



**IAAEU**

Institut für Arbeitsrecht  
und Arbeitsbeziehungen  
in der Europäischen Union

**IAAEU Discussion Paper Series in Economics  
No. 08/2013**

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Groups: Experimental Evidence**

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**June 2013**

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# The role of task meaning on output in groups: Experimental evidence

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June 7, 2013

## Abstract

This paper analyzes experimentally how the interaction of task meaning and peer presence affects work effort. We build on the experimental designs of Falk and Ichino (2006) and Ariely et al. (2008). Confirming previous results from the literature, we find positive peer effects and negative effects of low task meaning. In addition, we find that peer effects are even stronger if task meaning is low. We conclude that a peer setting is able to overcome the negative effort effect of low task meaning.

*Keywords: task meaning, peer effects, experimental economics*

*JEL: J20, J30, M50*

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# 1 Introduction

This paper analyzes whether the impact of task meaning on work effort depends on the presence of peers. The topic is highly relevant for two reasons. First, modern working environments are characterized by a high degree of specialization and functional segmentation. This might lead to situations in which workers cannot perceive the importance of their individual contribution to the overall output of the work process. As a result, they might question the meaningfulness of their work – a phenomenon that has often been referred to in the media in recent years. Previous experimental evidence suggests that the perceived meaning of a task has a large impact on work effort (Ariely et al. 2008). Given the structure of modern working environments, it is thus important to shed more light on this issue. Second, groups have gained a lot of importance in work processes in recent years (see, e.g., Lindbeck and Snower 2000 and Osterman 2000). In group settings peer effects can occur: the mere presence of peers influences individual performance of a group member. The influence of peer effects on individual work effort has been initially examined in a field experiment by Falk and Ichino (2006). In line with other studies (e.g., Mas and Moretti 2009), they find positive peer effects on work effort.

Given these observations, two questions arise: (a) How do peer effects interact with task meaning?; and (b) Can work groups be exploited to overcome potential adverse effects of low task meaning? The answers to these questions provide our main contributions to the existing literature. Although both aspects (low task meaning and the existence of work groups) can usually be found simultaneously in modern working environments, we are the first to explore a potential interaction between the meaning of a task and the presence of peers. Empirical and experimental evidence suggests that both aspects significantly influence work effort. However, they have only been investigated separately in the literature. By analyzing a potential interaction of the effects, we can provide clear implications regarding workplace design. Furthermore, we contribute to the literature by testing for peer effects under a piece-rate oriented payment scheme instead of under a fixed wage. As this was already suggested by Falk and Ichino (2006), this can be seen as an extension of their article.

We combine the experimental settings used by Ariely et al. (2008) and Falk and Ichino (2006) in the following way to answer the question of whether we can observe peer effects that depend on task meaning. We use a similar task as in Ariely et al. (2008): participants have to build LEGO diggers. As in Ariely et al. (2008), we vary the degree of task meaning in our experiment. Following Falk and Ichino (2006), some participants have to work alone while others work in groups of two. This experimental design allows to clearly distinguish between “task meaning effects” and “peer effects”. Most pertinently, we can investigate whether peer effects influence the impact of task meaning on work effort.

In line with Falk and Ichino (2006), we find positive peer effects on output in our experiment. That is, output is higher in peer sessions than in single sessions for a given level of task meaning. Our results show the predicted detrimental effect for a low level of task meaning in individual sessions, which supports the findings of Ariely et al. (2008). Most strikingly, the peer effects outweigh the task meaning effects. Average output is higher in the low task meaning-peer-condition than in the high task meaning-single-condition. The increase of output due to the presence of a peer is larger when task meaning is low. Hence, peer effects turn out to be particularly strong in the low task meaning condition. Moreover, in peer sessions, we do not find statistically significant differences in output levels depending on the level of task meaning. The presence of a peer increases individual output and makes the task meaning effects disappear. Consequently, our results indicate that implementing a peer setting might be appropriate to compensate for a detrimental effect of task meaning on output.

The remainder of the paper is structured as follows. Section 2 presents the related literature. In section 3, we describe our experimental design and hypotheses; section 4 then presents our results. Section 5 concludes the analysis and discusses our results' implications both for workplace design and future research.

## 2 Related Literature

Our analysis of the interaction of task meaning and peer effects combines two strands of literature. The first strand refers to the relevance, importance, or meaning of a task. Thus, we understand 'task meaning' as a characteristic of the task or work, and not something that the worker can generate himself or herself by gathering more information (see, e.g., Miranda and Saunders 2003). While the perceived relevance of the task for the company or society might influence many aspects, such as job satisfaction (see Hackman and Oldham 1976), attributions of responsibility (see Miller et al. 1978), or leaders' influence behavior (see Yukl et al. 1999), we focus on the relation of task meaning and motivation or effort of workers. The job design literature (see, e.g., Hackman and Oldham 1976) states that task relevance is an important determinant of workers' intrinsic task motivation (Thomas and Velthouse 1990), and thereby chosen effort. The few empirical studies testing this hypothesized relation report supporting evidence. In a survey study of engineers, Guion and Landy (1972) find that self-rated meaningfulness of work relates only weakly but positively to peer ratings of work motivation. For the peer ratings of work motivation, co-workers evaluated newly-employed engineers regarding professional identification, team attitude, job curiosity, task concentration, independence, persistence, and organizational identification. Murningham

and Leung (1976) run an experiment with a student sample in which they manipulate the involvement of the group leader and measure the perceived importance of the task, i.e., the problem to solve. They find that both leader involvement and task importance positively relate to the subsequent performance of the subjects. Most recently, Ariely et al. (2008) study the relation between task meaning and labor supply (or effort) using experimental data from a student sample. Manipulating the meaning of the task but not the task itself, they find that subjects work harder on tasks with higher meaning.

For our experimental setup we rely heavily on the experiment conducted by Ariely et al. (2008), incorporating the same task as well as their payoff scheme into our experimental design. The task is building LEGO models. Ariely et al. (2008) manipulate task meaning by either keeping the completed models visibly present (high meaning) or deconstructing them directly (low meaning). They pay subjects a linearly decreasing piece rate and subjects are free to stop working at any time.

The second strand of literature that we refer to is the literature on peer effects. The term 'peer effect' refers to an interdependence of the ability, performance, or output of peers. With regard to output (which we will focus on), the literature talks about 'positive' peer effects if the presence of peers increases individual output. In turn, 'negative' peer effects are present when individual output is lower in the presence of peers. Peer effects have been widely studied within the context of the educational system. The aim of the respective studies, mostly, is to give policy implications as to whether pupils or students should be sorted according to ability, so-called 'tracking' (see, e.g., Kim et al. 2008). To this end, the studies analyze how the ability or performance of one's peer group affects one's own ability or performance. The evidence points to a positive direction of peer effects, i.e. an increase in output of peers increases one's own output, while a decrease of peer output decreases one's own output. However, there is some debate about how the peer effects relate to one's own ability (see, e.g., Contreras et al. 2012). Some studies find an effect of highly productive peers on their *less productive peers* but not vice versa (e.g., Hanushek et al. 2003), leading to an increase in overall output. Some find that having low performing peers instead of high performing peers reduces the output of *high performers* (e.g., Lavy et al. 2012). Ficano (2012) finds significant peer effects only for male students on male peers but not on female peers or for female students. The study by Foster (2006) looks at the mechanisms behind peer effects and reports that the closeness of the relation to one's peers does not influence the strength of the peer effects.

The field study by Mas and Moretti (2009) is one of the few exceptions not focusing on pupils or students. Mas and Moretti (2009) examine how the productivity of cashiers at a large supermarket chain changes when a new cashier is introduced. They find evidence for

positive peer effects on low-productive cashiers, i.e. low-productive cashiers increase their productivity when a high-productive cashier is introduced into the group. However, high-productive employees seem not to react to the introduction of a low-productive employee. Given that the positive peer effect only occurs when the low-productive cashier is visible to the high-productive, Mas and Moretti (2009) conclude that social pressure (but not altruism) deters free-riding tendencies.

Most studies on peer effects relying on field data face the problem of correctly identifying peer effects and disentangling them from “endogenous, exogenous or correlated effects” (Contreras et al. 2012). One solution to this identification issue is to conduct controlled experiments. Falk and Ichino (2006) present evidence from an experiment in which subjects work individually on a simple task and receive a fixed payment. They vary whether the subjects work in the presence of a peer or alone. By comparing the variance in outputs of actual pairs and simulated pairs they are able to show that positive peer effects exist: performance (i.e. quantity of output within a given time frame) varies less in actual pairs than in simulated pairs. They also find that a higher performance of the peer leads to a higher performance of the considered subject. In our experiment, we rely on Falk and Ichino’s design: some of the participants have to work on the task alone while others work in the presence of a peer.

## 3 Experimental Design and Hypotheses

### 3.1 Experimental Design

We combine the experimental settings used by Ariely et al. (2008) and Falk and Ichino (2006) to answer the question of whether we can observe that the magnitude and direction of peer effects depend on task meaning. As in Ariely et al. (2008), we vary the degree of meaningfulness of the task. At the same time, some participants have to work alone while others work in the presence of one other participant as in Falk and Ichino (2006). Table 1 shows our 2x2 design. For the sake of brevity, we use the following notation for the different session types throughout the remainder of the paper:  $S_j$ , where  $S = C, T$  refers to control and treatment sessions, respectively, and  $j = 1, 2$  refers to single and peer sessions, respectively. Participants are randomly assigned to one of the four conditions (between-subjects design).

We use a similar task as in Ariely et al. (2008). Participants have to build LEGO diggers. We vary task meaning in the following way: in the control group (high task meaning), all diggers built by a participant are collected on his desk.<sup>1</sup> He can thus easily observe his

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<sup>1</sup>All participants of our experiment are male to rule out gender specific effects regarding (a) the preferences

|                                       | Individual sessions                          | Peer sessions                  |
|---------------------------------------|--|--------------------------------|
| High task meaning<br>(control group)  | 1 ( $C_1$ )<br>Ariely et al./Falk and Ichino | 3 ( $C_2$ )<br>Falk and Ichino |
| Low task meaning<br>(treatment group) | 2 ( $T_1$ )<br>Ariely et al.                 | 4 ( $T_2$ )                    |

Table 1: Experimental design: four conditions.

progress and see what he has “achieved” so far. In the treatment group (low task meaning), the experimenter deconstructs each digger immediately after completion. Thus, participants use exactly the same pieces to build new diggers.<sup>2</sup>

The procedure of the experiment is as follows:

(1) Participants arrive and receive written instructions on paper. The experimenter reads these instructions out loud and answers questions regarding the experiment if necessary. An example of the digger is given within the instructions. The instructions tell participants that they will receive a linearly decreasing piece rate for every completed digger. A table presents the marginal amount of money to be earned for each completed digger as well as the cumulated amount of money per total number of completed diggers. Following Ariely et al. (2008), a participant can earn 2 Euro for the first completed digger, 1.89 Euro for the second, 1.78 Euro for the third and so on. That is, the piece rate decreases by 11 cents per completed digger. Participants are also told that they can end the experiment at any given point in time by deciding not to build another digger.

(2) Announcing the piece rate for the first digger, the experimenter hands over the pieces for the first digger and participants start working.

(3) Whenever a digger is completed, the experimenter asks the participants whether he wants to proceed to build another digger for the newly applicable piece rate and acts as required by the experimental condition.

(4) When a participant decides not to build another digger, he is asked to fill in a questionnaire capturing personal characteristics.

Lastly, (5) the participant receives his payment. This payment contains a show-up fee of 2.50 Euro and the accumulated piece rates.

The experiment was conducted at the University of Trier. Individual and peer sessions were conducted in the same rooms by the same experimenters using the same instructions. The only difference was that the two participants in the peer sessions worked in a room with their co-worker. They saw each other, were allowed to communicate and to give each other

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with respect to building LEGO figures and (b) the composition of the “work groups”.

<sup>2</sup>For every participant, we have two sets of pieces to build the diggers in the low task meaning condition. This guarantees that there is no delay between finishing one digger and starting to build up another one in the treatment group.

advice.

Subjects were students recruited from the subject pool of the Trier Experimental Laboratory (TrEx) at the University of Trier. In total, 126 students participated in the experiment.<sup>3</sup> Table 2 displays the number of observations for the four different conditions. 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. That is, the number of sessions is about equal for all four experimental conditions.

|   | (1)        | (2)  |
|---|------------|------|
|   | individual | peer |
| <b>High task meaning (control group)</b>  | 22         | 40   |
| <b>Low taks meaning (treatment group)</b> | 20         | 44   |

Table 2: Number of observations per experimental condition.

### 3.2 Hypotheses

Before we present our results, we quickly recap the theoretical expectations. Based on the findings by Ariely et al. (2008) and therefore only looking at individual and not peer sessions, we expect participants to work more (proxied by the number of completed diggers) on the task with high meaning than on the task with low meaning. Within the following, we denote individual output in the experimental condition  $S_j$  as  $e(S_j)$ .

In line with proposition 2 of Falk and Ichino (2006), we propose that output in peer sessions is higher than in individual sessions. Falk and Ichino (2006) refer to the social facilitation paradigm, which states that “even the mere presence of another person improves one’s performance” (Falk and Ichino 2006:48). Our control condition is similar to Falk and Ichino’s design: in both experiments, individual output (envelopes in the Falk and Ichino case, LEGO diggers in our case) can be directly observed on each participant’s table. We will investigate the interaction of task meaning and peer effects in the following (hypothesis 2). Here we state the hypothesis only for the control group, that is the condition with high task meaning.

The combination of the propositions made by Falk and Ichino (2006) and Ariely et al. (2008) leads us to expect that individual output will be highest in the peer condition with

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<sup>3</sup>Ariely et al. (2008) rely on 20 sessions per experimental condition. Our aim was to base our analysis on the same number of observations. We therefore recruited a slightly larger number of participants and randomly assigned them to one of the four conditions. By chance, the show-up rate was slightly higher in two conditions. Therefore, we end up with between 20 and 22 sessions per condition, resulting in between 20 (single) and 44 (peer) observations.



high task meaning, second highest in the individual condition with high task meaning, and lowest in the individual condition with low task meaning. That is, we predict:

**Hypothesis 1** *Individual output is higher in control sessions (high task meaning) than in treatment sessions when participants work alone:  $e(C_1) > e(T_1)$  (replication of Ariely et al. 2008). Individual output is higher in peer sessions than in single sessions in the meaningful condition:  $e(C_2) > e(C_1)$  (replication of Falk and Ichino 2006). This can be condensed to:  $e(C_2) > e(C_1) > e(T_1)$ .*

Whereas the previous considerations basically aim at replicating existing results, we now turn to the nature of the interaction between task meaning and peer effects. This interaction will determine how the output of participants in the peer condition with low task meaning  $e(T_2)$  fits into the relation of outputs described in hypothesis 1. We refer to Table 3 for support of the following discussion on where to place  $e(T_2)$  in relation to the other conditions referred to in hypothesis 1. This discussion basically focusses on the interaction of task meaning and peer effects. In the following,  $p$  refers to peer effects and  $m$  to effects pertaining to a high task meaning in contrast to a low task meaning.

Analogously to hypothesis 1, output in the peer condition with low task meaning should be higher than output in the respective individual condition ( $e(T_2) > e(T_1)$ ). This will be the case if a low task meaning does not reverse the direction of the peer effect. That is, as long as peer effects are positive ( $p > 0$ ), a peer setting will lead to a higher individual output for a given level of task meaning. Assuming positive peer effects ( $p > 0$ ),  $e(T_1)$  (bottom left cell in Table 3) constitutes the lower boundary for individual output.

|                   | individual            | peer                      |
|-------------------|-----------------------|---------------------------|
| High task meaning | $e(C_1) = e(T_1) + m$ | $e(C_2) = e(T_1) + p + m$ |
| Low task meaning  | $e(T_1)$              | $e(T_2) = e(T_1) + p$     |

Table 3: Predicted relation of outputs in the four conditions.

Hypothesis 1 specifies the role of task meaning for individual output. Following Ariely et al. (2008), output in individual sessions with high task meaning is higher than that in individual sessions with low task meaning. Referring to Table 3, individual output in  $e(C_1)$  (upper left cell) exceeds that in  $e(T_1)$  (lower left cell) by  $m > 0$ . Assuming that the positive effect of task meaning on output is not only present in single sessions, but also in the presence of co-workers, this would imply  $e(C_2) > e(T_2)$ , because of  $e(C_2) = e(T_2) + m$ . Then, the upper boundary for individual output would be given by  $e(C_2)$ . Based on the above reasoning with regard to a lower and an upper bound for individual output, we can propose that  $e(T_2)$  lies between them, i.e.  $e(C_2) > e(T_2) > e(T_1)$ . However, we are not able

to rank  $e(T_2)$  in comparison to  $e(C_1)$ . On the one hand, (a) the positive peer effect  $p$  might be greater than the task meaning effect  $m$ , implying  $e(T_2) > e(C_1)$ . On the other hand, (b)  $e(C_1) > e(T_2)$  might hold if the task meaning effect  $m$  overcompensates the peer effect  $p$ .

Our considerations so far relied on the assumptions that (1) the marginal effect of task meaning ( $m$ ) does not depend on the session type (single vs. peer) and (2) the marginal effect of the presence of peers ( $p$ ) does not depend on the level of task meaning. To the best of our knowledge, there is no theoretical framework that supplies us with alternative hypotheses. Although these two assumptions appear to be plausible to a certain extent, it is worthwhile to relax them in order to get an impression of how this translates into the ranking of  $e(C_2)$ ,  $e(T_2)$ ,  $e(C_1)$ , and  $e(T_1)$ .

Turning to the dependency of the task meaning effect on the presence of peers, one might argue that participants in peer conditions provide more effort in the low task meaning condition than in the high task meaning condition. The rationale behind this assumption might be social dynamics leading participants to defy the circumstances and provide even more effort to show the peer that work motivation does not depend on a meaningful task (of course, without knowing that other participants work on a task with a higher meaning). In that case, referring to Table 3, in the low task meaning condition with peer setting we would have a new term  $x$  with  $x + p > m > 0$ :  $e(T_2) = e(T_1) + p + x$ .

One might also argue (2) that peer effects depend on the level of task meaning. Hypothesis 1 states that in the meaningful condition output in peer sessions is higher than output in single sessions, i.e.  $p > 0$ . However, in the case of a task with a low level of meaning, we might observe that individuals in the peer condition provide less effort than in the single sessions, so that  $p < 0$ . The rationale for this proposition is that given a low task meaning individuals might initially provide less effort than given a high task meaning (see hypothesis 1). Observing that the peer produces a low level of output might then lead the individual to believe that low output is acceptable. That is, observing the peer might reinforce the initial tendency to provide low effort when task meaning is low. Additionally, social pressure might yield a lower level of effort when the two co-workers discover the low level of meaning, ending in a downward spiral and causing the peer effect to negatively influence output.

As all these considerations hold some merit, although are at least in part mutually exclusive, we formulate alternative hypotheses capturing the different considerations with respect to the relation of output in peer sessions with low task meaning  $e(T_2)$  to output in the other conditions, especially individual sessions with high task meaning:

**Hypothesis 2** (a) *The peer effect overcompensates the meaning effect ( $p > m > 0$ ) resulting in:  $e(C_2) > e(T_2) > e(C_1) > e(T_1)$ .*

(b) *The meaning effect overcompensates the peer effect ( $m > p > 0$ ) resulting in:  $e(C_2) >$*

$e(C_1) > e(T_2) > e(T_1)$ .

(c1) Working in the presence of a peer reverses the effect of task meaning in sessions with low task meaning resulting in:  $e(T_2) > e(C_2) > e(C_1) > e(T_1)$ .

(c2) Working in the presence of a peer exaggerates the meaning effect in sessions with low task meaning resulting in:  $e(C_2) > e(C_1) > e(T_1) > e(T_2)$ .

Falk and Ichino (2006) find that in peer sessions the output of one participant influences the output of the other participant positively.<sup>4</sup> Therefore, output of the same individual should be higher when paired with a high-productive participant than with a low-productive participant. Consequently, following Falk and Ichino (2006), we propose:

**Hypothesis 3** *The output level of the respective peer has a positive influence on a participant's output.*

## 4 Results

To analyze how task meaning and peers influence work effort, we first compare the output (number of completed diggers) produced by each participant. This allows us to make inferences regarding hypotheses 1 and 2.

Figure 1 shows the histograms of the number of completed diggers for our different experimental conditions. The average number of diggers equals 13.8 in single control sessions (high task meaning) and 11.6 in single treatment (low task meaning) sessions, see Table 4. A two-sided t-test yields a  $p$ -value of 0.1116 and therefore the treatment effect slightly lacks significance at conventional levels. The  $p$ -value resulting from the Wilcoxon rank-sum (Mann-Whitney) test amounts to 0.1229. However, having a clear hypothesis about the direction of the difference between the expected values allows us to apply a one-sided test to explicitly test if we can confirm the result by Ariely et al.<sup>5</sup> Following our expectation that  $e(C_1) > e(T_1)$  holds, applying a one-sided t-test yields a  $p$ -value of 0.0558. However, besides statistical significance, the difference in the mean number of completed diggers is quite large in economic terms: output is almost 20% higher in the high task meaning condition. Given the small sample size (and, therefore, the large standard errors), we interpret our results as a replication of Ariely et al.'s findings. Therefore, we are not able to reject this part of hypothesis 1.

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<sup>4</sup>They refer to this effect as “positive peer effect”. Hence, this definition of the peer effect is concerned with the sign of the partial derivative of one participant's output with regard to the other participant's output. In our wording, a positive peer effect means that output is c.p. higher in peer sessions than in single sessions. However, these two definitions are perfectly compatible except for the case of the downward spiral described above.

<sup>5</sup>Ariely et al. (2008) also rely on one-sided tests.

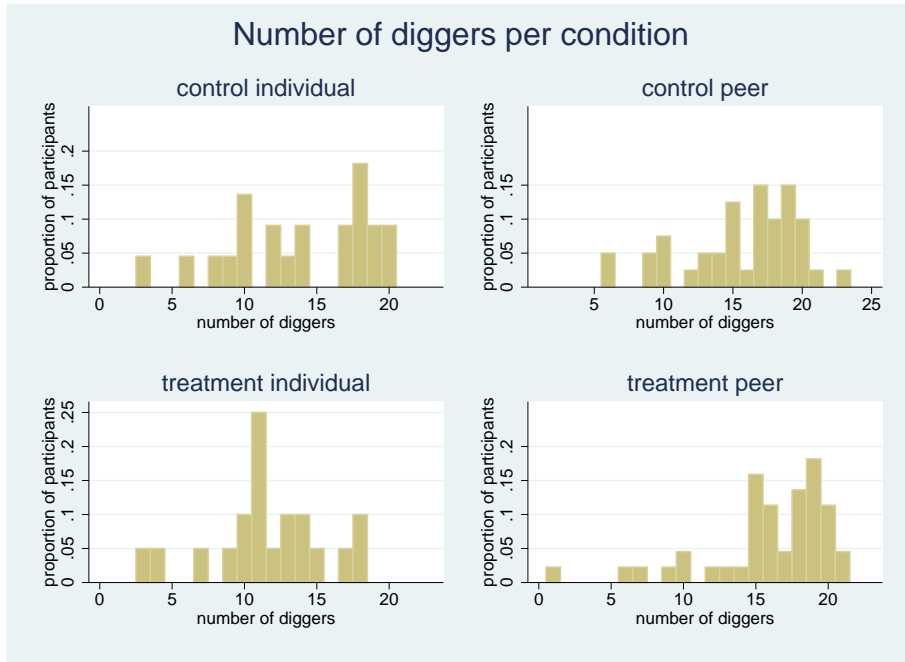


Figure 1: Histograms of output per condition.

|   | (1)<br>individual | (2)<br>peer | # of LEGO diggers<br>t-test<br>(two-sided) | Wilcoxon<br>rank-sum<br>(Mann-Whitney)<br>test (two-sided) | t-test<br>(one-sided) |
|---|-------------------|-------------|--|--|-----------------------|
| Control   | 13.8              | 15.7        | ( $p=.1176$ )                              | ( $p=.1762$ )  | * ( $p=.0588$ )       |
| Treatment   | 11.6              | 16.0        | *** ( $p=.0003$ )                          | *** ( $p=.0001$ )  | *** ( $p=.0001$ )     |
| t-test (one-sided)                                      | ( $p=.1116$ )     | n.s.        |  |  |                       |
| Wilcoxon rank-sum<br>(Mann-Whitney) test<br>(two-sided) | ( $p=.1229$ )     | n.s.        |  |  |                       |
| t-test (two-sided)                                      | * ( $p=0.0558$ )  | n.s.        |  |  |                       |

Table 4: Average output per experimental condition.

With respect to the second part of hypothesis 1, Figure 1 reveals that the share of participants who built a larger number of diggers is higher in peer sessions for both the treatment and the control condition. On average, participants in the control condition (high task meaning) built 1.9 diggers more when they worked with a peer, supporting hypothesis 1. This peer effect just fails to be statistically significant in a two-sided t-test ( $p = 0.1176$ ). A similar result can be obtained using the two-sided Wilcoxon rank-sum (Mann-Whitney) test. However, as we once again have a clear expectation about the direction of the peer effect ( $e(C_2) > e(C_1)$ ), we can apply a one-sided t-test resulting in  $p = 0.0588$ .<sup>6</sup> Falk and Ichino

<sup>6</sup>Falk and Ichino (2006) also rely on one-sided tests.

show that working in the presence of a peer increases the output level of low-productive workers most strongly. We follow their empirical strategy and compare different quantiles with respect to output between the  $C_1$  and  $C_2$  conditions. For the 25% quantile, output is considerably higher in the peer condition (13.5 diggers) than in the single condition (10 diggers). The same holds for the 50% quantile (17 vs. 14 diggers). Peer effects turn out to be smaller for high-productive workers (19 vs. 18 diggers), which is perfectly in line with Falk and Ichino’s results.

It appears to be noteworthy that all these differences in the mean numbers of completed diggers are economically large: Output increases by nearly 20 percent if one increases task meaning in the single sessions. Moreover, we observe a further increase in output by about 14 percent when comparing the single control condition with the peer control condition.<sup>7</sup> All in all, the obtained results from the LEGO experiment are consistent with the findings of Falk and Ichino (2006) and Ariely et al. (2008). Based on our experiment, we can replicate their results and are not able to reject hypothesis 1.

As described in Section 3.2, we have no clear prediction as to where average output in the peer treatment (low task meaning) sessions stands in relation to the outputs in the other three conditions. It could be that either the task meaning effect or the peer effect are stronger or that both effects interact. Given these competing arguments, we proposed several different rankings in hypothesis 2. Examining actual average outputs in the LEGO experiment (see Table 4) reveals that there is no significant difference in outputs between the two peer conditions. On average, participants in the control group (high meaning) build 15.7 diggers, while in the treatment group (low meaning) they build 16 diggers. Whereas the peer effect in the high task meaning case amounts to 1.9 diggers, participants in the treatment condition (low task meaning) built 4.4 diggers more when they worked with a peer. The latter peer effect is statistically highly significant with  $p$ -values of 0.0003 (two-sided t-test) and 0.0001 (two-sided Wilcoxon rank-sum (Mann-Whitney) test).

These results lead to the following order of outputs:  $e(T_2) = e(C_2) > e(C_1) > e(T_1)$ . This ranking is consistent with both hypotheses 2(a) and 2(c1). Participants build more diggers in the peer treatment condition than in the single control condition, indicating that the peer effect overcompensates the meaning effect ( $p > m > 0$ ). If there is a second person present working on the same task, the level of task meaning appears to have no effect on individual effort. It might even be the case that working in the presence of a peer reverses the effect of task meaning in sessions with low task meaning. However, due to the lack of statistical significance between the average output levels in conditions  $T_2$  and  $C_2$ , we cannot make any

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<sup>7</sup>This result is quantitatively very similar to the results obtained by Falk and Ichino (2006). In their experiment, output increased by 16% when comparing the average production levels in single and peer sessions.

further statement here.

After the experiment, participants had to answer a short questionnaire. Within this questionnaire, we asked them for some personal characteristics such as age and field of study. Additionally, we asked them how much they liked the experimental task (on a scale from 1 (not at all) to 5 (very much), captured in the variable *task satisfaction*). We perform a series of OLS regressions to test for the influence of these items on output. In these estimations, we use a participant's number of completed diggers as the dependent variable. The first set of estimations only makes use of two dummy variables. The dummy variable *treatment* takes the value of 1 whenever participant  $i$  participated in a session with a low task meaning, and 0 otherwise. The dummy variable *peer* equals 1 if the participant  $i$  participated in a peer session and 0 otherwise.

Regression results are presented in Table 5. Column (1) relies on OLS estimations which are based on these two dummy variables and their interaction term only. Obviously, this estimation basically tells us the same as the t-test regarding the mean levels of output in the four experimental conditions.<sup>8</sup> An F-test of joint significance of all the three coefficients (peer, treatment, peer\*treatment) supports our findings described above and confirms that  $e(T_2) > e(C_1)$  holds. Including the participants' age and dummy variables indicating their major field of study yields insignificant coefficients of all these control variables without changing our results of main interest (results not shown).

|                   | (1)                 | (2)                | (3)                |
|-------------------|---------------------|--------------------|--------------------|
| Peer              | 1.861<br>(1.229)    | 1.615<br>(1.141)   | 1.624<br>(1.144)   |
| Treatment         | -2.264*<br>(1.367)  | -2.639*<br>(1.367) | -2.607*<br>(1.369) |
| Peer * Treatment  | 2.516<br>(1.649)    | 2.961*<br>(1.576)  | 2.892*<br>(1.592)  |
| Task satisfaction |                     | 2.578***<br>(.596) | 2.541***<br>(.590) |
| Ability           |                     |                    | .272<br>(.727)     |
| Constant          | 13.864***<br>(1.04) | 2.381<br>(2.801)   | 2.395<br>(2.795)   |
| Observations      | 126                 | 126                | 126                |
| $R^2$             | .12                 | .29                | .29                |

Notes: heteroscedasticity-robust standard errors in brackets;  
\* sign. at 10%; \*\* sign. at 5%; \*\*\* sign. at 1%.

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

In column (2), we include the control variable that captures the participants' satisfaction

<sup>8</sup>Of course except for the fact that in the OLS estimations  $H_0$  for the coefficients is always tested using a two-sided t-test.

with the task. It turns out that a higher level of satisfaction is accompanied by a higher output. Additionally, the coefficient of the peer\*treatment interaction term is now significant at the 10%-level. Given the task the participants had to carry out in the experiments, one might argue that skill levels might differ between participants as some participants might have been experienced LEGO constructors in their childhood. We therefore captured the time each participant needed to build the first digger. It took the participants between 4 and 35 minutes to build the first digger, with a median of 10 minutes. The control variable *ability* indicates whether a particular participant needed less time than the median (*ability*=1) or more (*ability*=0). Adding it into our regressions (see column (3)) shows no significant ability effect. The other coefficients remain stable.

In a last step, we look only at subjects in peer sessions to test hypothesis 3. We follow Falk and Ichino's technique to identify the effect of one additional digger built by the peer on the participant's own number of completed diggers (Falk and Ichino 2006, pp. 45). Our calculations show that one additional digger completed by participant *i*'s co-worker is accompanied by .28 additional diggers completed by *i* if he is in the treatment group. For the control group, one additional digger completed by the co-worker yields .12 additional diggers of participant *i*. These findings reveal a positive correlation between a particular participant's output and his peer's output and therefore support hypothesis 3.

## 5 Conclusion

The aim of this paper was to examine whether the effect of task meaning interacts with the effect of a peer setting in influencing work effort or output. Given that modern work situations are often characterized by (1) a high degree of functional segmentation and specialization, potentially leading to a low task meaning, or (2) a peer setting or both, it seems highly relevant to analyze how these two characteristics interact to influence workers' performance. Our experimental design allows us to separate pure effects of the two aspects and interaction effects. Basically, we find that a peer setting is able to compensate for lower output caused by a low level of task meaning. This is good news for organizations with a high level of functional segmentation or very specialized tasks. They can overcompensate the negative effect of a low meaning of the task by having employees work in the presence of co-workers.

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