complex. Individuals of lower ability may have to spend more time in preparation and discussion to arrive at similar results than more able individuals. At the same time, they may be more likely to give up trying and so invest less effort. Individuals of higher ability may need less preparation time to achieve a given target, but also may invest more effort in the work in total, aspiring to hit higher targets. Finally, our model is based on average levels of effort and a snapshot of ability. It ignores the dynamics of knowledge acquisition (e.g., impact of knowledge acquired on the MPCR in the next period).

5 Research hypotheses

To derive the hypotheses, we start with standard predictions regarding the effect of ability and effort on performance ($\frac{\partial k_i}{\partial a_i} > 0, \frac{\partial k_i}{\partial p_i} > 0, \frac{\partial k_i}{\partial t_i} > 0$).

Hypothesis 1 The effect of ability and effort on individual performance

1. Subjects with higher ability have better individual performance.
2. Effort devoted to individual preparation or team discussions increases individual performance.

Now we turn to the hypothesis regarding the focus of the study: the effect of social preferences on performance in the modified team setting, where teamwork is required to produce knowledge, which fosters the incentivized individual performance. This teamwork situation resembles a public good game: Spending effort on problem-solving is individually costly (MPCR < 1), but if both partners pull their weight, the total knowledge of the team members increases ($n *$ MPCR > 1). It has been shown that production of a public good is more successful when the group includes conditional cooperators (Fehr and Fischbacher 2004; Rustagi et al. 2010), because conditional cooperators contribute if they think the other group members are contributing as well, and they are willing to punish deviators even at a personal cost. In our modified team setting, the punishment could mean withholding effort for joint problem solving with the team partner in the future or preparing less individually. Thus, building on the findings from standard public good settings, we arrive at the following hypotheses:

Hypothesis 2 The effect of social preferences on individual performance

1. Conditional cooperators' individual performance is better than that of other social types, controlling for ability.
2. Conditional cooperators' partners' individual performance is better than that of other social types, controlling for ability.

Finally, we predict that this positive effect on individual performance also translates into higher satisfaction with the teamwork itself. Several studies have shown theoretically and empirically that workers value team production in a cooperative environment (Kosfeld and von Siemens 2011; Rabin 1993; Hamilton et al. 2003), so we expect this to be the case in our setting as well.

Hypothesis 3 The effect of social preferences on the perception of teamwork quality by the team members.

- Individuals whose team partner is a conditional cooperator are more satisfied with their partners' engagement and competence, and the overall collaboration than individuals paired with a person of any other social type.

The following section contains analyses evaluating these hypotheses.

6 Results

6.1 Descriptive statistics

Figure 2 shows the distribution of the $N = 111$ individuals for whom we obtained social preferences and ability: 48.7% ($N = 54$) are classified as conditional cooperators following the definition by Fischbacher et al. (2001). 17.1% ($N = 19$) contribute 0 in every conditional decision, and are classified as free riders. Around 17.1% ($N = 19$) show a hump-shaped contribution pattern. 2 subjects (1.8%) altruistically contribute all their endowment independently of the decision of the counterpart. For 15.3% ($N = 17$), social preferences cannot be classified according to standard definitions.

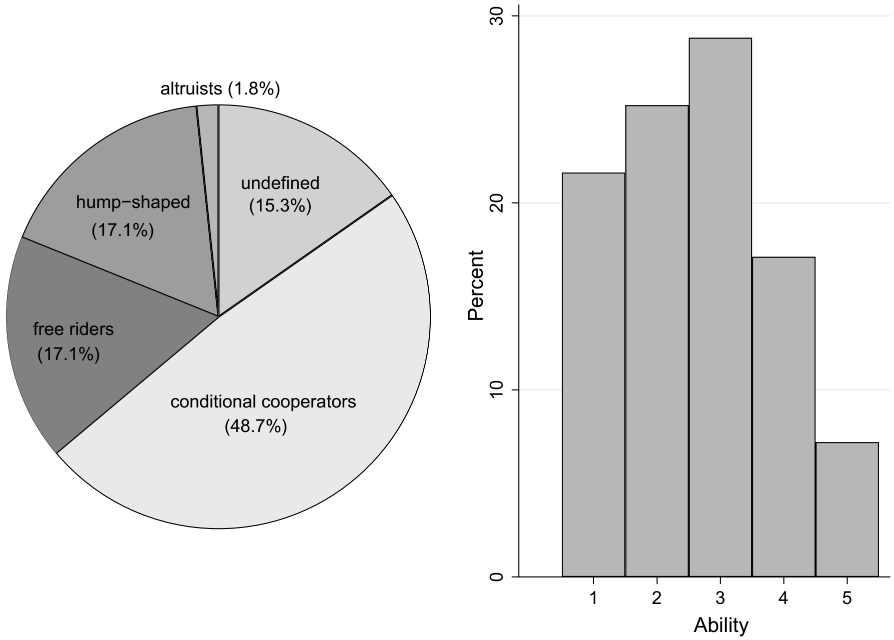

Fig. 2 Distribution of social preferences and ability among subjects. Classification of social preferences according to Fischbacher et al. (2001). Ability is coded discretely from 1 to 5 with 1 being the worst and 5 being the best grade in the initial test

Ability is coded discretely between 1 and 5, with 1 the lowest grade and 5 the highest. A Kruskal-Wallis rank test[7] cannot reject the hypothesis that the distribution of ability does not differ across social types ($\chi^2_4 = 3.050$, $p = 0.55$); that is, social preferences do not explain differences in ability.

Table 2 summarizes the number of students participating in each exam, the average number of points for those who passed (the main dependent variable), and the percentage of students who failed the exam.

In the following, we illustrate the relationship between individual preparation time and the time spent in team discussions. The Spearman correlation shows no correlation (Spearman's rho = −0.0256 at $p < 0.79$), suggesting that the two types of contributions are neither substitutes nor complements. Figure 3 clusters the two variables against each other and illustrates the respective frequencies. Distributions are shown on an aggregate level for all types and then separately for the social types of main interest: conditional cooperators and free riders.

We observe that free riders seem to underinvest in individual preparation time and thus to free ride on this public good contribution. While the Kruskal-Wallis test of the distribution of individual preparation among social types is not significant ($p = 0.15$), a logistic regression (Table 5, "Appendix 2") shows evidence that free riders indeed tend to contribute less individual preparation time ($p < 0.1$). We provide a potential reason for this finding in the discussion.

6.2 Regression analyses

Table 3 contains the main regression analyses of this study related to Hypotheses 1 and 2. The dependent variable is individual performance measured by the number of points obtained on the exam, distributed between 0 and 60, with 30 points as the minimum number necessary to pass.[8] In model (1), the independent variables are ability, and the self-reported number of weekly hours spent on the homework with individual preparation and working together with the team partner.[9] For both effort variables, the category "less than 5 hours per week" serves as a reference. Model (2) considers the effect of the student's social type and model (3) the effect of the team partner's social type. In all cases the undefined social types serve as the reference category.[10] Changing the reference type to all non-free riders yield qualitatively similar results.

[7] All tests are two-sided.

[8] We use Tobit regressions to fit the data to the lower and upper bounds as given by the exam. The coefficients and significance are qualitatively the same if we use an ordinary least squares (OLS) regression instead. In order to rule out multicollinearity, we conduct an analysis of variance inflated factors (VIF) of the main regressions. The average values of each regression are between 1.10 and 1.52 with no individual value exceeding 2.01. Following Hair et al. (2010), those values indicate no issues with multicollinearity.

[9] Table 6 in "Appendix 2" shows the same regression with combined effort levels. Results remain qualitatively the same, with more effort implying a better performance on the exam.

[10] Two students classified as altruists are also part of the reference category. Regressions in which these two observations are part of a separate category or in which they are dropped yield results similar to those presented here.

Table 2 Exam results

	Exam I	Exam II	Exam III	Total
Number of students	8	127	58	150
Average points for students who pass	38.8	36.1	31.0	34.9
Failure rate (%)	37.5	41.7	53.4	29.3

Notes: Of the 158 totally enrolled students, 8 did not sign up for an exam, and 44 failed, of whom 43 students retook the exam. In the column *Total*, each student is counted once. Exams are designed to be of comparable difficulty. Differences in the failure rate can be explained by selection effects

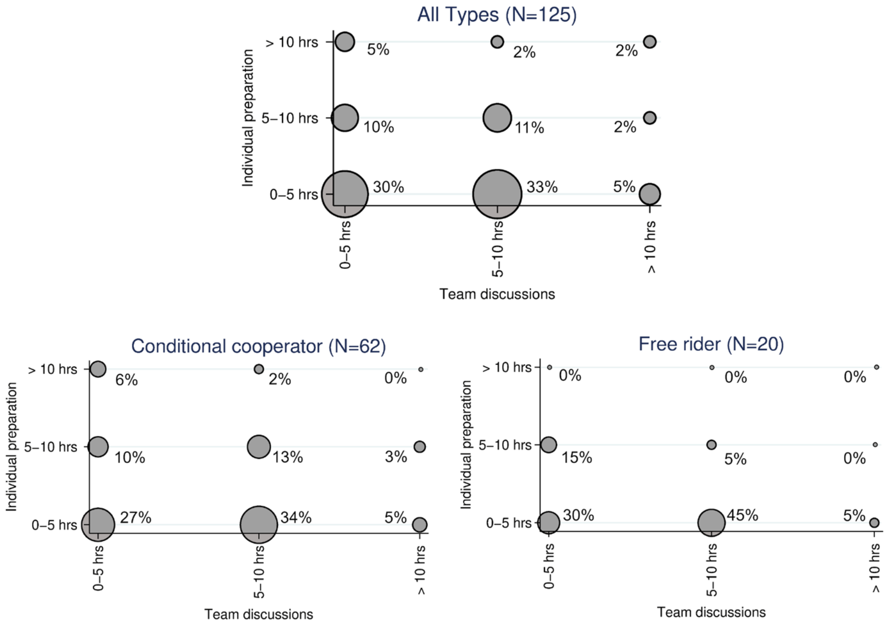

Fig. 3 The relationship between individual preparation time and time spent in team discussions pooled across all types and separated for conditional cooperators and free riders

The first hypothesis predicts that the main output (individual performance) depends on one's ability and the effort invested in solving the assignments. Table 3 provides evidence in support of this hypothesis. The coefficient of *Ability* is statistically significant in all three models.[11] For example, according to model (1), a student who obtains a one-point higher grade on the ability test in the first week receives around an additional 3.7 points on the final exam. Regarding effort, it can be seen

[11] Adding a measure for the differences in ability among the team members does not qualitatively change the results.

Table 3 Tobit regressions with exam score as the dependent variable

	(1)	(2)	(3)
Ability	3.703*** (0.985)	3.794*** (1.007)	4.039*** (1.091)
Team discussions: 5–10 h	−0.426 (2.586)	−0.679 (2.603)	3.948 (2.724)
Team discussions: > 10 h	6.386 (3.910)	7.265* (3.666)	9.047** (3.905)
Indiv. preparation: 5–10 h	9.596*** (2.824)	10.08*** (2.616)	9.876*** (3.379)
Indiv. preparation > 10 h	−1.815 (4.849)	−0.396 (4.978)	7.783 (5.102)
Free rider		9.793*** (3.267)	6.925** (3.474)
Conditional cooperator		4.249 (3.427)	3.058 (3.385)
Hump-shaped		3.449 (3.874)	4.832 (4.361)
Partner, free rider			0.373 (4.992)
Partner, conditional cooperator			−1.580 (4.015)
Partner, hump-shaped			4.903 (4.160)
Constant	17.33*** (3.284)	12.58*** (4.182)	10.95* (5.561)
Observations	111	111	85
Pseudo-R^2	0.027	0.034	0.037

Lower and upper bounds, 0 and 60, respectively. Robust standard errors, clustered on the team level, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4 Tobit regressions on the satisfaction with the team partner's competence, engagement and the cooperation overall

	(1) Competence	(2) Engagement	(3) Cooperation
Partner conditional cooperator	0.742 (0.494)	0.256 (1.038)	−0.326 (0.208)
Partner free rider	1.280** (0.540)	−0.058 (1.054)	−0.120 (0.305)
Partner hump-shaped	0.066 (0.598)	−0.777 (1.089)	−0.054 (0.327)
Partner's ability	0.475*** (0.175)	0.502 (0.324)	−0.083 (0.093)
Ability of person who assesses	−0.131 (0.160)	−0.309 (0.291)	0.135 (0.110)
Constant	1.258*** (0.456)	2.971*** (1.091)	1.930*** (0.288)
Observations	76	76	76
Pseudo R^2	0.061	0.027	0.017

Notes: Lower and upper bounds, from 0 ("fully unsatisfied") to 3 ("fully satisfied"). Robust standard errors, clustered on team level, in parentheses. Significance levels:

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$

that individual preparation time is already useful at a lower level, while working together pays off in grades only after students spend more than 10 h per week working together. This result is reasonable, because individual task-solving capacities are attained after a short phase in the beginning, whereas teams need to spend time with interacting socially and overcoming communication problems at first. Then, teamwork becomes extremely effective, with team members earning 7–9 additional points individually on the exam. Table 6 in "Appendix 2" combines both types of effort for each student.[12] In all specifications, more effort is associated with a better individual performance. Evidence can be summarized as:

Result 1 Ability and effort, spent on individual preparation or team discussions, increase individual performance.

The main Hypothesis 2 examines the individual performance of the social types. According to models (2) and (3) in Table 3, conditional cooperators do not perform statistically significantly better than other social types. In addition, in model (3) the coefficient of *Partner, conditional cooperator* is negative and is not statistically significant, meaning that working together with a conditional cooperator does not lead to higher individual grades.

In contrast, free riders statistically significantly outperform other social types, earning, on average, around 7 to 10 more points on the exam. Next, we examine whether the free rider's success comes at the expense of their team partners. In model (3), the coefficient of *Partner, free rider* is not significant, meaning that being on a team with a free rider does not lead to earning lower individual grades. Incorporating the partner's ability in models (1)–(3) does not change the results, while the respective coefficient is small and insignificant in every model. The same holds for incorporating the partner's individual preparation time.[13] The main result of the study can be summarized as follows:

Result 2 Controlling for ability, conditional cooperators do not perform statistically significantly better on the exam compared to other social types. In addition, the conditional cooperator's team partners also do not perform significantly better. In contrast, free riders produce significantly higher individual output than other social types, and do not generate externalities for their partners, measured by individual performance compared to that of students, whose team partners are not classified as free riders.

Hypothesis 3 concerns the students' self-reported satisfaction with joint work. Satisfaction with their partners' engagement and competence, and the overall cooperation is measured on a scale between 0 ("fully unsatisfied") to 3 ("fully satisfied"). Table 4 presents the regression results of the assessments.

The team partner's assessment of the conditional cooperators' competence is positive, but not statistically significant. In contrast, partners are significantly more satisfied with free riders' competence, compared to the reference category of unclassified individuals ($p < 0.05$). This result holds when controlling for ability, which is itself a significant factor of satisfaction with a student's competence, as assessed by his or her teammate ($p < 0.01$). There are no significant differences across the partners' social types regarding the satisfaction with their engagement or the overall cooperation. The below results summarizes the observations:

[12] Different specifications, such as controlling for the exam date, leave the results qualitatively the same.

[13] Results available on request.

Result 3 Free riders are perceived as more competent by their team partners, controlling for ability. There is no such effect for conditional cooperators or other social types. The assessment of the team partner's engagement and the overall collaboration does not depend on the partner's social type.

7 Discussion and conclusion

The present study tests the effect of social preferences on performance in a modified teamwork setting. In this setting, collective work is not continuously externally incentivized, but is necessary to produce valuable individual output. This framework applies to a number of important situations in the organizational context, such as internal knowledge sharing, peer coaching or cross-functional collaboration. In general, any situation where collaboration with others is desired (by the organization, the management or other architects of those environments), but not incentivized as strongly as individual work, can be described by our modified teamwork environment.

For example, salespeople typically receive motivation based on individual performance, potentially combined with a (lower weighted) component of team performance. However, the organization would like salespeople to learn from and share knowledge with their peers to promote everyone's competence and ultimately the combined sales. To conduct a useful coaching session in the sales context, both partners need to prepare and to make time to sit down together to serve a client. Of course, the individual abilities influence the effectiveness of coaching and the resulting level of sales.

A similar description is valid for typical situations of cross-functional collaboration. Assuming that the organization does not work in an agile project mode, typically workers in every department would be incentivized according to their specific functional responsibilities (e.g., the performance indicators for workers in product development would reflect the success of the development of products, those of workers in operations the quality of product servicing, etc.). At the same time, the organization would attempt to foster cross-functional collaboration, reduce siloed thinking, to make sure, e.g., that the new products designed are easy to service. To engage in a cross-functional exchange, workers would have to spend time on preparation and the exchange itself, and the results of such an exchange would be influenced by the workers' abilities as would be their ultimate incentivized performance.

Even though not explicitly embedded in a corporate environment, the study context—a lab-in-the-field experiment with university students combined with field data—allows us to reliably reflect on the modified team setting, measuring individual output (final grades), abilities, and to some extent the effort invested into individual preparation and teamwork.

The initial hypotheses regarding the higher achievement of conditional cooperators with respect to individual performance and quality of teamwork must be rejected. We do not find better performances on the exam for conditional cooperators or their team partners. Conditional cooperators are also not perceived as more engaged or competent by their team partners and their team partners are not more satisfied with the general level of team cooperation than other social types' partners. In contrast, free riders perform significantly better on the final exam compared to other social types. Free riders do not generate externalities, negative or positive, on their partners' individual performance, measured by comparing the partners' performance on the exam to other students' results, who were not on teams with free riders. Teams that include free riders do not need significantly more time to achieve joint production targets, and team partners are significantly more satisfied with free riders' competence than with the competence of other social types, controlling for ability.

Overall, based on the data, we conclude that when team exchanges are just part of a bigger picture, ultimately resulting in individual production, the presence of conditional cooperators does not always have a positive effect, and the presence of free riders does not always have a negative effect on team production, as in classical teamwork. On the contrary, free riders seem to be more successful in producing individual output without hurting others' performance, even though there is some evidence that they may contribute less individual preparation to the joint work, whereas we see no differences in contributions to team discussions. These findings on contribution levels could be due to the fact that individual preparation time is a non-observable contribution to the public good. Contrary to that, free riders are at risk of being punished by the team partner when they shirk on the observable contribution: team discussions.

A possible reason for the success of free riders in the final exam could be that they have a tendency toward rationality, which is an advantage for math studies. This explanation is, however, unlikely to be decisive in this case, as free riders do not perform better on the initial test, and we control for ability in the regression. Another potential explanation for our observations is that, having spent less time on individual preparation, free riders are less depleted when joining the team discussion. Thus, they benefit more from the discussion and make a more competent impression on their team partners than other, better prepared but more depleted social types. A further explanation can be that free riders, whose social preferences have been found to correlate with higher creativity (Diebels et al. 2018; Silvia et al. 2011), come up with innovative solutions during the discussion, impressing their team partners with their competence. Creativity and selfishness both correlate with a higher propensity to lie (Gino and Ariely 2012; Guentner 2016), so that the team partners may never find out that the free riders have invested less time in individual preparation. Regarding the higher competence rating of free riders, it has also been found that free riders are more assertive (Diebels et al. 2018). This may contribute to them being perceived as more competent according to the influential stereotype content model (Fiske et al. 2018; Fiske 2018).

By showing that free riders may work more efficiently in a modified team setting, the study provides clear managerial implications. First, hiring people with selfish social preferences for jobs that involve the modified team setting may prove useful based on the results of the study. In addition, for firms that like to capture the benefits of teamwork, but at the same time, aim to reduce the problem of free riding, they could try to transform teamwork in a modified team setting, by adding an individually measurable output, or linking the joint production more clearly to the incentivized individual output.

Indeed, in our case, there was no doubt for the students that by investing time into the public good they finally and significantly promoted their individual performance, which may explain why the free riders in our case behaved differently than in some other studies on cooperative learning. These measures could help organizations save resources on screening out free riders at the recruitment stage, or giving up on team output lost due to free riding, but strategically embed workers, based on their social preference, in suitable team environments.

In the given setting, several factors beyond social preferences and ability can influence performance. For instance, the degree of dynamic inconsistency (impatience) may vary among students, leading some of them to abandon coursework during the semester in favor of leisure and partying, despite the wish to earn a high grade (Augenblick et al. 2015). In addition, the level of trust toward the course instructor, and his claim that teamwork is important, may lead students to take the homework assignments more or less seriously. We chose not to control for these factors, for two reasons. First, because we are not aware of studies that show that these reasons are related to social preferences. Second, we aimed to keep the data collection simple to realize in a classroom environment during a lecture.

The study, of course, has several limitations. The analysis uses self-reported data on the team partner's assessment and on the effort invested, which might be biased systematically by social preferences. In addition, we were not able to use random assignment to teams. Although 93% of students claimed that they had not known their team partner before the course, there might still be unobserved factors influencing team composition that have not been reflected in the data. Finally, because this study focused on only one course in the curriculum, we are not able to observe the effect of partnering with a free rider in a multitasking context, for example, taking multiple courses into account. It may well be that students in teams with free riders must invest more effort to study for the selected challenging mandatory course, and that their performance in other courses suffers. Our data, though, does not provide support for that potential observation, given that the time spent on individual preparation or team discussions of Analysis I does not depend on the partner's social preferences.

Future research on the modified team setting should use longitudinal data to study how the effects of social preference on performance develop over time, and take into account multitasking, as described in the previous paragraph. Also, studying social preferences in the modified team setting in a corporate environment would help understand whether the results of our study might have been driven by its educational context.

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Appendix 1: Instructions

Dear Student,[14]

By participating in today's game you take part in a scientific study about decisions. Please read this instruction carefully. The game is going to last approximately 45 min. You won't have any additional effort. Depending on your decisions you have the opportunity to earn a **payment** which you will receive in cash in Analysis 1 on December 9, 2015.

You are not allowed to speak during the game. If you have a question, raise your hand and a person who conducts the game will come to your seat. A non-observance of these rules leads to an exclusion of the game and the payment.

Of course, you are free to choose whether to take part in the study or not. You have the possibility to withdraw your agreement at any time without giving reasons and without personal disadvantages.

During the game, your payment is determined in points and will be converted to Euro at the end of the game. It counts

$$1 \text{ point } = 0.5 \text{ EUR} .$$

General rules

You are in a **group of two**. Every group member needs to decide about the use of 10 points. The points can be put **wholly or partly** to a **private account** or can be invested in a **project**. Every point that is not invested in the project will be automatically put in the private account.

Earnings from the private account

For every point you put in the private account you earn exactly one point:

$$\text{Earnings from private account} = \text{Own contribution to private account}$$

Example: If you put 10 points in the private account, you earn 10 points out of it. If you put 6 points in the private account, you earn 6 points out of it. No person other than yourself earns out of your contribution to your private account.

Earnings from the project

Not just you, but also your other group member will earn from your investment to the project. Conversely, you earn from the other group member's investment to the project.

[14] Translated from German.

The earnings from the project for every group member are defined as followed:

$$\text{Earnings from the project} = \text{Sum of the contributions to the project} \times 0.7$$

Example: If every group member invests 10 points to the project, you and your other group member earn $20 \times 0.7 = 14$ points out of the project. If one group member invests 8 points and the other one invests 7 points, every group member earns $(8 + 7) \times 0.7 = 10.5$ points out of the project.

Total earnings

Your total earnings are the sum of your earnings from the private account and the project.

$$\begin{aligned} \text{Earnings from the private account} &= 10 - \text{your contribution to the project} \\ + \text{ Earnings from the project} &= 0.7 \times \text{sum of the contributions to the project} \\ &= \text{total earnings} \end{aligned}$$

Comprehension questions

Please respond to the following comprehension questions. They are merely aimed at familiarizing you with the calculation of the earnings which occur with the different decisions about the use of the 10 points.

1. Every group member has ten points at his disposal. You invest nine points to the project. The other group member contributes six points to the project.

   (a) How high are **your** total earnings in points?
   ☐ 10.0 ☐ 15.0 ☐ 11.5 ☐ 10.5 ☐ 6.5
   (b) How high are the total earnings of the **other** group member in points?
   ☐ 8.0 ☐ 11.5 ☐ 7.5 ☐ 14.5 ☐ 8.0

2. Every group member has 10 points at his disposal. The other group member contributes 5 points to the project.

   (a) How high are **your** total earnings if you invest - additionally to the 5 points invested by the other group member - 0 points in the project?
   ☐ 15.0 ☐ 13.0 ☐ 19.4 ☐ 13.5 ☐ 9.0
   (b) How high are **your** total earnings if you invest - additionally to the 5 points invested by the other group member - 10 points in the project?
   ☐ 12.5 ☐ 6.5 ☐ 10.5 ☐ 8.0 ☐ 6.0

The game

The game involves the decision situation as previously described. From now on you are part of a group of two. The other group member is a student from another university. **Neither you nor another participant knows who the other person of his group is.** The compositions of the other groups are also unknown.

Now you have 10 points at your disposal which you can put in your private account or invest to the project. Every group member has to make two types of contribution decisions. In the following, they're called **unconditional** and **conditional contribution**.

1. In the first type of contribution decisions (**unconditional** contribution) you have to determine how many of the 10 points you want to invest.
2. Your second task is to complete a **contribution table** with your **conditional** contributions. For **every possible contribution** of the **other** group member you need to give an amount of points to the project in the contribution table as answer to this contribution.

Once all participants have made their unconditional and conditional contribution decisions one group member of each group will be randomly chosen. For the **randomly chosen group member** only the completed table is relevant. For the other, not randomly chosen group member is solely the unconditional contribution relevant. Therefore the unconditional contribution of one group member and the corresponding conditional contribution of the other group member is included in the calculation of the payments

Your decisions

You and your other group member each have ten points to spend. Please decide on the unconditional contribution and all possible conditional contributions.

Unconditional contribution

1. How many points would you like to invest to the project? .... points

Conditional contribution (Please take all eleven decisions):

Please fill **whole** numbers between 0 and 10.

1. If the other group member contributes **0** points: .... points
2. If the other group member contributes **1** points: .... points
3. If the other group member contributes **2** points: .... points
4. If the other group member contributes **3** points: .... points

5. If the other group member contributes **4** points: .... points
6. If the other group member contributes **5** points: .... points
7. If the other group member contributes **6** points: .... points
8. If the other group member contributes **7** points: .... points
9. If the other group member contributes **8** points: .... points
10. If the other group member contributes **9** points: .... points
11. If the other group member contributes **10** points: .... points

Please fill out the questionnaire on the next page. For this you receive additional **2 EUR** to your earnings from the game.

Appendix 2: Supplementary analyses

See Tables 5 and 6

Table 5 Ordered logistic regression with time spent on team discussions and time spent on individual preparation as the dependent variables

	(1) Team discussions	(2) Individual preparation
Ability	−0.327 (0.201)	0.0104 (0.196)
Free rider	−0.127 (0.783)	−1.480* (0.866)
Conditional cooperator	0.307 (0.647)	-0.915 (0.704)
Hump-shaped	−0.508 (0.924)	−2.553* (1.339)
Partner, free rider		1.161 (0.920)
Partner, conditional cooperator	−0.542 (0.434)	0.479 (0.813)
Partner, hump-shaped	−0.596 (0.694)	0.386 (0.842)
Observations	85	85
Pseudo R^2	0.038	0.070

Robust standard errors, clustered on team level, in parentheses. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

Table 6 Tobit regressions on the final score (individual and team time combined)

	(1)	(2)	(3)
Ability	4.160*** (0.960)	4.237*** (1.000)	4.397*** (1.082)
Individual prep. and team disc.: 10–15 h	2.770 (3.054)	2.172 (3.010)	7.133** (3.484)
Individual prep. and team disc.: 15–20 h	6.750* (3.544)	6.918* (3.531)	8.271* (4.768)
Individual prep. and team disc.: > 20 h	6.758 (6.123)	8.380 (5.924)	16.73*** (4.367)
Free rider		8.929** (3.677)	5.871 (3.591)
Conditional cooperator		3.248 (3.633)	3.268 (3.084)
Hump-shaped		0.934 (3.844)	3.664 (4.280)
Partner, free rider			−0.594 (4.586)
Partner, conditional cooperator			−3.437 (3.255)
Partner, hump-shaped			3.110 (3.464)
Constant	15.70*** (3.279)	12.42*** (4.239)	11.50** (5.233)
Observations	111	111	85
Pseudo-R^2	0.018	0.024	0.050

Lower and upper bounds, 0 and 60, respectively. Table contains new categories for individual preparation time and team discussions. Robust standard errors, clustered on team level, in parentheses. Significance levels: $*p < 0.10$, $**p < 0.05$, $***p < 0.01$

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