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## Peer Effects in Cheating on Task Performance

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# Peer Effects in Cheating on Task Performance

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## Abstract

Recent research has shown that the presence of peers can increase individual output both in the lab and the field. As a new explanation for higher individual output levels, we test whether peer settings are particularly prone to cheating even if peer settings do not provide additional monetary benefits of cheating. Participants in our real effort experiment had the opportunity to cheat when declaring their output levels. Although cheating did not have different monetary consequences when working alone than when working in the presence of a peer, we find that cheating on task performance is a more severe problem in peer settings. Our results potentially have far-reaching repercussions regarding organizational design in the context of group settings where principals are not fully able to observe agents' output levels.

*Keywords: cheating, peer effects, personnel economics, organizational design, experimental economics*

*JEL: J20, J30, M50*

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# 1 Introduction

Recent research indicates the existence of positive peer effects on work effort and individual output levels (e.g., Falk and Ichino 2006, Mas and Moretti 2009, Bäker and Mechtel 2013, Beugnot et al. 2013). These studies show that individual output is, on average, higher when working in the presence of one or more peer(s) as opposed to working alone.<sup>1</sup> Interestingly, these results hold even when there are no peer-specific monetary rewards or task interdependencies between workers (Falk and Ichino 2006, Bäker and Mechtel 2013). From a management perspective, it therefore appears to be promising to rely on peer settings when designing organizations. However, it is evident that in almost all situations principals cannot (fully) observe agents' effort/output levels and output quality. The resulting moral hazard problem opens the floor for agents to behave in a way not desirable from the principal's point of view. Thinking about organizational design, it is therefore important to test whether peer settings are more prone to moral hazard in terms of cheating.<sup>2</sup> Following Nargin et al. (2002), we understand cheating as a form of shirking, i.e. reducing effort and not *behaving* according to the rules.<sup>3</sup> If we found more cheating behavior in peer settings, implementing such organizational structures would superficially increase output to the cost of negative side effects such as worse product quality. With regard to the design of organizational processes, this result would then question the overall benefits of peer settings.

With this study we aim to shed more light on peer effects, opening the floor for cheating behavior in a real effort experiment. We implement experimental conditions that differ with respect to whether cheating is possible or not.<sup>4</sup> To analyze peer effects in cheating, we run these conditions as peer and individual sessions (as done by Falk and Ichino 2006). In the former, two participants work in the same room on their own tasks, while each participant works alone in a separate room in the latter condition. Comparing the output between session types allows us to identify whether peer settings are more prone to cheating behavior, i.e.

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<sup>1</sup>Within this paper, we focus on peer effects in terms of differences in average output levels between single and peer settings. Hence, we are not primarily interested in productivity spillovers between low and high productive workers, but focus on the question whether it, on average, pays for principals to rely on peer settings instead of letting agents work alone.

<sup>2</sup>In general, several ways of cheating seem possible: (1) manipulating oneself (i.e. doping, see e.g. Preston and Szymanski 2003, Kräkel 2007, Schermer 2008), (2) manipulating others (i.e. sabotage, see e.g. Preston and Szymanski 2003, Dato and Nieken 2013), (3) manipulating the evaluator or principal (i.e. influence activities, see e.g. Milgrom and Roberts 1988, Kräkel 2007) or (4) manipulating one's output. Our study contributes to this last category of cheating. The agent manipulates the quality of output by reducing his or her (unobservable) effort. An example could be a researcher not proofreading an article though asked to do so by his or her co-authors, a journalist not checking the accuracy of facts, a sales person not presenting all the selling points of a product or a teacher not correcting pupils' exams for spelling mistakes.

<sup>3</sup>Lying, in turn, would refer to not telling the truth (see e.g. Croson et al. 2003).

<sup>4</sup>As in Ariely et al. (2008) and Pascual-Ezama et al. (2013), participants' real effort task is to solve riddles. Please see Section 3.1.1 for a detailed description of the task.

whether higher average output levels are caused by actual cheating.

As previous studies have shown that the degree of undesirable behavior such as cheating also depends on monetary incentives, we implement two different payoff schemes to test for the sensitivity of our results. In the first, subjects receive a piece rate for every completed task. As in Ariely et al. (2008) and Pascual-Ezama et al. (2013), this piece rate is linearly decreasing in cumulated output and participants can decide to end the experiment at any point of time, allowing to calculate individual reservation wages. In the second, participants receive a fixed wage and have to be present for a given period of time (similar to the setup chosen by Falk and Ichino 2006). This research design allows us to identify whether potential cheating effects occur under both payoff schemes, which increases the validity of our findings.

Our results show that peer settings are indeed more prone to cheating and that the higher average output level in peer settings is to large parts driven by cheating. For conditions where cheating is not possible, we find that the presence of a peer increases individual output only very moderately (6% in the piece rate scenario, 7% under the fixed wage). The difference in absolute output levels between single and peer sessions when cheating is not possible is not statistically significant.<sup>5</sup> However, for conditions in which cheating is possible, we find that the number of completed tasks is significantly higher in peer sessions (11% under the piece rate, 13% in the fixed wage scenario).

Given this finding, we then test whether the increase of output in peer settings where cheating is possible is driven by actual cheating. It turns out that overall cheating rates are rather low. In the piece rate setting, the cheating rate (i.e. the share of incorrectly solved riddles that were handed in by the participants as being correctly solved) is 3% in individual sessions, whereas it is 7% in peer sessions. Correcting average output levels for actual cheating, we find no differences between the *no cheating* and *cheating* conditions any more. The existence of positive and significant peer effects on average output levels is thus driven by cheating. Once we correct for cheating, the difference between output levels in peer and individual sessions decreases from 11% to 6%. A similar picture emerges when we look at the fixed wage scenario. We also find that cheating is more pronounced in peer than in individual sessions (6% compared to 4%). A large part of the increase in average output between individual and peer sessions when cheating is possible is indeed driven by actual

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<sup>5</sup>At first glance, this result seems to contradict previous studies. However, as in the piece rate scenario the average reservation wage in both conditions is almost zero, the participants of our experiment were on average highly motivated (and therefore highly productive) workers. In the fixed wage scenario, average output levels are around 15% smaller, but the subjects were obviously far from being unproductive. Falk and Ichino (2006), Mas and Moretti (2009), and Bäker and Mechtel (2013) show that the overall positive effects of peer settings are mostly driven by low productive workers who increase their output levels in the presence of peers. Given that participants in our experiment are rather productive, the absence of strong positive peer effects is not surprising and fits the existing evidence.

cheating behavior. However, in contrast to the piece rate scenario, “real” output levels (i.e. corrected for actual cheating) are higher when cheating is positive. Overall, average output here is 13% higher in peer sessions than in individual sessions when cheating is possible. This difference shrinks to 10.6% once we account for actual cheating behavior. We find very similar results when we use the speed with which participants fulfilled their tasks, i.e. the number of solved riddles per minute, as variable of central interest – which is, obviously, only an informative measure under the piece rate compensation scheme.

Given our experimental design, we can clearly identify that the increase in output/speed is to a large extent driven by actual cheating behavior. Working in the presence of a peer appears to cause participants to feel a certain pressure to perform. However, it does not increase productive effort but cheating under a piece rate compensation scheme. Even under a fixed wage, the percentage increase in average output levels between individual and peer sessions is considerably driven by actual cheating. This finding casts some doubt on the desirability of implementing peer settings – at least when other motivational instruments can be applied and cheating is possible.

The remainder of the paper is organized as follows. In Section 2, we describe the related literature. Section 3 presents the experimental design and sets up a small theoretical model to derive our hypotheses. Results are described and discussed in Section 4, before Section 5 concludes.

## 2 Related Literature

Peer effects have mainly been studied in the context of the educational system with the aim of e.g. giving policy implications as to whether to apply ability tracking in school (e.g. Hanushek et al. 2003, Kim et al. 2008, Lavy et al. 2012). However, recently some studies have dealt with peer effects in the work place (Mas and Moretti 2009) or analyzed peer effects in (field) experiments (Falk and Ichino 2006 and Bäker and Mechtel 2013). These recent studies point to the existence of positive peer effects on individual output for work place settings. In addition to analyzing whether peer effects exist and whether they are indeed positive, some studies try to shed more light on specific factors that foster or hinder the appearance of peer effects such as gender or race of peers.

An important aspect to be considered when judging the results of studies on peer effects is the interdependence in tasks or compensation between peers. For example, the study by Mas and Moretti (2009) analyzed supermarket cashiers. While they were paid independently in the form of an hourly wage, their tasks were not independent, because work (checking of goods) that was done by one cashier did not have to be done by another, i.e. one hard

working cashier could reduce the workload of her peers. Consequently, peer effects in this setting might in part be due to a desire to help one’s coworkers. Similarly, peer effects found based on field data from study groups or school classes might be driven by interdependence of tasks (studying together might facilitate learning) if not compensation.

One way to isolate effects arising from peers’ monetary or task interdependence from “pure” peer effects is conducting experiments which exclude both types of interdependence. Falk and Ichino (2006) conducted a field experiment where subjects had to prepare letters for mailing either with another subject working on the same task in the same room or not. Participants earned a fixed hourly wage and worked for four hours on the task. Consequently, there was neither task nor monetary interdependence and still Falk and Ichino find that participants in the peer settings had a significantly higher output on average, i.e. completed more letters per hour.

What drives this effect? Social Comparison Theory (Festinger 1954) tells us that individuals base their opinion of themselves on – among other things – comparisons with other individuals of their reference group. In peer settings, the peers are likely to form the reference group and it is, thus, important to measure up or outperform them to maintain a positive self-perception. That is social processes might indirectly and potentially unintentionally induce a competitive mind frame in peer settings. The management toolbox contains instruments to actively foster such a competitive setting, for example tournament compensation under which employees compete for a bonus (see e.g. Lazear and Rosen 1981). The multitude of studies on worker behavior under tournament compensation schemes tells us that it is a powerful motivational instrument, but that it also induces unwanted behavior, such as rat races or unproductive behavior in the form of sabotage or cheating (e.g., Cadsby et al. 2010, Gilpatric 2011, Harbring and Irlenbusch 2011).<sup>6</sup> If peer settings induce a similar competitive mind frame (even in the absence of monetary consequences) then it appears plausible that they also induce adverse behavior.

While there is a vast body of literature looking at determinants and consequences of cheating or fraud, evidence on cheating in social settings or personal interactions is rather scarce. The existing studies contain elements of monetary and/or task interaction, thereby impeding the measurement of pure peer effects in cheating. They report that under team compensation individuals cheat more than under individual compensation, because under the latter they cannot “help” their colleagues by cheating (Conrads et al. 2013, Danilov et al. 2013, see Briggs et al. 2013 for a theoretical analysis, see Erat and Gneezy 2012 for higher likelihood of lying when it only helps others).<sup>7</sup> In tournament settings where

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<sup>6</sup>Using data on cheating behavior of teachers in schools, Jacob and Levitt (2003) show that an increase in performance incentives leads to increased cheating behavior even without a competitive or team setting.

<sup>7</sup>An exception to these findings is Waller and Bishop (1990) who find higher cheating under a piece rate

cheating only helps oneself, the experimental findings by Schwieren and Weichselbaumer (2010) show positive effects of competition on cheating, which seems to be driven by the rather unproductive who do not want to be seen as the low performers or want to increase their chances of winning.<sup>8</sup> Using field data on vehicle emission tests, Pierce and Snyder (2008) find that the degree of (un)ethical behavior of inspectors working for different organizations is influenced by the norms of the employing organizations, i.e. organizational norms and managers influence fraud behavior. This finding is in line with the experimental results by Jones and Kavanagh (1996) who find an influence of managers' (un)ethical behavior on employees' (un)ethical behavior. However, they also find evidence for peers' (un)ethical behavior on employees' (un)ethical behavior. This ties in with the results of a number of studies which show that own cheating behavior positively depends on perceptions of others' cheating behavior, i.e. the acceptability of cheating (see Ichino and Maggi 2000, Carrell et al. 2008, Megehee and Spake 2008, and O'Fallon and Butterfield 2008), and negatively depends on the penalty for cheating (see Megehee and Spake 2008 and O'Fallon and Butterfield 2008) that might be imposed by e.g. the manager or the organization in general. With respect to the effect of peers, some articles argue that they serve as a reference point and thereby influence behavior (e.g. Trevino 1986). However, Gould and Kaplan (2011) make a case for peers *learning* to cheat from their (high performing) peers.

To formally derive our hypotheses, we will present a small theoretical model based on insights from the literature presented above in section 3.2.

## 3 Experimental Setup and Theoretical Predictions

### 3.1 Experimental Setup

#### 3.1.1 Experimental Design

Following Falk and Ichino (2006), we implement a real effort task in both an individual setting as well as a peer setting. The only difference between the two settings is that in the peer setting participants work in the presence of another participant working on the same task. They can see each other and are allowed to communicate, but work individually on their own task. We did not conduct a field experiment but chose to implement a laboratory setting instead, allowing us to vary the possible degree of cheating which would have been very complicated in a field setting (and may be perceived as artificial by the subjects) for a

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compensation scheme than under an implicit team compensation. This might be due to the fact that the compensation was not communicated as a team compensation and cooperation could not be guaranteed.

<sup>8</sup>Kandel and Lazear 1992 argue that in teams, peer pressure induces the low productive team members to increase their effort. However this effort is generally assumed to be productive.

given level of experimental control.

To generate conditions that differ in the potential for cheating, we rely on the real effort task used by Ariely et al. (2008) and Pascual-Ezama et al. (2013). Participants have to solve riddles: They receive a sheet of paper with a sequence of 850 randomly drawn letters. Within this sequence, there are 10 instances of two consecutive letters “p”. The participants’ task is to find these 10. We create our two conditions by varying whether cheating is possible.<sup>9</sup> In the “no cheating” condition (NC), each solved riddle is checked for correctness before the participant may begin with working on the next riddle. Thus, cheating is not possible. In the “cheating” condition (C), solved riddles are not checked for correctness but simply collected on a pile. Thus, in the aftermath of the experiment, it was possible to check how often participants cheated,<sup>10</sup> i.e. whether they declared to have successfully solved a riddle while in fact they did not solve it correctly.

Table 1 shows our 2x2 design. Applying a between-subjects design, participants are randomly assigned to one of the four session types.

	Individual sessions	Peer sessions
No cheating possible (NC)	1 ( $NC_1$ )	3 ( $NC_2$ )
Cheating possible & observable (ex-post) (C)	2 ( $C_1$ )	4 ( $C_2$ )

Table 1: Experimental design: four session types.

### 3.1.2 Compensation Schemes

As stated in the introduction, we run these four conditions for two different compensation schemes: a piece rate and a fixed wage. With respect to the first, we use Ariely et al.’s (2008) and Pascual-Ezama et al.’s (2013) setup of a linearly decreasing piece rate as it offers an interesting setting for observing the strength of the motivational effect induced by peer settings. Any peer effect that can be observed in addition to the strong motivational instrument of a piece rate speaks for peer settings being a very strong motivator. Implementing a declining piece rate allows to measure motivational effects (or task performance) not only in how quickly participants worked on the task, but also on how many tasks they decided to work, or phrased differently: when they quit working. This allows us to compare reservation wages between the four experimental conditions. In accordance with Ariely et al. (2008),

<sup>9</sup>Ariely et al. (2008) have a third condition, in which cheating is possible but cannot be observed ex-post. We exclude this condition from our analysis because it likely differs in more than one aspect from our condition without the possibility to cheat.

<sup>10</sup>The identification strategy is similar to the one used by Fischbacher and Föllmi-Heusi (2013).



participants earn 55 cents for the first riddle, 50 cents for the second riddle, and so on. That is, the piece rate declines by 5 cents per completed riddle. The eleventh riddle is the last one to pay any monetary amount different from zero.

In comparison, a fixed wage c.p. provides less motivation to generate output, thereby potentially strengthening the motivational effects caused by peer settings because the initial level of output is expected to be lower under that compensation scheme. We implement the fixed wage in accordance with the setup by Falk and Ichino (2006). Participants have to work for 25 minutes on the task (a time window that was chosen to be most similar to the average time worked under the piece rate) and receive a fixed wage amounting to the average wage obtained under the piece rate compensation scheme (5.80 Euro).

### 3.1.3 Experimental Procedure

The procedure of the experiment was as follows (see Appendix for detailed instructions):

(1) Written instructions on the task, the procedure and the compensation are presented on paper and read out loud by the experimenter. Any questions are answered publicly (in peer sessions). The instructions contain an example riddle. For the piece rate a table depicting the amount of money earned per completed riddle as well as the cumulated amount of money for any number of completed riddles is given, for the fixed wage the table shows that total compensation is the sum of the show-up fee (2.50 Euro) and a fixed wage (3.30 Euro). At several points within the instructions, participants are informed that they can stop solving riddles at any point in time. Under the piece rate scheme, participants are free to leave the room upon deciding to stop solving riddles (see Ariely et al. 2008).

(2) The experimenter hands over the first riddle, and in case of the piece rate announces the piece rate for the first riddle (55 cents). Participants start working on it.

(3) Once a riddle is completed, the experimenter acts according to the experimental condition (checking the riddle or simply collecting it) and asks whether the participant wants to work on another riddle (in case of the piece rate the applicable piece rate is stated).

(4) In the piece rate scenario, once a participant declines working on another riddle, the experiment ends and (s)he fills out a short questionnaire. In the fixed wage scenario, a participant in total has to be present for 25 minutes even if (s)he does not work on additional riddles. After this working period of 25 minutes is over, the experiment ends and (s)he fills out the questionnaire.

(5) The participant is paid privately according to the number of solved riddles (piece rate) or the fixed wage of 3.30 Euro (fixed wage) plus in any case a show-up fee of 2.50 Euro.

### 3.2 Theoretical Predictions

To illustrate potential effects of peer settings on individual output levels, we summarize the previously discussed results from the literature in a simple theoretical model. We assume an agent's utility to depend on three components. First, utility depends positively on the individual's wage  $w$  which might depend on individual output (piece rate scenario) or not (fixed wage scenario). Second, producing output is costly to the individual who does not want to exert effort. Utility costs of producing output are given by the function  $c(o_i, \bar{o})$ , where  $o_i$  denotes  $i$ 's output level and  $\bar{o}$  captures the average output level of her peers. Suppose  $\frac{\partial c}{\partial o} > 0$ ,  $\frac{\partial^2 c}{\partial o^2} > 0$ , and  $\frac{\partial^2 c}{\partial o \partial \bar{o}} < 0$  to hold. The latter follows the theoretical approach of Falk and Ichino (2006) and reflects their idea that the disutility of producing  $o$  is lower when average production is higher. As Falk and Ichino, we are not interested in identifying the determinants of peer effects here, but just aim to derive predictions about what we should see in the experimental results if peer effects are at work.

In our experiment, subjects have the possibility to cheat in some conditions. Cheating means that they tell the experimenter that they have correctly solved their task, while in fact they did not do that (which cannot be observed by the experimenter during the session). The possibility to cheat reduces agents' marginal costs of producing output. We thus impose a weighting factor  $\delta$  on  $c$  which takes the value of 1 whenever cheating is not possible. If cheating is possible,  $0 < \delta < 1$  holds, indicating that individual disutility of producing one marginal unit of output is smaller than in the case where cheating is not possible.<sup>11</sup>

For the piece rate scenario, these two components of individual utility are sufficient to derive hypotheses about differences in individual output levels depending on whether cheating is possible or not and whether a subject works in the presence of a peer or not. However, in the fixed wage scenario, subjects would not have a monetary incentive to work at all as their payment does not depend on the output level. We, therefore, add a third component to our utility function:  $a(o_i)$  with  $a' > 0$ . This function might reflect a number of things that could cause a positive effect of produced output on the agent's utility level.<sup>12</sup>

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<sup>11</sup>Note that we do not explicitly model the individual's actual decision for/against cheating.  $\delta < 1$  simply means that subjects cheat to *some* extent. We do not focus on the question of whether  $\delta$  might be endogenous in the way that it might be smaller in peer sessions than in individual sessions due to a higher perceived social pressure to produce output in peer sessions (see, e.g., Falk and Ichino 2006; Mas and Moretti 2009), yielding a higher amount of cheating. We discuss this point in more detail after presenting our hypotheses.

<sup>12</sup>For instance, an agent might reciprocate in the way of a gift exchange: the principal pays her a fixed wage and she thus experiences an increase in utility whenever she produces more output (which would increase the principal's profits). Alternatively,  $a(o_i)$  might represent altruism against the principal whose profits increase in the output level.  $a(o_i)$  might as well be interpreted as compliance to a social norm saying that producing a high level of visible output is an adequate reaction to receiving a fixed wage. Given the above reasoning, it appears not to be plausible to assume  $a'' > 0$ . We therefore assume  $a'' \leq 0$ . Our hypotheses do not depend on whether  $a'' < 0$  or  $a'' = 0$  holds.

Note that  $a(o_i)$  is solely needed to guarantee a positive output level in the fixed wage scenario. We do in no respect focus on what causes  $a(o_i)$ , but just need it as a technical matter in order to guarantee positive output levels in the absence of a piece rate to be able to derive hypotheses on the effects of (1) peer settings and (2) introducing the possibility to cheat on individual output levels.

Agent  $i$ 's utility function has the following appearance under a piece rate compensation scheme:

$$U_i = w(o_i) - \delta c(o_i, \bar{o}) + a(o_i), \quad (1)$$

with  $w' > 0$ . In our experiment,  $w'' < 0$  holds. However, all of our hypotheses that we are about to derive in the following remain if we assume  $w'' = 0$ . Under the fixed wage compensation scheme, the first term in 1 does not depend on  $o_i$  and thus  $w' = 0$  holds.

We will base our analysis on the piece rate compensation scheme. As will be shown later, all hypotheses derived from the model also hold for the fixed wage. The agent chooses the output level  $o^*$  that maximizes her utility. The first order condition for an interior solution is

$$\frac{\partial U_i}{\partial o_i} = w'(o_i) - \delta c'(o_i, \bar{o}) + a'(o_i) \stackrel{!}{=} 0.$$

Given our assumptions about the functional forms ( $w'' < 0$ ,  $c'' > 0$ ,  $a'' \leq 0$ ), the second order condition is obviously fulfilled.

Within the setup of our experiment, four cases are possible: subjects work (i) alone without the possibility to cheat ( $o_{i,NC}^*$ ), (ii) alone with the possibility to cheat ( $o_{i,C}^*$ ), (iii) in the presence of a peer without the possibility to cheat ( $o_{p,NC}^*$ ), (iv) in the presence of a peer with the possibility to cheat ( $o_{p,C}^*$ ). The first order conditions for the four possible cases read:

$$w'(o_i) - c'(o_i, 0) + a'(o_i) = 0, \quad (2)$$

$$w'(o_i) - \delta c'(o_i, 0) + a'(o_i) = 0, \quad (3)$$

$$w'(o_i) - c'(o_i, \bar{o}) + a'(o_i) = 0, \quad (4)$$

$$w'(o_i) - \delta c'(o_i, \bar{o}) + a'(o_i) = 0. \quad (5)$$

Based on these FOCs, we can derive our hypotheses. Comparing 2 and 3, it turns out that 3 cannot be fulfilled for  $o_{i,NC}^* = o_{i,C}^*$  as  $\delta < 1$  holds in 3. Hence,  $o_{i,C}^*$  must be higher than  $o_{i,NC}^*$  as this increases  $c'$ , decreases  $w'$ , and decreases  $a'$  (if  $a'' < 0$  holds). The possibility to cheat reduces the marginal costs of producing output. Thus, our first hypothesis is:

**Hypothesis 1** *Individual output is higher in individual sessions where cheating is possible than in individual sessions where cheating is not possible.*

Comparing 2 and 4, our model yields the same behavioral prediction as derived by Falk and Ichino (2006). 4 cannot be fulfilled for  $o_{i,NC}^* = o_{p,NC}^*$  and  $\bar{o} > 0$  as  $c'(o_i, \bar{o}) < c'(o_i, 0)$  due to  $\frac{\partial^2 c}{\partial o \partial \bar{o}} < 0$ . Hence,  $o_{p,NC}^*$  must be higher than  $o_{i,NC}^*$  as this increases  $c'$ , decreases  $w'$ , and decreases  $a'$  (if  $a'' < 0$  holds). The presence of a peer reduces the marginal costs of producing output (positive peer effect). Thus, our second hypothesis is:

**Hypothesis 2** *Individual output is higher in peer sessions where cheating is not possible than in individual sessions where cheating is not possible.*

Hypotheses 1 and 2 have highlighted our main effects. Both effects ((1) higher level of output when cheating is possible ( $o_{i,NC}^* < o_{i,C}^*$ ) and (2) higher level of output in peer than in individual settings ( $o_{i,NC}^* < o_{p,NC}^*$ )) do not only hold for the comparisons analyzed above, but also when we vary (1) the individual/peer dimension and (2) the no cheating/cheating dimension. Comparing 4 and 5, it turns out that 5 cannot be fulfilled for  $o_{p,NC}^* = o_{p,C}^*$  as  $\delta c'(o_i, \bar{o}) < c'(o_i, \bar{o})$ . We thus end up with  $o_{p,NC}^* < o_{p,C}^*$ . Imposing symmetry between the peers yields  $\bar{o}_{p,NC} < \bar{o}_{p,C}$  which in addition strengthens the result that output is higher in the peer condition when cheating is possible than in the peer condition when cheating is not possible. Similarly, comparing 3 and 5 reveals that 5 cannot be fulfilled for  $o_{i,C}^* = o_{p,C}^*$  due to  $\delta c'(o_i, 0) > \delta c'(o_i, \bar{o})$  for  $\bar{o} > 0$ . Thus,  $o_{i,C}^* < o_{p,C}^*$  holds.

Our hypothesis of main interest covers the comparison of the impact of the possibility to cheat between the individual and peer conditions. Comparing 2 and 3 with 4 and 5, it is obvious that  $(o_{i,C}^* - o_{i,NC}^*) < (o_{p,C}^* - o_{p,NC}^*)$  results. On the one hand, the possibility to cheat increases optimal output in both the individual and peer condition due to  $\delta < 1$ . On the other hand, due to  $\bar{o}_{p,NC} < \bar{o}_{p,C}$ , there is an additional increase of optimal individual output in the peer condition. Combining the above reasoning, we derive the third hypothesis:

**Hypothesis 3** *Individual output is highest in the peer sessions where cheating is possible.*

Hypotheses 1 to 3 also apply to the fixed wage compensation scheme. In that case,  $w' = 0$  holds. However, all further theoretical reasoning presented above is still valid as can easily be seen from the FOCs.

So far, our hypotheses focus on individual output levels in the different conditions. As described earlier, we do not focus on the individual *decision* to cheat, but assume that there is *some* level of actual cheating behavior whenever cheating is possible (reflected by  $\delta < 1$ ). However, it might obviously be possible that the perceived social pressure in peer settings induces a higher level of *actual* cheating. If that was the case,  $\delta$  (reflecting the actual degree of

cheating) would be smaller in peer sessions than in individual sessions. Imposing  $\delta_C < \delta_{NC}$  in our theoretical model would exactly generate this result. In that case, all hypotheses regarding individual output levels presented above would remain as they are. However, we abstained from assuming  $\delta_C < \delta_{NC}$  in our theoretical analysis as the resulting hypothesis “More cheating in peer sessions than in individual sessions” would obviously directly depend on this assumption. Nonetheless, we will use our experimental data to test whether the actual amount of cheating is indeed higher in peer sessions than in individual sessions.

## 4 Results

In the following subsections, we first present the results of the sessions under the piece rate scenario and then the results from the fixed wage sessions.

### 4.1 Piece Rate

#### 4.1.1 Descriptive Statistics

Subjects were students at the University of Tübingen. In total, 167 students participated in the experiment. The allocation of subjects to conditions was random.

Table 2 displays the number of observations for the four different session types. For individual sessions, the number of observations equals the number of sessions. For the peer sessions, the number of sessions equals half the number of observations.

	Individual sessions	Peer sessions
No cheating possible (NC)	36	70
Cheating possible & observable (ex-post)	25	36

Table 2: Piece rate: Number of observations per session type.

Figure 1 shows the distribution of the number of completed riddles per session type. It is evident that the majority of participants completed exactly 11 riddles, i.e. worked as long as it paid a positive piece rate. The average reservation wage for the no cheating condition is 10 cents in the individual sessions and 7 cents in the peer sessions. For the cheating conditions, the average reservation wage is 7 cents and 5 cents for individual and peer sessions, respectively. However, as Figure 1 shows, there is also substantial variation in the number of completed riddles, ranging from the theoretical minimum of 1 to 20, the maximum number of riddles provided. Looking at the distributions, they vaguely resemble a normal distribution, but results from t-tests (see below) should be interpreted with caution. We therefore additionally run Wilcoxon rank sum tests.

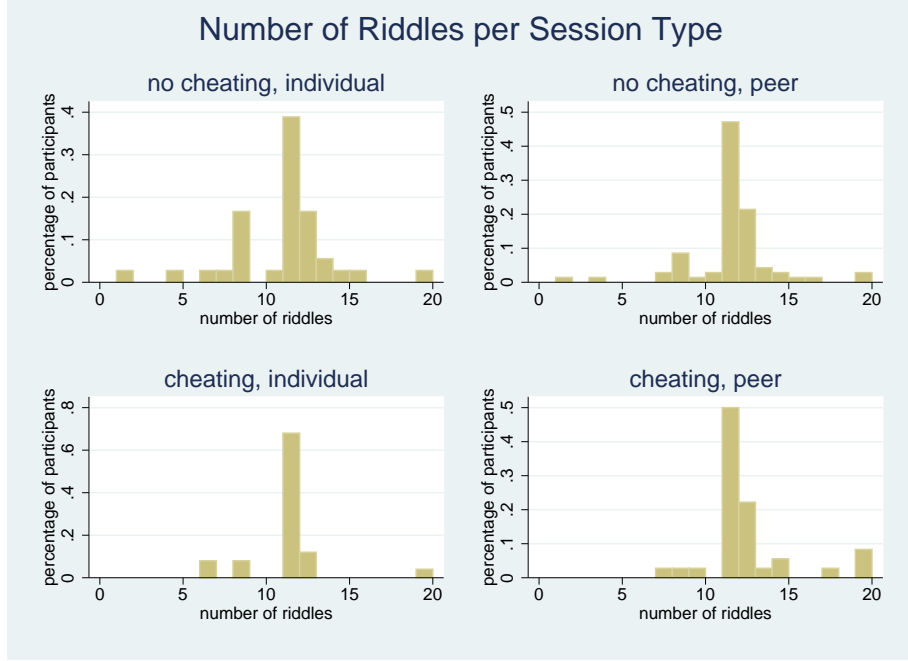


Figure 1: Piece rate: Histograms of output per session type.

#### 4.1.2 (Non-)Parametric Tests and Regression Results

To test whether peer effects exist, we first compare individual sessions and peer sessions per experimental condition with respect to (a) the average number of completed riddles and (b) the number of completed riddles per minute, i.e. participants' speed. Table 3 shows the average number of completed riddles, Table 4 displays the average speed per sessions type. The last two columns in both tables show results of two-sided t-tests and Wilcoxon rank sum tests, testing for significant differences between individual and peer sessions.

Looking at the 'no cheating' conditions (first row in Tables 3 and 4, we find no evidence for statistically significant peer effects on the number of completed riddles and only slight evidence for peer effects on speed, where the number of completed riddles per minute is slightly higher in the peer sessions. However, for the cheating condition we find significant positive peer effects on the number of completed riddles and also on speed. Taken together, these findings suggest that in a setting where a piece rate is already causing high motivation, the peer pressure induced by a peer setting does not lead to an additional increase in productive effort (i.e. working faster or more) when cheating is not possible. However, we find peer effects when cheating is possible. These results are (in parts) in favor of Hypothesis 2: there is a (no) positive peer effect on average output if cheating is (not) possible ( $o_{p,C}^* > o_{i,C}^*$ , whereas there is no significant difference between  $o_{p,NC}^*$  and  $o_{i,NC}^*$ ). A mixed picture also emerges with respect to Hypothesis 1: average output levels are (not) higher when cheating

is possible in peer (individual) sessions. The results from the piece rate compensation scheme support Hypothesis 3: the highest average output level can be found for the peer condition where cheating is possible.

	<b># of riddles</b>			
	Individual sessions	Peer sessions	t-test	Wilcoxon
No cheating	10.47	11.09	n.s.	n.s.
Cheating	10.84	12.08	*	**

Notes: \* significant at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%.

Table 3: Piece rate: Average output per session type.

	<b># of riddles per minute</b>			
	Individual sessions	Peer sessions	t-test	Wilcoxon
No cheating	0.44	0.49	*	n.s.
Cheating	0.48	0.52	**	n.s.

Notes: \* significant at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%.

Table 4: Piece rate: Average speed per session type.

Given the ex-post observability of cheating behavior, as the next step of the analysis we now check whether the observed increases in output and speed when cheating is possible are indeed driven by cheating. While it is not possible to tell which of the participants cheated (similar as in Fischbacher and Heusi 2013, Gill et al. 2012), we can calculate the percentage of riddles that participants cheated on, i.e. did not solve correctly, separately for individual sessions and peer sessions. We find that the share of cheating (i.e. the number of incorrectly solved riddles that were handed in by the participants as being correctly solved) is 3% in individual sessions and 7% in peer sessions. The fact that cheating is more than twice as common in peer sessions supports our conjecture that higher average output levels in sessions where cheating is possible are caused by increased cheating and not increased productive effort. When we correct average output levels in the cheating sessions for the share of wrong solutions in the cheating condition, it turns out that the observed positive peer effects on output levels are driven by cheating. Average output in cheating individual sessions equals 10.84 riddles (see Table 3). Correcting for the share of 3% wrong solutions, we end up with 10.52 corrected units of output – which perfectly corresponds to average output in the no cheating individual condition (10.47). The same holds for peer sessions. Correcting average output (12.08) when cheating is possible for the share of 7% wrong answers gives a number of 11.23 corrected units of output – once again very close to the value of 11.09 that we observe for peer sessions when cheating is not possible.

	Model 1			Model 2		
	(1)	(2)	(3)	(4)	(5)	(6)
	Piece rate	Fix wage	Pooled	Piece rate	Fix wage	Pooled
$C_1$	0.368 (0.728)	1.242 (0.794)	0.792 (0.536)	0.386 (0.773)	1.437** (0.698)	0.777 (0.509)
$C_2$	1.611** (0.721)	2.591*** (0.796)	2.121*** (0.540)	1.715** (0.767)	2.222*** (0.763)	2.036*** (0.556)
$NC_2$	0.613 (0.626)	0.669 (0.756)	0.662 (0.481)	0.572 (0.635)	0.589 (0.646)	0.682 (0.468)
Ability (inverse)				0.178 (0.192)	-0.925*** (0.177)	-0.453*** (0.162)
Male				-0.327 (0.613)	0.373 (0.656)	-0.187 (0.454)
Year of birth				0.0455 (0.0377)	0.0903 (0.0766)	0.0543 (0.0371)
Conscientiousness				1.500 (1.363)	3.556** (1.519)	1.949* (1.048)
Agreeableness				2.684 (2.307)	-2.310 (1.716)	0.355 (1.396)
Openness				0.981 (1.261)	0.647 (1.612)	0.836 (1.024)
Neuroticism				0.750 (1.042)	0.00430 (1.483)	0.332 (0.945)
Extraversion				0.0231 (1.172)	2.662** (1.277)	1.387 (0.889)
Fixed wage			-0.977*** (0.364)			-0.885*** (0.361)
Constant	10.47*** (0.530)	9.091*** (0.540)	10.28*** (0.417)	-84.63 (74.73)	-171.4 (152.3)	-100.0 (73.63)
Observations	167	151	318	163	150	313
$R^2$	0.038	0.095	0.082	0.084	0.315	0.152

*Notes:* Coefficient estimates from ordinary least squares estimations. \* significant at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%. The dependent variable is the number of riddles solved (i.e. handed in) by subject  $i$ .  $C_1$  and  $C_2$  represent dummy variables that take the value of 1 whenever a subject took part in an individual/a peer session where cheating was possible.  $NC_2$  is a dummy variable that takes the value of 1 whenever a subject took part in no cheating peer session. *Ability (inverse)* captures the number of minutes participant  $i$  needed for completing the first riddle as an inverse measure of ability. The dummy variable *Male* takes the value of 1 whenever participant  $i$  was male and is 0 otherwise. *Year of birth* captures participant  $i$ 's age. *Fixed wage* is a dummy variable that takes the value of 1 in all fixed wage sessions in the pooled estimations (columns 3 and 6). The additional variables capture the Big Five personality measures of neuroticism, openness to experiences, agreeableness, conscientiousness, and extraversion. They were measured using the short item version of the NEO-FFI by Costa and McCrae (1989) and normalized to values between 0 and 1. Some subjects did not provide information on all items asked in the questionnaire. We therefore end up with 163 (150) observations for the piece rate (fixed wage) when including all control variables. Heteroskedasticity-robust Huber-White standard errors are in brackets. Standard errors are clustered at the session level.

Table 5: OLS regression results. Dependent variable: number of riddles per participant.



In addition to comparing the average number of completed riddles and the speed across individual and peer sessions, we also run Ordinary Least Squares (OLS) regressions with the number of completed riddles and the speed as dependent variables. Table 5 shows the results of OLS regressions for the dependent variable “number of completed riddles” for different estimation models; Table 6 shows the results for the dependent variable “speed (number of completed riddles per minute)”. Our main explanatory variables are dummy variables for the session types:  $C_1$  is a dummy for the individual cheating sessions,  $C_2$  is a dummy for the peer cheating sessions, and  $NC_2$  is a dummy capturing the peer no cheating sessions. The reference category is individual no cheating sessions. We run the estimations separately for observations under the piece rate compensation scheme (column 1), the fixed wage (column 2) and pooled for both schemes (column 3), where in the latter we include a dummy for observations under the fixed wage (1=fixed wage). Model 2 further includes the number of minutes needed for completing the first riddle as an inverse measure of ability, gender (1=male), year of birth, and the Big Five personality measures of neuroticism, openness to experiences, agreeableness, conscientiousness and extraversion. They were measured using the short item version of the NEO-FFI by Costa and McCrae (1989). Again, the estimations are run separately and pooled for the compensation schemes (columns 4 to 6).

As can be seen from Tables 5 and 6, columns 1 and 4, under the piece rate the possibility to cheat does not increase the number of riddles and the number of riddles per minute (“speed”) in individual sessions (the coefficients of the dummy variable  $C_1$  are positive but statistically insignificant). However, in peer sessions where cheating is possible ( $C_2$ ), both output measures are significantly higher than in individual sessions where cheating is not possible. This suggests that participants cheat less in individual sessions than in peer sessions.<sup>13</sup> Thus, we find that the results of the (non-)parametric tests are confirmed when controlling for factors such as ability, gender, age, and the Big Five personality inventory. The coefficients of these control variables reveal that male participants complete less riddles per minute (lower speed) and more conscientious participants work faster. Also, more able participants do not complete more riddles, but they are significantly faster, i.e. they complete more riddles per minute.

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<sup>13</sup>We can of course not identify actual cheating in the estimations, but the share of cheated solutions is higher in peer sessions, see the discussion above.

	<b>Model 1</b>			<b>Model 2</b>		
	(1)	(2)	(3)	(4)	(5)	(6)
	Piece rate	Fix wage	Pooled	Piece rate	Fix wage	Pooled
$C_1$	0.0370 (0.0286)	0.0497 (0.0318)	0.0432** (0.0212)	0.0286 (0.0261)	0.0575** (0.0279)	0.0404** (0.0183)
$C_2$	0.0748** (0.0334)	0.104*** (0.0318)	0.0904*** (0.0228)	0.0660** (0.0289)	0.0889*** (0.0305)	0.0837*** (0.0214)
$NC_2$	0.0420* (0.0243)	0.0268 (0.0302)	0.0358* (0.0191)	0.0401* (0.0235)	0.0236 (0.0259)	0.0364** (0.0170)
Ability (inverse)				-0.0452*** (0.00857)	-0.0370*** (0.00708)	-0.0387*** (0.00551)
Male				-0.0472** (0.0203)	0.0149 (0.0262)	-0.0164 (0.0171)
Year of birth				0.00118 (0.00178)	0.00361 (0.00307)	0.00233 (0.00157)
Conscientiousness				0.0980* (0.0531)	0.142** (0.0608)	0.104** (0.0415)
Agreeableness				-0.0113 (0.0785)	-0.0924 (0.0687)	-0.0490 (0.0511)
Openness				-0.0208 (0.0506)	0.0259 (0.0645)	0.00405 (0.0395)
Neuroticism				0.0734 (0.0550)	0.000172 (0.0593)	0.0268 (0.0403)
Extraversion				0.0344 (0.0422)	0.106** (0.0511)	0.0651** (0.0330)
Fixed wage			-0.0756*** (0.0161)			-0.0665*** (0.0140)
Constant	0.443*** (0.0157)	0.364*** (0.0216)	0.441*** (0.0146)	-1.888 (3.553)	-6.854 (6.092)	-4.192 (3.131)
Observations	166	151	317	162	150	312
$R^2$	0.039	0.095	0.130	0.279	0.315	0.320

*Notes:* Coefficient estimates from ordinary least squares estimations. \* significant at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%. The dependent variable is subject  $i$ 's number of riddles solved (i.e. handed in) per minute.  $C_1$  and  $C_2$  represent dummy variables that take the value of 1 whenever a subject took part in an individual/a peer session where cheating was possible.  $NC_2$  is a dummy variable that takes the value of 1 whenever a subject took part in no cheating peer session. *Ability (inverse)* captures the number of minutes participant  $i$  needed for completing the first riddle as an inverse measure of ability. The dummy variable *Male* takes the value of 1 whenever participant  $i$  was male and is 0 otherwise. *Year of birth* captures participant  $i$ 's age. The additional variables capture the Big Five personality measures of neuroticism, openness to experiences, agreeableness, conscientiousness, and extraversion. They were measured using the short item version of the NEO-FFI by Costa and McCrae (1989) and normalized to values between 0 and 1. Some subjects did not provide information on all items asked in the questionnaire. We therefore end up with 162 (150) observations for the piece rate (fixed wage) when including all control variables. Heteroskedasticity-robust Huber-White standard errors are in brackets. Standard errors are clustered at the session level.

Table 6: OLS regression results. Dependent variable: number of riddles per minute per participant.

## 4.2 The Fixed Wage

### 4.2.1 Descriptive Statistics

Subjects were students at the University of Trier. In total, 151 students participated in the experiment. Table 7 displays the number of observations for the four different session types. For individual sessions, the number of observations equals the number of sessions. For the peer sessions, the number of sessions equals half the number of observations.

	Individual sessions	Peer sessions
No cheating possible (NC)	33	50
Cheating possible & observable (ex-post)	24	44

Table 7: Fixed wage: Number of observations per session type.

Figure 2 shows the distribution of the number of completed riddles per session type. Other than under the piece rate, there is much more dispersion in the number of completed riddles under the fixed wage. Again the distributions vaguely resemble a normal distribution, but instead of relying on t-tests only, we will additionally run Wilcoxon rank sum tests.

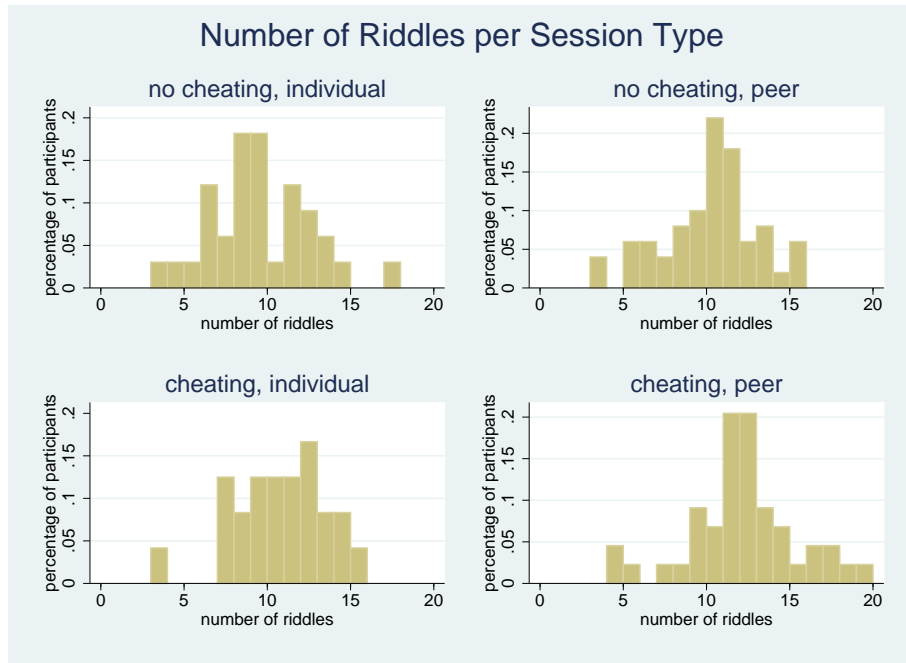


Figure 2: Fixed wage: Histograms of output per session type.

### 4.2.2 (Non-)Parametric Tests and Regression Results

In line with our analysis of the data for the piece rate, we first compare individual sessions and peer sessions per experimental condition with respect to (a) the average number of

completed riddles and (b) the number of completed riddles per minute, i.e. participants' speed.<sup>14</sup> Table 8 shows the average number of completed riddles, Table 9 displays the average speed per sessions type. The last two columns in both tables show results of two-sided t-tests and Wilcoxon rank sum tests, testing for significant differences between individual and peer sessions.

	# of riddles		t-test	Wilcoxon
	Individual sessions	Peer sessions		
No cheating	9.09	9.76	n.s.	n.s.
Cheating	10.33	11.68	*	*

Notes: \* significant at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%.

Table 8: Fixed wage: Average output per session type.

	# of riddles per minute		t-test	Wilcoxon
	Individual sessions	Peer sessions		
No cheating	0.36	0.39	n.s.	n.s.
Cheating	0.41	0.47	*	*

Notes: \* significant at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%.

Table 9: Fixed wage: Average speed per session type.

Looking at the 'no cheating' conditions (first row in Tables 8 and 9), we find that average output and speed are higher in the peer sessions, however, these differences are not statistically significant. This result is in line with our findings from the piece rate compensation scheme. However, given Hypothesis 2 and the previous literature on peer effects, we would have expected to find a significantly higher output in the peer setting. Other than for the piece rate scheme this lack of a peer effect cannot be explained with the very high level of motivation induced by the compensation scheme, which hardly allows to increase output further.<sup>15</sup> For the conditions where cheating is possible, average output is significantly higher in the peer sessions. As for the piece rate, average output is the highest in peer sessions where cheating is possible, supporting Hypothesis 3. The results furthermore support Hypothesis 1 as they show that average output is higher when cheating is possible (both in individual and

<sup>14</sup>Given the experimental design, the average number of riddles per minute ("speed") is perfectly correlated with the absolute level of individual output because all of the participants had to be present for 25 minutes. We will thus focus our analysis on the absolute number of riddles instead of speed for the fixed wage regime. In order to make comparisons between the piece rate and the fixed wage scenarios as convenient as possible, we nevertheless report the results with respect to speed under the fixed wage compensation scheme.

<sup>15</sup>As can be seen from comparisons of Tables 3 and 8, average output levels are lower under the fixed wage – an effect that perfectly corresponds to the existence of a positive motivation effect caused by the piece rate.

peer sessions). Taken together, these findings together with the previous findings from the piece rate suggest that independently of the compensation scheme, peer pressure induced by a peer setting alone does not lead to an additional increase in productive effort (i.e. working faster or more). However, peer settings lead to an increase in average output when cheating is possible.

This result again suggests that the increase in output is – at least in parts – driven by actual cheating. To check whether participants indeed cheated more in the peer setting than in the individual setting, we, again, calculated the percentage of riddles that participants cheated on, i.e. did not solve correctly, separately for individual sessions and peer sessions. In line with our findings for the piece wage scheme, we find that the share of cheating (i.e. the number of incorrectly solved riddles that were handed in by the participants as being correctly solved) is higher in peer sessions (6%) than in individual sessions (4%). This result yields first evidence supporting our conjecture that positive peer effects in sessions where cheating is possible are caused by increased cheating and not increased productive effort.

When we correct average output levels in the cheating sessions for the share of wrong solutions in the cheating condition, it turns out that the positive peer effects on output levels are (as for the piece rate compensation scheme) driven by cheating. According to Table 8, average output in cheating individual sessions equals 10.33 riddles. Correcting for the share of 4% wrong solutions, the average number of correct units of output is 9.92. For peer sessions, correcting average output (11.68) when cheating is possible for the share of 6% wrong answers gives a number of 10.98 corrected units of output. Thus, the positive peer effect on average output when cheating is possible shrinks from 1.55 riddles (including incorrectly solved riddles) to 1.06 riddles. A part of what we would, based on the previous literature, call “positive peer effect” thus vanishes once we correct the results for actual cheating. However, in comparison to the piece rate scheme, there remains a positive effect on productive effort.<sup>16</sup>

Columns (2) and (5) of Tables 5 and 6 show the results of OLS regressions for the dependent variables “number of completed riddles” (Table 5) and “speed (number of completed riddles per minute)”, based on the same explanatory variables as for the piece rate compensation scheme. Column (2) of Table 5 replicates the findings from the statistical tests presented above. However, controlling for averse ability, gender, year of birth, and the Big Five personality inventory, column (5) reveals that the possibility to cheat increases the num-

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<sup>16</sup>Corrected average output in individual sessions where cheating was possible (9.92) is higher than in individual sessions where cheating was not possible (9.09). The same holds for the peer conditions. This suggests that the possibility to cheat (which c.p. lowers effort costs to produce one marginal unit of output) appears to increase social pressure for the participants. In parts, they react with an increase of cheating, but in parts they react with an increase of productive effort.

ber of riddles in individual sessions under the piece rate ( $C_1$  is statistically significant at the 5% level). In peer sessions where cheating is possible ( $C_2$ ), individual output is significantly higher than in individual sessions where cheating is not possible. The coefficient of the  $C_2$  dummy variable is considerably larger than the coefficient of  $C_1$ . This suggests that participants cheat more in peer sessions than in individual sessions – which corresponds to the shares of cheating presented above. Overall, we find that the results of the (non-)parametric tests are confirmed when controlling for factors such as ability, gender, age, and the Big Five personality inventory.

### 4.3 Discussion

Overall, our experimental results show that positive peer effects on output and speed are significantly driven by actual cheating behavior. Individual output levels are highest in peer sessions where cheating is possible – both under the piece rate and the fixed wage compensation scheme.

We now augment our analysis by estimating our econometric models for the pooled sample of piece rate and fixed wage sessions. Columns (3) and (6) of Table 5 are based on this pooled sample, including the dummy variable *fixed wage* that takes the value of 1 for the latter sessions. The estimation results based on this full sample support the previously discussed results; the coefficient of *fixed wage* again reveals that average output levels are lower for the fixed wage conditions. In Table 6, we also estimate the according regression models using individual speed as the dependent variable.<sup>17</sup> Columns (3) and (6) show that the largest increase in average speed can be found for the peer sessions where cheating is possible (reference group: individual sessions without the possibility to cheat). This result holds with and without controlling for ability, gender, age, and the Big Five. Average speed is significantly lower under the fixed wage.

Given the larger share of actual cheating in peer sessions, these results show that peer sessions should be looked at carefully. In situations where the quality of individual output is not directly observable for principals, peer sessions might induce cheating. Observing higher average output levels in peer conditions than in individual working situations might then not necessarily be driven by positive peer effects, but also by actual cheating.

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<sup>17</sup>As mentioned before, speed is isomorphic to individual output under the fixed wage compensation scheme given that all participants had to be present for 25 minutes.

## 5 Conclusions

Peer settings inducing positive peer effects have been deemed a cheap instrument to increase productivity. The aim of this experimental study was to analyze whether these peer effects are indeed always “positive” from principals’ point of view in the sense that they stem from increased productive effort. An alternative and much less desirable explanation would be that peer settings increase adverse behavior such as cheating and sabotage, as has been found for competitive settings, e.g. rank-order tournaments.

Our results challenge previous findings regarding positive peer effects. In our experiment, average output levels are higher in peer settings than in individual settings in experimental conditions in which cheating is possible, but not in those in which it is not. We find that cheating is more pronounced in peer settings than in individual settings. The observed increase in output levels is driven by actual cheating behavior in peer settings. This is a first indication that peer settings might induce cheating.

The potential implications of our study for management are straightforward: Having shown that peer settings increase counterproductive behavior (and only weakly increase productive effort), managers are well advised to reconsider peer settings as a cheap tool for increasing performance. While they cause no harm if cheating and potentially other counterproductive behavior such as sabotage are not feasible, they provide strong incentives to engage in said adverse behavior if possible. This holds even if there is no monetary interdependence between peers in our setting – in contrast to tournaments or team compensation settings. Based on our results, future research might address two issues. First, it would be important to test for the robustness of the finding that peer settings induce cheating using different experimental tasks and settings. Second, it might be worthwhile to move the analysis from the lab to the field. Although it is difficult to provide causal evidence on peer effects in the field, implementing a field experiment might yield additional insights regarding the robustness of our core result.

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# Appendix

## No cheating condition

### Instructions:

Welcome to this experiment and thank you for your participation. You will receive 2.50 Euro for arriving on time. Please turn off your mobile phones. Please read the instructions - which are identical for everyone - carefully. In case you have any questions, please raise your hand, so that we can assist you.

The amount of money you will have earned throughout the experiment will be paid out in cash at the end of the experiment. The payoff will be made in private so that no other participants will know your payoff. Your task in this experiment is to solve riddles, such as:

```
elapmkklogfygnasahyhzxfcaktrnzwatwsrudxkhbcynbehuu  
fmcrksyjdscetrhsmxzzmqjliuynifcwuoxnjmufryiyryilj  
kouzafuhmsxpycxhqdmwnpplzoqqpputnlbwpkigsgpptdzikw  
giexwehcxjxofbnsstdfmrpaseflsrphellwfaqmngxtyrkzkmp  
zdmgkxjqigjfukaeeckotlsqczibliyrwcdpturpjnlczbcxkq  
gotstuurpbaarttkggugqgbgauppjreqppcxluhemrzbrtzrw  
yqwzzzututtifsltmlhejhinejqsyrbdsoubulrpaeypbjuks  
lzpoxmkmkgiedjbiqceunepddzselqkmlqlocztmoffutiuymp  
ggtgwpnadrqbhlqgabsxhiowqrxlfgyucwhkycjczuqtqqdz  
bphzlcycgcghihgsbqzotpsdhuxuuffsdaijeibnddkqrppxffi  
ufyrdgfcqqiwwgkebgadeohqwjrreuqwreyippaxlcsijuuwqfb  
ieokzuhguxczjyhhppksdxcqasbwbrcyrhixkbcsungasiznbas  
zkjlyteggliybefdqonmqwzxiceemhxneewggzjaahyycdkwf  
xwatbcpntowiluqattgoaiqfnqouhmmhhtmkgxdrppunoibold  
qtjwbfpdkhhfbohuljoyosnbhyzaqaxwdwgtncchnioueaep  
zryujtejyokglnpkwkmgrluiwbjjozzcqdwraetxscmzzyialh  
bblqoymbxwheqebsktaksczcfgzfrbdizuujlrxycdhckukrgdd
```

In the beginning of the experiment you are handed out a sheet of paper which contains ten pairs of the letter P which are printed side by side (pp). In order to solve the task of this sheet, all of these ten pairs must be found and highlighted.

Your payoff depends on the number of solved sheets. You receive the most money (55 cents) for the first sheet, for the second it is less (50 cents), even less for the third (45 cents), and so on (in 5 cent decrements). An overview over the exact payoffs depending on the amount of solved sheets can be found in the payoff table at the end of the instructions. You can end the experiment anytime at any self-determined point of time in the experiment. Before you are handed out a new sheet an experimenter is going to tell you how much money you can earn by solving this specific sheet.

It is up to you how many sheets you are going to solve. The only rules are:

1. Before you start, put your name on the top of the sheet.

2. You can work at only one riddle at once.
3. Do not start with a new riddle before you have completed the one you are working on.
4. After completing a sheet you hand it to the experimenter who checks it and files it in a folder.

If you want to solve another riddle afterwards, the experimenter is going to hand one out to you.

If you do not want to solve another sheet, please tell the experimenter. This is when the experiment ends. You fill in a short questionnaire about your person and then you receive your payoff.

Payoff table:

Sheet	Payoff	Accumulated Payoff
1	0.55 Euro	0.55 Euro
2	0.50 Euro	1.05 Euro
3	0.45 Euro	1.50 Euro
4	0.40 Euro	1.90 Euro
5	0.35 Euro	2.25 Euro
6	0.30 Euro	2.55 Euro
7	0.25 Euro	2.80 Euro
8	0.20 Euro	3.00 Euro
9	0.15 Euro	3.15 Euro
10	0.10 Euro	3.25 Euro
11	0.05 Euro	3.30 Euro
12+	0.00 Euro	3.30 Euro

+ 2.50 Euro for arriving on time.

## Observable cheating condition

### Instructions:

Welcome to this experiment and thank you for your participation. You will receive 2.50 Euro for arriving on time. Please turn off your mobile phones. Please read the instructions - which are identical for everyone - carefully. In case you have any questions, please raise your hand, so that we can assist you.

The amount of money you will have earned throughout the experiment will be paid out in cash at the end of the experiment. The payoff will be made in private so that no other participants will know your payoff. Your task in this experiment is to solve riddles, such as:

```
e l a p m k k l o g f y g n a s a h y h z x f c a k t r n z w a t w s r u d x k h b c y n b e h u u  
f m c r k s y j d s c e h t r h s m x z z m q j l i u y n i f c w u o x n j m u f r y i y r y i l j  
k o u z a f u h m s x p y c x h q d m w n p p l z o q q p p u t n l b w p k i g s g p p t d z i k w  
g i e x w e h c x j x o f b n s s t d f m r p a s e f l s r p h e l l w f a q m g x t y r k z k m p  
z d m g k x j q i g j f u k a e e c o t l s q c z i b l i y r w c d p t u r p j n l c z b c x k q  
g o t s t u u r r p b a a r t t k g g u q q g b g a u p p j r e q p p c x l u h e m r z b r t z r w  
y q w z z z u t u t t i f s l t m l h e j h i n e j q s y r b d s o u b u l r p a e y p b j u k s c  
l z p x o x m m k g i e d j b i q c e u n e p d d z s e l q k m q l o c z t m o f f u t i u y m y p  
g g t g w p n a d r q b h l q g a b s x h i o d w q r x l f g y u c w h k y c j c z i u q t q q d z  
b p h z l c y g c g h i h g s b q z o t p s h d u x u u f f s d a i j e i b n d d k q r p p x f f i  
u f y r d g f c q q i w w g k e b g a d e o h q w j r e u q w r e y i p p a x l c s i j u u w q f b  
i e o k z u h g u x c z j y h p p k s d x c q a s b w b r c y r h i x k b c s u n g a s i z n b a s  
z k j l y t e g q l i y b e f d q o n m q q w z x i c e e m h x n e e w g g z j a a h y y c d k w f  
x w a t b c p n t o w i l u q a t t g o a i q f n q o u h m m h h t m k g x d r p p u n o i b o l d  
q t j w b f p p d k h h f b o h u l j o y o s n b h y z a q a x w d w g t n c c h n i o u e a e p  
z r y u j t e j y o k g l n p k w k m g r l u i w b j j o z z c q d w r a e t x s c m z z y i a l h  
b b l q o y m b x w h e q e b s k t a k s z c f g z f r b d i z u u j l r x y c d h c k u k r g d d
```

In the beginning of the experiment you are handed out a sheet of paper which contains ten pairs of the letter P which are printed side by side (pp). In order to solve the task of this sheet, all of these ten pairs must be found and highlighted.

Your payoff depends on the number of solved sheets. You receive the most money (55 cents) for the first sheet, for the second it is less (50 cents), even less for the third (45 cents), and so on (in 5 cent decrements). An overview over the exact payoffs depending on the amount of solved sheets can be found in the payoff table at the end of the instructions. You can end the experiment anytime at any self-determined point of time in the experiment. Before you are handed out a new sheet an experimenter is going to tell you how much money you can earn by solving this specific sheet.

It is up to you how many sheets you are going to solve. The only rules are:

1. You can work at only one riddle at once.
2. Do not start with a new riddle before you have completed the one you are working on.

3. After completing a sheet you hand it to the experimenter who adds it to the other completed sheets.

If you want to solve another riddle afterwards, the experimenter is going to hand one out to you.

If you do not want to solve another sheet, please tell the experimenter. This is when the experiment ends. You fill in a short questionnaire about your person and then you receive your payoff.

Payoff table:

Sheet	Payoff	Accumulated Payoff
1	0.55 Euro	0.55 Euro
2	0.50 Euro	1.05 Euro
3	0.45 Euro	1.50 Euro
4	0.40 Euro	1.90 Euro
5	0.35 Euro	2.25 Euro
6	0.30 Euro	2.55 Euro
7	0.25 Euro	2.80 Euro
8	0.20 Euro	3.00 Euro
9	0.15 Euro	3.15 Euro
10	0.10 Euro	3.25 Euro
11	0.05 Euro	3.30 Euro
12+	0.00 Euro	3.30 Euro

+ 2.50 Euro for arriving on time.

## Blind cheating condition

### Instructions:

Welcome to this experiment and thank you for your participation. You will receive 2.50 Euro for arriving on time. Please turn off your mobile phones. Please read the instructions - which are identical for everyone - carefully. In case you have any questions, please raise your hand, so that we can assist you.

The amount of money you will have earned throughout the experiment will be paid out in cash at the end of the experiment. The payoff will be made in private so that no other participants will know your payoff. Your task in this experiment is to solve riddles, such as:

```
elapmkkllogfygnasahyhzhxfcaktrnzwatwsrudxkhbcynbehuu  
fmcrksyjdscetrhsmxzzmqjliuynifcwuoxnjmufryiyryilj  
kouzafuhmsxpycxhqdmwnpplzoqqpputnlbwpkigsgpptdzikw  
giexwehcxjxofbnsstdfmrpaseflsrphellwfaqmgtyrkzkmp  
zdmgkxjqigjfukaeeckotlsqczibliyrwcdpturpjnltzbcxkq  
gotstuurpbaarttkggugqgbgauppjrepppcxludemrzbtrzrw  
yqwzzzututtifsltmlhejhinejqsyrbdsubulrpaeypbjuksc  
lzpoxmmkgiedjbiqceunepddzselqkmlqlocztmoffutiuymp  
ggtgwpnadrbhlqgabsxhiodwqrxlfgyucwhkycjczuqtqgdz  
bphzlcycgcghihgsbqzotpsduduxuuffsdaijeibnddkqrppxffi  
ufyrdgfcqqiwwgkebgadeohqwjreuqwreyippaxlcsi juuwqfb  
ieokzuhguxczjyhppksdxcqasbwbrcyrhixkbcsungasiznbas  
zkjlyteqqliybefdqonmqwzxiceemhxneewggzjaahyycdkwf  
xwatbcpntowilugattgoaiqfnqouhmmhhtmkgxdrppunoibold  
qtjwbfpdkhhfbohuljoyosnbhyzaqaxwdwgtncchnioueaep  
zryujtejyokglnpkwmgrluiwbjjjozzcqdwraetxscmzzyialh  
bblqoymbxwhegebsktakszcfgzfrbdizuujlrxycdhckukrgdd
```

In the beginning of the experiment you are handed out a sheet of paper which contains ten pairs of the letter P which are printed side by side (pp). In order to solve the task of this sheet, all of these ten pairs must be found and highlighted.

Your payoff depends on the number of solved sheets. You receive the most money (55 cents) for the first sheet, for the second it is less (50 cents), even less for the third (45 cents), and so on (in 5 cent decrements). An overview over the exact payoffs depending on the amount of solved sheets can be found in the payoff table at the end of the instructions. You can end the experiment anytime at any self-determined point of time in the experiment. Before you are handed out a new sheet an experimenter is going to tell you how much money you can earn by solving this specific sheet.

It is up to you how many sheets you are going to solve. The only rules are:

1. You can work at only one riddle at once.
2. Do not start with a new riddle before you have completed the one you are working on.



3. After completing a sheet you hand it to the experimenter who puts it into the document shredder.

If you want to solve another riddle afterwards, the experimenter is going to hand one out to you.

If you do not want to solve another sheet, please tell the experimenter. This is when the experiment ends. You fill in a short questionnaire about your person and then you receive your payoff.

Payoff table:

Sheet	Payoff	Accumulated Payoff
1	0.55 Euro	0.55 Euro
2	0.50 Euro	1.05 Euro
3	0.45 Euro	1.50 Euro
4	0.40 Euro	1.90 Euro
5	0.35 Euro	2.25 Euro
6	0.30 Euro	2.55 Euro
7	0.25 Euro	2.80 Euro
8	0.20 Euro	3.00 Euro
9	0.15 Euro	3.15 Euro
10	0.10 Euro	3.25 Euro
11	0.05 Euro	3.30 Euro
12+	0.00 Euro	3.30 Euro

+ 2.50 Euro for arriving on time.