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ABSTRACT

Quitting and Peer Effects at Work[*]

While peer effects have been shown to affect worker's productivity when workers are paid a fixed wage, there is little evidence on their influence on quitting decisions. This paper presents results from an experiment in which participants receive a piece-rate wage to perform a real-effort task. After completing a compulsory work period, the participants have the option at any time to continue working or quit. To study peer effects, we randomly assign participants to work alone or have one other worker in the room with them. When a peer is present, we manipulate the environment by giving either vague or precise feedback on the co-worker's output, and also vary whether the two workers can communicate. We find that allowing individuals to work with a co-worker present does not increase worker's productivity. However, the presence of a peer in all working conditions causes workers to quit at more similar times. When, *and only when,* communication is allowed, workers are significantly more likely to (1) stay longer if their partner is still working, and (2) work longer the more productive they are. We conclude that when workers receive a piece-rate wage, critical peer effects occur only when workers can communicate with each other.

JEL Classification: C91, D83, J63, J28, J81

Keywords: quits, peer effects, communication, feedback, experiment

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I. INTRODUCTION

Quitting is an important issue but its determinants have not received extensive research. Quitting lets an individual benefit from alternative opportunities but it usually also has costs, either monetary or moral, or both. There are also many reasons to believe that quitting is affected by social interactions and by observing others' quitting decisions. This is particularly the case when thinking about quitting addictive behavior. For instance, evidence suggests that it may be easier to stop smoking when other members of the reference group stop smoking (Nakajima 2007). Peer effects may also affect quitting in many other situations, and in particular in the work environment, which we study in this paper.

Labor economists have shown that quitting does not only depend on one's own alternative opportunities on the market but also on social comparisons. For example, Galizzi and Lang (1998) find that quits are negatively correlated with the average wage in the firm for similar workers. Stark and Taylor (1991) also find that the rank in the local income distribution is a good predictor of migration. One may also think about other possible social interaction effects on an individual's quitting decision. For example, for a given compensation scheme, the working time chosen by a worker may be influenced by the working time chosen by his co-workers or the decision to quit a job may be made easier if other employees have recently quit.

Recent behavioral studies have examined peer effects at work, but most of them have focused on productivity (Ichino and Maggi, 2000; Falk and Ichino, 2006; Mas and Moretti, 2009; Bandiera, Barankai and Rasul, 2005, 2007; Azmat and Irriberri, 2010; Charness, Masclet and Villeval, 2010). Not many have considered the influence of social comparisons on quitting (exceptions are Eriksson, Poulsen and Villeval, 2009 in both piece-rate and tournament environments; Fershtman and Gneezy, 2010 in racing tournaments, on the influence of others' performance on quitting decisions; Linardi and McConnell, 2009 on the impact of others' quitting decisions on the time spent volunteering for a charity).

The first aim of this study is to identify the influence of peers on the individual decision to quit a job or to remain at work. Do people work longer when they are working alone or in the presence of co-workers? We can think about peer effects on quitting as decreasing the marginal cost of quitting or, equivalently, as increasing the marginal cost of staying. The second aim is to tease apart several reasons for which peers may exert an influence on this decision. Peers may influence an individual's quitting decision through the comparison of one's own relative performance to that of co-workers, even when the incentive scheme is only based on absolute performance. Indeed, by comparing himself to a co-worker, an individual may quit because he feels discouraged if he performs less well and consequently earns relatively less than his co-worker (comparison effect). Peers may also influence the quitting decision simply through the example of co-workers quitting or staying (conformity effect or avoidance of a possible stigma associated with early quitting). Last, peers may influence the quitting decision because the presence of another person creates a better work environment. People may quit later if the presence of a co-worker creates a more pleasurable work environment (sociability effect).

It is difficult, however, to identify the existence of social interactions on behavior. Indeed, it has been shown that the use of survey data does not generally allow for a clean identification of endogenous interactions because it is hard to distinguish the different forms that interdependent behavior can take (Manski, 1993, 2000). The quitting behavior of an individual may depend on the behavior of his co-workers (employees tend to quit together because of social comparisons or of a willingness to conform), but it may also be influenced by the exogenous characteristics of the co-workers (exogenous social interactions) or by the presence of correlated effects (employees quit at the same time because they have similar unobserved characteristics or they are affected by similar shocks). In addition, there may be some estimation problems linked to the fact that others' decisions are likely to be endogenous especially in small groups (see Fortin *et al*., 2007): indeed, individuals tend to self-select within groups so that their unobserved characteristics are likely to be correlated, thus both the individual's and the group's behavior may be determined simultaneously. Although they do not solve all the identification problems, laboratory experiments may help in circumventing some of these difficult identification problems by allowing random allocation of individuals to treatments.

To study the influence of social interactions on quitting decisions, we designed a laboratory experiment in which participants perform a cognitive task and are compensated with a fixed wage plus a piece-rate scheme. The participants choose not only the intensity of their work effort but also when to quit working. There is a compulsory work period followed by an optional work period in which workers may choose to continue to work or permanently quit at any time.

To study peer effects, we randomly assigned all participants to one of four work environments. In the Single treatment, one participant at a time works alone in the laboratory, so the quitting decision cannot be influenced by, or influence, anyone else. We also designed three peer treatments in which two participants work separately but at the same time in the laboratory. In the No Communication – Vague Feedback (NCVF) treatment, the participant is not informed on his co-worker's current output but he can form a belief on this productivity and he can see if and when his co-participant quits working. In the No Communication – Precise Feedback (NCPF) treatment, each participant is continuously and precisely informed on his co-participant's productivity. In both of these non-communication treatments, workers are separated by a partition and are strictly forbidden to communicate in any way with each other. In the

Communication – Precise Feedback (CPF) treatment, in addition to receiving precise feedback on their co-worker's current score, the participants are allowed to communicate orally and are no longer separated by a partition. Comparing behavior between the Single treatment and peer treatments lets us measure the presence of positive or negative peer effects on productivity and quitting. It also lets us identify whether the presence of a co-worker, his productivity, when he quits, and communication affect productivity and the quitting decision.

We first measure the existence of peer effects on quitting by comparing the standard deviation of the quitting time within pairs and between pairs in each peer treatment and in hypothetical pairs generated through random allocation of participants from the Single treatment (as done in Falk and Ichino 2006, for identifying peer effects on production). We then provide evidence from a discrete choice non-parametric hazard model that presents estimates of the determinants of the decision to quit. Our main findings support the existence of significant, and sometimes dramatic, peer effects on the decision to quit. First, we find that having individuals work in the presence of another worker is not sufficient by itself to increase the total working time or productivity compared with a work environment in which individuals work alone. Indeed, when the two workers are not allowed to communicate, individuals tend to quit earlier than when working alone, especially when a worker has low ability. This suggests that either (even imprecise) relative comparisons in productivity or being in an environment where talking is not allowed discourage individuals from exerting a longer period of effort. The non-parametric hazard estimates suggest that the inability to communicate is driving the earlier quitting behavior. Second, a smaller standard deviation within pairs compared with the hypothetical pairs of the Single treatment further suggests that observing the co-worker quitting has an impact on one's own decision to quit. The hazard estimates confirm the importance of the presence of a co-worker as highly significantly decreasing a worker's decision to quit, but only in the communication condition. This evidence suggests that the non-pecuniary benefit of having a co-worker present, despite not affecting worker productivity, is critical to the labor supply decision.

Third, the most striking result comes from the treatment in which we allow the participants to communicate. Indeed, while we could expect that individuals would not communicate because communication might reduce productivity in a task requiring full concentration and in which help is of little use, we observe the opposite. All pairs communicate and the average output is higher than when workers were not permitted to communicate. Moreover, the average quitting time is higher than in the other treatments, especially for the first quitter. Further, the within-pair standard deviation in quitting time is lower than the between-pair standard deviation. Finally, the within-pair standard deviation is also lower in the communication than in the two non-communication peer treatments and, more importantly, than in hypothetical pairs formed from the Single treatment. This clearly suggests that allowing free communication between co-workers creates a more social and pleasurable environment; this in turn generates peer effects that exert a positive influence on total production.

The remainder of this paper is organized as follows. Section 2 presents the related literature. Section 3 details the experimental design and the procedures and derives our predictions. Section 4 reports our experimental results. Section 5 discusses these results and concludes.

II. RELATED LITERATURE

The study of peer effects at work has primarily focused on productivity, both theoretically (Kandel and Lazear, 1992) and empirically. In the latter perspective, Falk and Ichino (2006) designed an experiment in which participants received a flat wage to stuff envelops for four hours. The participants worked either alone or simultaneously with another worker. Falk and Ichino find that the average output is higher in their pair than single treatment, the within-pair outputs are quite similar, and the standard deviation of output is larger between than within pairs. They also show that peers have a bigger influence on the less productive workers. Finally, they find that the estimated peer effect on productivity is similar to a comparable estimate for employees of a large Italian bank reported in Ichino and Maggi (2000). Falk and Ichino do not explain, however, the mechanism by which peers influence productivity since they examine only one peer condition and there is no record of interactions between the workers while they were working.

Mas and Moretti (2009) study the extent to which peers influence super market cashiers' productivity. These employees are paid a flat wage and thus have an incentive to unload the workload on other workers. However, Mas and Moretti find that the introduction of more productive employees during a work shift generates positive spillovers. This is the case only when the spatial arrangement of the workspace allows employees to monitor one another visually, which suggests a role for social pressure. These results are related to a literature on interim feedback showing how information about relative performance influences effort through competitive preferences (e.g. Azmat and Irriberri, 2010; Charness, Masclet and Villeval, 2010).

Other studies examine peer effects on performance when performance pay is introduced. In these studies, the evidence is mixed. Bandiera, Barankay, and Rasul (2005) show that when a piece-rate pay scheme is in use and mutual monitoring is possible, negative spillovers between co-workers affect a worker's productivity. Bandiera *et al*. (2007) find that the presence of a friend working nearby increases productivity, whereas working next to a non-friend co-worker has no impact. Guryan, Kroft and Notowidigdo (2009) show that in golf tournaments in which partners are randomly assigned the partner's ability does not affect performance. In a laboratory setting, Eriksson, Poulsen and Villeval (2009) analyze the influence of feedback about co-worker's productivity on the individual performance when workers are paid a piece-rate payment scheme and when they participate in a competitive tournament. They identify a negative quality peer effect as the relative performance feedback reduces the quality of the low performers' work, possibly due to stress. They also find some peer effects in tournaments as the frontrunners do not slack off and the participants falling behind almost never quit the competition, even when lagging significantly behind. This suggests that there may be a moral cost of quitting.

Except for the last study, not much attention has been paid so far to the possible influence of others on quitting. Fershtman and Gneezy (2010) manipulate the level of incentives in tournaments in a field experiment in schools. Students were asked to run a race, either side-by-side or alone. The authors show that there may be a trade-off between performance and quitting in strong incentives tournaments. They find that while low incentives do not give rise to quitting, (like in Eriksson *et al*., 2009), higher incentives increase both participation and performance but also lead to more drop-outs, especially when children run side-by-side. These behavioral analyses explain the quitting behavior in relation to the level of incentives through the comparisons of relative abilities. However, participating with others in a task may also influence quitting through the mere presence of others or the quitting behavior of others. Consistent with this latter peer effect, in an experimental study of time spent volunteering for a charity in which participants could stop volunteering when they chose, Linardi and McConnell (2009) show that individuals avoid being the first to stop but are more likely to stop once others have stopped. In the context of volunteering, social pressure and moral costs of quitting may change substantially from being the first to a later quitter.

Our study differs from the previous ones in several respects. First, we consider a piece-rate payment scheme so that in the absence of peer effects, relative performance should be irrelevant to the quitting decision. Second, we measure the influence of peers both on productivity and on working time in the absence of external beneficiaries. Third, and most fundamentally, we attempt to identify the reasons for which peers may influence the decision to quit by manipulating not only the presence of a co-worker, but also the feedback on relative performance and communication opportunities.

III. EXPERIMENTAL DESIGN

3.1 Structure of the experiment

We initially collected demographic information. We then read aloud instructions for the rest of the experiment that included a detailed description of the computerized work task (see Appendix A). The real effort task required participants to add sets of four two-digit numbers and then multiply the sum by three. The numbers were randomly generated and displayed on the computer screen in a column. The participant had to submit by entering the number they chose for their answer and then clicking a "submit" button. The use of paper, pencil, or calculator was strictly forbidden to increase the effort of the task. This task requires substantial focus and concentration to be successful. After submitting each answer the participant was immediately told whether her answer was correct or incorrect. If the answer was correct, the score would increase by one unit. Regardless of whether the answer was correct or incorrect, a new series of numbers was generated automatically and displayed on the participant’s screen.

Once the instructions were completed, the experimenter checked that each participant understood the instructions by means of a quiz. To avoid experimenter demand effect, the experimenter left the room permanently. The instructions explained that the experimenter would not return.

The first part of the real effort task was designed to measure each participant's ability. In this initial part of the work, participants had three minutes to solve as many problems as they could in which each correct answer could pay 10 points (= €0.33). Each participant was continuously informed of the number of problems he had correctly solved. At the end of the experiment, after completing all the tasks, participants had a 50% chance to get paid for their performance during this first three minute task. The relatively high piece-rate during the first three minutes was intended to measure a benchmark for each worker's potential maximum output level. To reduce potential wealth effects from the first three minutes, participants were not told whether they earned the money from the initial three minute task until they had made their quitting decision.

After completing the initial three minute task the main part of the experiment began and consisted of performing the same addition-multiplication task. During the remainder of the experiment the screen always displayed the elapsed time since the beginning of this part of the task, the participant's current score (which incremented by one with each correct answer), and her cumulative earnings for this part of the experiment. The score was also represented visually by a cursor bar that increased in length after every five additional correct answers. Participants were paid a combination of a flat wage of 300 points (€10) and a piece-rate of one point for each correct answer.[1] There was no penalty for submitting an incorrect answer.

The main part of the task was divided into a compulsory 15 minute working time followed by an additional 60 minutes in which the participant could decide at any time to stop working. The maximum total working time of 75 minutes (including the compulsory working time) was common information. If the worker chose to stop, the decision was irreversible. To quit working,

[1] This was purposely a modest piece-rate: on average a participant produced 1.85 correct answer per minute in this part of the experiment, corresponding to a piece-rate of approximately €3.50/hour. We are interested in studying when participants quit and so we did not want to introduce incentives to stay too long.

the participant had to press a « stop » button. After confirming this decision, his final score was immediately sent electronically to the person in charge of payments (different from the initial experimenter). The participant was informed to proceed immediately to the payment room. In the payment room, he was invited to indicate his reasons for quitting the task at this precise moment.

3.2 The four treatments

The ***Single*** treatment is our pure baseline condition for individual decisions without any potential for peer effects. In the Single treatment only one participant at a time was invited to a session and the participant worked alone in the computer room for the entire work time (see Appendix B).

We investigate three peer treatments. The instructions, the task and the payment rules were identical to the Single treatment. The key difference between the three peer conditions and the Single treatment is that there were two individuals at the same time in the same room. The two participants received the same set of problems in the same order but the numbers were displayed in different orders. Each participant worked at his own pace. Participants in all three peer treatments received no feedback on the performance of their co-worker at any point for the initial three-minute task. The three peer treatments differ from each other in (1) the *feedback* participants received regarding their co-worker's performance during the main task (vague or precise) and (2) whether the co-workers could communicate with each other.

In ***No Communication - Vague Feedback*** (**NCVF**, hereafter), two desks were arranged in the room such that they were separated by a partition to prevent the co-workers from communicating or seeing each other while they were working (see Appendix B). However, each participant was able to see his co-worker if his co-worker left the room once he had quit working. Oral communication was explicitly forbidden. The participants were informed that the microphones on their desks were turned on and connected to the experimenter's office.[2] They were also informed that any attempt to talk would be heard and would lead to the immediate end of the experiment for both of them. Identical to the Single treatment, they were continuously informed of their own score. In this treatment participants received no explicit information on the score of the co-worker. Nonetheless, we call this treatment "vague feedback" because each co-worker may form a belief on his co-worker's productivity by hearing the frequency that his co-worker clicks on his mouse.[3]

The ***No Communication - Precise Feedback*** (**NCPF**, hereafter) treatment is identical to the NCVF treatment except that participants in NCPF were also given the precise current score of their co-worker. Specifically, a counter was updated each time the co-worker submitted a correct answer and a second cursor visually showed the increase in the co-worker's score after a new set of five problems had been solved correctly.

Finally, the ***Communication – Precise Feedback*** (**CPF**, hereafter) treatment was identical to the NCPF treatment except that communication in CPF was allowed without any restrictions. Participants were informed that their conversations would be recorded but that it would not be listened to during the experiment. To avoid biasing the nature of the conversation between co-workers, the instructions avoided suggesting any topics or indication that they should discuss:

> *"Throughout the session you are allowed to communicate with the other participant as much as you like. The communication is recorded but is not listened to directly. The recording will not allow anyone to identify you."*

[2] A microphone was also present in the Single treatment, but it was not used.
[3] This number of clicks gives biased information since it may differ from the number of correct answers. As there is no visual monitoring device, we cannot control whether a participant stands up and indicates his current score to his co-worker with gestures – but one can reasonably assume that this was very unlikely.

3.3 Predictions

All the participants were invited to participate from the same subject-pool. Therefore, on average ability to add and multiply, economic necessity, opportunity costs, intrinsic utility for the task and any other factors that may affect choices should be identical across treatments. Therefore, if there are no peer effects, then behavior in the four treatments should be identical:

Prediction 1. If there are no peer effects, then the distribution of productivity and quitting time should be the same across the Single and three peer treatments.

Now suppose there are peer effects. Falk and Ichino (2006) propose that peer effects affect the marginal cost of effort. They are positive (negative) when observing another worker increasing his output reduces (increases) the individual's marginal cost of effort.[4] We further propose that peer effects may similarly affect the marginal cost of quitting. While the co-worker continues to work, peer effects on quitting are negative (positive) by increasing (decreasing) the marginal cost of quitting; if the co-worker continues to work, a worker's decision to quit includes the added cost of being the first to quit. However, peer effects on quitting reverse and become positive (negative) when observing a co-worker quitting reduces (increases) the individual's marginal cost of quitting; once the co-worker has quit, a worker's decision to quit now includes the added benefit of not being the first to quit. Thus, peer effects may cause the first co-worker to quit later than workers working alone. Peer effects may also cause the second worker to quit sooner after his co-worker quits than the time between two workers quitting who were working alone. Thus, while the overall prediction of peer effects on the quitting time of the second worker to quit is ambiguous, we should observe *i*) a later quitting time of the first worker to quit in the peer

[4] In our experiment, workers are given large latitude in their working time. Therefore, peer effects on production are less likely to be bounded by corner solutions than in other experiments in which they cannot significantly influence effort if workers already exert a maximum effort (see Eriksson *et al*., 2009).

conditions than the first worker in the randomly generated pairs in the Single treatment, *ii*) a lower within-pair standard deviation of quitting time than the between-pair standard deviation in the peer treatments and *iii*) a lower within-pair standard deviation of quitting time in the peer treatments than with randomly generated pairs of participants in the Single treatment.

Prediction 2. If there are positive peer effects on quitting, then the time the first participant quits should be later in the peer than in Single treatment.

Corollary. The mean difference in quitting time within pairs of co-workers in the peer treatments should be smaller than either the between-pair differences in the peer treatments or the time between a randomly composed pair of participants in the Single treatment.

If peer effects on quitting are mainly conveyed by relative comparisons on productivity, then peer effects, if any, should be larger when the feedback is more precise, *i.e*. in NCPR compared with NCVF. Indeed, the less well performing worker should quit sooner than the better performing worker in the NCPF treatment, and the latter should tend to stay longer as he knows he is a more able worker. But if the peer effects on quitting are mainly conveyed by observing that the co-worker is quitting, then the feedback precision should have little effect.

Prediction 3. If peer effects are conveyed by relative productivity comparisons, then they should lead to more within-pair differences in the quitting time in NCPF than in NCVF.

To maximize payoffs, workers should have no reason to communicate. However, communication may allow for either positive or negative peer effects. On the one hand, communication may increase the marginal cost of effort and decrease the marginal cost of quitting: the workers may slack off in order to communicate, thus losing concentration and performance falls, and so may quit earlier than when no communication is allowed. On the other hand, communication may reduce the marginal cost of effort and increase the marginal cost of quitting if it contributes to learning to perform the task better. Further, the option to communicate may lead to a more pleasurable environment than when no communication is allowed. We thus derive two contrasting predictions.

Prediction 4a. Communication reduces workers' productivity and leads to earlier quitting than when no communication is allowed.

Prediction 4b. Communication increases workers' productivity and leads to later quitting than when no communication is allowed.

We further hypothesize that the negative effect of communication (4a) seems less plausible since workers can (optimally) choose to not communicate if they anticipate negative consequences on their productivity that would lower their overall utility during the work time.

3.4 Procedures

The experiment was conducted at the GATE laboratory, Lyon, France, using the Regate software (Zeiliger, 2000). In total, 104 undergraduate students from local business and engineering schools were recruited via the ORSEE software (Greiner, 2004). In the peer treatments, we were careful to avoid inviting students from the same school to minimize the risk that they knew each other. A between-subjects design was used. Twenty-six students participated in each of the four treatments for a total of 65 sessions with 26 Single sessions and 13 sessions in each of the three peer conditions. Each subject participated in exactly one condition. Sessions lasted on average 75 minutes each. The experimenter was the same person for every session.

Upon arrival, participants were required to leave their belongings in the payment room so that no pen, paper, cell phone or calculator would be in the laboratory. In the no-communication treatments, the experimenter listened from a control room while the participants were performing the task to make sure that they did not communicate. The experimenter never heard any communication. A secretary who was not aware of the content of the experiment paid the participant in cash. The participants earned on average €13.85 (€14.79 in the Single treatment, €14.25 in the CF treatment, €13.19 in the NCVF treatment and €13.15 in the NCPF treatment).

IV. RESULTS

We first present summary statistics. We then examine whether peer effects influenced the productivity of workers. Next, we show evidence of the peer effects on quitting by analyzing the within-pair and between-pair standard deviations of the quitting times. Finally, we analyze the determinants of quitting behavior using duration models.

4.1 Summary statistics

Table 1 provides descriptive statistics on quitting time and productivity by treatment. To compare first and the second quitter statistics in the peer treatments with the Single treatment, we generated 676 (26*26) hypothetical pairs matching each participant with each other in the Single treatment. This allows us to identify first and second quitter statistics in the Single treatment where no peer effects were possible.

(*Table 1 about here*)

Regarding first quitting times, Table 1 shows that the behavior in the two no-communication treatments, NCVF and NCPF, are remarkably similar, hence throughout this discussion we will refer to them jointly as the no-communication conditions. Table 1 indicates that quitting times are highest in the communication treatment and lowest in the no-communication treatments. Moreover, participating in the communication treatment *i*) leads the first quitter to quit much later than in the other treatments, while the second worker quits no later than in the Single treatment; *ii*) reduces the within-pair difference in the quitting time; and *iii*) increases the share of participants who quit together (more than twice as likely as in the other three conditions).

Most of these results are corroborated by Figures 1a and 1b that plot the cumulative frequency of the quitting times of the first and second quitters, respectively. To determine who quit first and second in the Single treatment we use the hypothetically matched pairs. These figures also show that the profile of quitting times differs somewhat across treatments. In particular, in the two no-communication peer treatments there appears to be a substantial amount of quitting in the first several minutes after the compulsory work period is completed (see Figure 1a). For instance, within three minutes after the compulsory work period had finished over 50% of first quitters had quit in the no-communication treatments whereas under 25% had quit in the Single and CPF treatments.

(*Fig. 1a and 1b about here*)

Regarding performance, Table 1 shows that the mean score during the compulsory working time is similar across the four treatments and in all treatments scores are lower for those who quit first compared to those who quit second. However, the communication treatment distinguishes itself from the others in that the final score of the first quitters is between 51% and 102% higher than in the other treatments. Given the similar productivity during the compulsory time, the higher final score in the communication treatment suggests that communication's primary impact is to cause first quitters to stay longer rather than become more productive.[5] The following analyses will confirm this conclusion.

4.2 Productivity during the compulsory work time

While researchers have investigated the existence of peer effects on productivity when workers are paid a flat wage, we investigate whether peer effects also exist when people are paid a piece-rate. We examine peer effects during the compulsory 15 minute work time before selection factors are introduced due to quitting behavior. Table 1 shows that during the compulsory work time there are on average only small differences in productivity (scores) between the single worker condition and the pairs treatments, ranging from -7 percent to +3 percent. Formal analyses will show that these differences are insignificant.

Table 2 presents OLS regressions (with robust standard errors clustered at the pair level) that examine the effect of the peer treatments on workers score during the compulsory 15 minute work period. Column 1 shows that ability measured by each participant's score during the initial three-minute task (that was identical across all treatments) strongly predicts individual performance.[6] Note that ability was measured under identical conditions across all four

[5] All the participants in all 13 communication pairs talked with each other. Six groups exchanged information on how to do the task. For example, "First I write the sum and then I write the multiplication's result and cancel the sum's result. It is faster like that." Three of these six groups exchanged advice during the initial three-minute task. Four groups exchanged advice during the compulsory 15-minute task (one of these four groups started exchanging advice during the 3-minute task). However, no group exchanged advice after the compulsory 15–minutes, suggesting that any gains in productivity due to communicating ideas on the task should have been primarily realized by the compulsory time. In addition, six of the 13 groups spoke primarily about topics entirely unrelated to the experiment. For example, "Where do you come from?" Interestingly, given the task involved addition and multiplication by three, all the groups spoke about the difficulty of the task. For example, " I am so bad in mental calculations," and "I have not done calculations since primary school."

[6] We find a potentially surprising gender difference. Related tasks adding two five-digit numbers (e.g. Niederle and Vesterlund, 2007) and Slonim and Garbarino (2009)) find no gender differences in productivity. However, note that since we control for Ability, the variable Male estimates how behavior not captured by individual differences in Ability differs between men and women. Hence, the Male parameter estimates indicate that men are significantly more likely than women to be *less productive in the compulsory than initial three minute higher stakes (and riskier) work period.* Thus, the Male parameter estimates do not indicate that men were overall less productive than women, but rather indicate that men were relatively less productive than women in the compulsory

conditions, so it controls for individual differences that explains nearly 44 percent of the variation in productivity ($R^2 = 0.439$) in the compulsory scores, and thus reduces variation in scores to better estimate treatment effects.

(*Table 2 about here*)

The models in the subsequent columns show that while directionally the peer treatments positively affect performance during the compulsory period, in no condition does the effect reach the level of significance (p>.20 in all models). Columns 2'-4' investigate whether the peer treatments had a distinct effect on workers with higher or lower ability by interacting the ability variable with treatment variables. In contrast to the results of Falk and Ichino (2006), the current estimates show no significant difference in the effect of ability across treatments.[7] Thus, while some participants exchanged advice in the CPF treatment (see footnote 7), the advice did not improve productivity during the compulsory period. One possible reason the current results differ from Falk and Ichino is that peer effects on productivity need a longer working period than 15 minutes to express themselves. Another possible reason is that workers in the current study received piece rate wages which may have pushed them to higher effort and thus reducing any potentially positive peer effects on productivity.

This analysis leads to our first result that supports prediction 1 with regards to productivity.

Result 1. There is no significant difference in productivity during the compulsory period when workers work with or without the presence of another worker.

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than initial work period. Moreover, in comparison to the previous studies (Niederle and Vesterlund 2007, Slonim and Garbarino 2009), the current task differs in many ways such as (1) participants also needed to multiply the sum by three, (2) the current setting with a French rather than US student population and (3) a lower wage per correct answer. There were 60 male and 44 female participants in the experiment.

[7] Sample size is unlikely to explain the difference in results since we examine 39 pairs across our three peer treatments whereas Falk and Ichino (2006) examined 8 pairs. There are, however, many differences in our two studies, such as fixed vs. piece rate, stuffing envelopes vs. adding numbers, four-hour work vs. a 15 minute compulsory work time. Nonetheless, our results are directionally the same as Falk and Ichino.

4.3 Within-pair and between-pair heterogeneity in quitting time

Our first method to formally study the existence of positive peer effects on quitting is to examine whether the quitting time is more similar within than between pairs. In NCVF the average within-pair standard deviation (SD, hereafter) is 919 seconds while the average between-pair SD is 1,247 seconds. The corresponding values are 969 seconds and 1,228 seconds respectively in the NCPF treatment. The difference between within and between pair quitting times is even larger when communication is allowed: in CPF the average within-pair SD is 569 seconds while the between-pair SD is 1,233 seconds. Note that the between-pair SD is quite similar across all three peer treatments, whereas the within-pair SD is much lower when communication was allowed.

Our second method to examine positive peer effects is to test whether the within-pair SD of the quitting time is lower in the peer treatments than in hypothetical pairs generated by the random allocation of the participants in the Single treatment. We should also observe that the between-pair SD of the quitting time is higher in the peer treatments than in the same hypothetical Single treatment pairs. To test this, we proceed as follows. We generate and select randomly 30,000 configurations of 13 hypothetical pairs formed with the 26 participants of the Single treatment.[8] In each hypothetical pair, we first compute the within-pair SD, given by the absolute value of the difference in the quitting time expressed in seconds between the two co-workers, divided by the square root of 2. We then compute the mean within-pair SD for each possible configuration of the 13 pairs. Figure 2a plots the Kernel density of the within-pair SD for the 30,000

[8] In the rest of the paper, we have generated hypothetical pairs in the Single treatment by simply matching artificially each participant with each participant in this treatment (26*26). However, in this section, to study the standard deviations more extensively, we considered the total number of possible configurations of 13 pairs in the Single treatment, which is 7,905,853,580,625 configurations (25*23*21*...*1). For obvious computing time constraints, we have selected only a fraction of these hypothetical pairs. We believe, however, that this number of observations provides sufficient power to test our hypotheses. The choice of 30,000 configurations is arbitrary.

configurations. Next, we calculate the within-pair SD of the quitting time for each true pair in each peer treatment. Thus, for each pair treatment, we obtain one mean value of the within-pair SD for the true pairs that are represented by a vertical line in figure 2a. We proceed similarly for the analysis of the between-pair SD; we first calculate the mean quitting time in each hypothetical pair of the Single treatment and then for each of the 30,000 configurations we compute the standard deviation between the hypothetical pairs. Figure 2b displays the Kernel density of the between-pair SD for the 30,000 configurations obtained with the hypothetical pairs. Next, we calculate the average quitting time for each true pair in each peer treatment and the corresponding SD of these values. Thus, for each peer treatment, we obtain one value of the between-pair SD for the true pairs that are represented by a vertical line in figure 2b.

Figures 2a and 2b show that in each peer treatment the within-pair SD lies on the left of the within-pair SD distribution for the hypothetical pairs in the Single treatment, while the between-pair SD lies on the right of the distribution for hypothetical pairs. The difference is particularly striking when communication is allowed. In the CPF treatment, the average within-pair SD for the true pairs is lower than all 100% of the observations for the hypothetical pair configurations (thus, $p<.001$). Similarly, the between-pair SD is higher than 99.8% of the observations for the hypothetical pair configurations (thus, $p<.001$).[9]

(*Fig. 2a and 2b about here*)

This analysis of quitting times leads to the following results that reject Prediction 1 and supports Prediction 2 and its corollaries:

Result 2: We find evidence of peer effects on the quitting decision. Indeed:

[9] The percentages for the within-pair SD are 98.40% in the NCVF treatment ($p<.02$) and 97.95% in the NCPF treatment ($p<.03$). The percentages for the between-pair SD are 99.81% in both the NCVF and the NCPF treatments ($p<.001$).

Result 2a: The difference in quitting time is smaller within pairs than between pairs.

Result 2b: The difference in quitting time is smaller within pairs in the peer treatments than in hypothetical pairs generated by the random allocation of the participants in the Single treatment.

Result 2c: The difference in quitting time is larger between pairs in the peer treatments than in the hypothetical pairs.

4.4 Determinants of the continuing to work vs. quitting decision

We estimate the decision to continue working or to quit with a non-parametric discrete choice survival model (Singer and Willett, 1993). The dependent variable $y_{i,t \mid \text{work in } s}$ equals 1 if worker i continues to work at a given time *t* and equals 0 otherwise, conditional on worker i working at time *s*, *s* < *t*. The survival function over the 60 minutes in which participants could quit after the compulsory time does not fit any conventional hazard model function (e.g., exponential) nor does it appear to be the same across the treatments, hence we estimate non-parametric effects of time on the decision to continue to work.[10] Further, since we have only 26 participants per treatment, we can only estimate a minimum number of time effects. Based on the patterns of data observed in Figure's 1a and 1b and Kaplan-Meier survival estimates (see Appendix C), we assume three distinct time periods; an initial (early) period from minute 15 to 25 in which participants could quit immediately, a (middle) period from minute 26 to 40 and a (late) period covering the last half of the time from minute 41 to 71 in which workers could quit.[11] The number of participants working at each time and the (conditional) percent that continued to work

[10] For the Single treatment, the conditional survival function has an inversed "U" shape. For the two non-communication peer treatments, it is slightly increasing over time and for the communication treatment it is slightly decreasing over time. Table 3 shows this pattern most clearly. Moreover, the intercepts for the initial survival rates are over 20% different between the peer treatments with or without communication.

[11] We exclude the final four minutes (72-75) since at this time workers may quit for reasons associated with the impending forced ending time at 75 minutes. Alternative choices for this final time do not change the interpretation of any of the results.

who were working at the previous time are shown in Table 3.

(*Table 3 about here*)

Table 3 shows that the two no-communication peer treatments have lower percents of participants who continue to work than the Single treatment in the initial and middle time periods. The communication treatment has a higher survival of participants compared to the two no-communication treatments and to the Single treatment at all times except in the middle period when the Single treatment workers exhibit the highest survival rate.

Table 4 presents estimates of the determinants of choosing to continue to work (survival) at each time t conditional on working at time s as a function of the treatment, whether the partner continued to work up to minute t-1 (1 if yes, 0 otherwise), the three distinct times t = 25, 40 and 71 that were described above, and the normalized average productivity at time s (normalized (score at s / s)). We use the normalized score so that the estimate reports the effect of a one-standard deviation shift in productivity. To compare how the presence of a partner affects the decision to continue to work in the peer treatments to the Single treatment, we include the data from the 26*26 hypothetical pairs generated in the Single treatment, as explained before. These hypothetical pairs provide a baseline to control for how partners would affect behavior when we know that any estimated effect would be strictly spurious.

(*Table 4 about here*)

Column 1 shows that participants in the Single treatment are marginally significantly (at the 10% level) more likely to keep working the higher their average productivity. This result suggests that labor supply is upward sloping since participants who earn more per minute at any given time were more likely to continue to work. Not surprisingly, these estimates also show that whether a worker's (hypothetical) partner is currently working has no effect on whether he continues to work. Consistent with the inverse "U' shaped survival rates observed in Table 3 for the Single treatment, the estimates also show that Single participants are marginally significantly more likely to continue working in the middle than early period of the optional work time and less likely to continue working in the later than early period.

Column 2 presents the estimates for all three peer treatments. These estimates show that a worker's average productivity has a highly significant positive effect on continuing to work (p<.01). This result suggests, in contrast to the Single treatment where productivity only had a marginal effect, that having another worker present may provide participants with a potential benchmark to assess whether their own productivity is relatively high (so they are more likely to continue working) or relatively low (so they are less likely to continue working). Thus, another effect of working with a peer is that it tends to reduce early quitting of high productivity workers and late quitting of low productivity workers. Column 2 also shows that if the co-worker is working, the participant is marginally significantly more likely to continue to work, consistent with the more similar quitting times discussed above. Finally, the probability of survival falls slightly over the three time periods, but the differences between the times is not significant.

Columns 3-5 present the critical estimates comparing the peer to the Single treatments. The Single treatment is compared to all the peer treatments in column 3, to the two no-communication treatments in column 4 and to the communication treatment in column 5. Column 3 shows that while the average productivity has a larger effect on continuing to work in the peer treatments, the difference is not significant from the Single treatment. Column 3 further shows that if the co-worker is working then the participant is marginally significantly more likely to continue to work in the peer treatments. Finally, compared to when the Single worker quits, participants in the peer treatments are less likely to keep working during the early period (marginally) and the middle period, all else equal. However, the subsequent estimates in Columns 4 and 5 will show that there are significant distinct effects on survival when peers can communicate and we thus turn to these models that estimate these unique effects for a richer understanding of peer effects.

Column 4 shows that there are almost no differences in the determinants of workers' decision to quit or continue to work between the no-communication treatments (NCVF and NCPF) and the Single treatment. Perhaps surprisingly, the effect of whether the partner is working is not significantly different in the no-communication and Single treatments. However, given that participants could not interact with each other or even see each other, the critical aspect of peers when paid a piece rate wage is not their mere presence, but rather the ability to interact with each other. The estimates in Column 5 confirm this conjecture for the critical role of communication.

Column 5 shows a very different story for peer effects if co-workers are able to communicate. First, the estimates indicate that participants who can communicate are significantly more likely to continue to work if their partner is still working compared to the Single treatment. The marginal effects shown in column 5M indicate that if a co-worker continues to work then a participant is 14.7 percent more likely to continue working at any time. This suggests that communication may either reduce the non-pecuniary cost of effort or increase non-pecuniary benefit of working enough to entice workers to persist longer in their work. The estimates further show a strong (and highly significant) effect of productivity on whether participants continue to work; *ceteris paribus*, the more productive the participant, the more likely they are to continue working if they can communicate with their co-worker than if they are working alone in the Single treatment. The marginal effect in column 5M shows that a worker with one standard deviation higher productivity than another worker is 66 percent more likely to keep working in the communication than Single treatment. More generally, the marginal effects in Column 5 indicate that an above average productivity worker in the communication treatment compared to the Single treatment will be significantly more likely to keep working at any time. Unless the worker has well below average productivity and his co-worker has quit working, the worker in the communication condition will be more likely to continue working than the solo worker in the Single treatment.

Column 6 estimates the effect of communication compared to the no-communication peer treatment (the bottom third of Table 4). It shows nearly identical results to when we compared the effects of communication with the Single treatment in Column 5. Thus, the effect of peers on the duration of labor supply and quitting when workers are paid a piece rate wage depends critically on the ability of peers to communicate with each other rather than on the mere presence of another worker or the precision of feedback workers receive about their co-workers.[12]

We summarize below these findings that reject Predictions 3 and 4a and support Prediction 4b.

Result 3. The possibility to communicate with a peer leads to later quitting decisions.

Result 3a. Compared to the Single treatment with hypothetical pairs, when a co-worker is still working then the participant is more likely to continue to work in the peer treatments.

Result 3b. Peer effects are not driven by relative productivity comparisons, as there is no

[12] For robustness we examined a variety of alternative model specifications. First, we examined the importance of the specific three time periods. We varied, one at a time, the initial time period (to end between 20 and 30 minutes), the middle time (to end between 40 and 50 minutes) and the later time period (to end between 66 and 74 minutes) and found that all of our results were qualitatively unchanged. Second, we examined whether adding additional times might improve the fitness of the model. However, given only 26 participants in each treatment, adding one additional time did not offer any significant improvement, and including more than four time periods often led to multi co-linearity of the parameter estimates.

difference in the decision to quit between no-communication peer treatments and the Single treatment. Peer effects on quitting are entirely driven by the possibility to communicate.

Result 3c. Communication influences the more productive workers who are more likely to continue to work if their partner is still working compared to a Single worker.

V. CONCLUSION

A positive influence of peers on workers' productivity has been found in various environments when workers receive a flat wage for repetitive tasks. We have little knowledge of the influence of peers in tasks requiring higher cognitive abilities or when working under other compensation schemes. In addition, the influence of peers on the duration of working time and on the decision to quit has remained almost unexplored. The aim of the current paper was to investigate the existence of peer effects on the voluntary decision to quit and the role of feedback and communication between peers.

Our findings indicate that in the context of a demanding cognitive task paid by a piece-rate wage, having co-workers present does not affect productivity for a fixed time. This differs from previous results in the literature, and this is probably due to a combination of both the cognitively intense nature of the task and the piece-rate compensation scheme. In contrast, we find evidence of peer effects on quitting decisions. Iin the presence of a co-worker, participants are more likely to quit at the same time than would be expected based on the Single treatment quitting times without any peer effects. This behavior is most pronounced when workers can communicate with each other. We also find that, relative to workers working alone or together but who cannot communicate, workers who can communicate are more likely to work longer overall; they work longer the more productive they are; and they work longer if their co-worker remains working. While workers within the same pair tend to quit at the same time, the presence of a peer only increases the total amount of working time when workers can communicate. When workers cannot communicate, the first worker to quit tends to quit earlier than workers in either the Single or Communication treatment, and this then drove their partner to also be more likely to quit early. Indeed, by comparing himself to a co-worker, an individual may quit because he feels discouraged if he performs less well and consequently earns less than his co-worker (comparison effect). Thus, the mere presence of a co-worker is not sufficient to increase the time working; allowing communication is critical to cause workers to work longer. Finally, the presence of another worker, regardless of communication, appears to have one benefit over the Single treatment in that it reduces the number of workers with the lowest productivity from working a long time. Apparently, feedback on the other worker's productivity, even noisy, provides enough of a signal to poorly performing workers that they are not earning as much as others which causes them to quit early.

Overall, this experiment shows that when workers work with peers present, permitting the workers to communicate results in a higher overall effort than when communication is not allowed due to the social effect of making the work more pleasant (or less unpleasant). We also found that when workers can communicate, they are most likely to quit together. This suggests that the presence of a co-worker may set a relatively higher reference point for the work environment, and then when a co-worker quits, the relative loss in the quality of the work environment may be sufficient to lower the overall utility, which is sufficient to cause the remaining worker to also quit at the nearly identical time. One possible implication is that a negative shock in a work environment may lead to a contagion in the decisions to quit, as we have found that observing a peer quitting increases the likelihood of one's own quitting decision.

REFERENCES

Azmat, G. and N. Iriberri (2011), "The Importance of Relative Performance Feedback Information: Evidence from a Natural Experiment using High-school Students," forthcoming in *Journal of Public Economics*.

Bandiera O., I. Barankay I., and I. Rasul (2005). "Social Preferences and the Response to Incentives: Evidence from Personnel Data," *The Quarterly Journal of Economics* 120 (3), 917-962.

Bandiera O., I. Barankay I., and I. Rasul (2007). "Social incentives in the workplace," University College London, mimeo.

Charness, G., D. Masclet, and M.C. Villeval (2010). "Competitive Preferences and Status and Incentive: Experimental Evidence," IZA Discussion Paper 5034, Bonn.

Eriksson, T., A. Poulsen, and M.C. Villeval (2009). "Feedback and Incentives: Experimental Evidence," *Labour Economics* 16 (6), 679-688.

Falk, A., and A. Ichino (2006). "Clean evidence on peer pressure," *Journal of Labor Economics* 24 (1),39-57.

Fershtman C., and U. Gneezy (2011). "The trade-off between performance and quitting in high-power tournaments," forthcoming in the *Journal of the European Economic Association*.

Galizzi, M. and K. Lang (1998). "Relative Wages, Wage Growth and Quit Behavior," *Journal of Labor Economics*, 16, 367-391.

Greiner, B. (2004). "An Online recruitment System for Economic Experiments," *Kurt Kremer, Voler Macho (eds). Forschung und wissenschaftliches Rechnen, GWDG Bericht 63, Göttingen: Ges. Fr Wiss. Datenverarbeitung,* 79-96.

Guryan J., K. Kroft, and M. Notowidigdo (2009)." Peer effects in the workplace: Evidence from random groupings in professional golf tournaments," *American Economic Journal: Applied Economics* 1 (4), 34-68.

Haraguchi K.H., Waddell, G.R. (2007). "Interdependency in performance," IZA Discussion Paper 2944, Bonn.

Ichino, A. and G. Maggi (2000). "Work environment and individual background: Explaining regional shirking differentials in large Italian firm," *The Quarterly Journal of Economics* 115 (3), 1057-1090.

Kandel, E. and E.P. Lazear (1992). "Peer Pressure and Partnerships," *Journal of Political Economy* 100 (4), 801-817.

Linardi, S. and M.A. McConnell (2009). "No excuse for good behavor," CALTECH, mimeo.

Manski, C.F. (1993). "Identification of Endogenous Social Effects: The Reflection Problem," *Review of Economic Studies* 60(3), 531-542.

Manski, C.F. (2000). "Economic Analysis of Social Interactions," *Journal of Economic Perspectives* 14(3), 115-136.

Mas, A., and E. Moretti (2009). "Peers at work," *American Economic Review* 99 (1),112-145.

Nakajima, R. (2007). "Measuring Peer Effects on Youth Smoking Behavior," *The Review of Economic Studies*, 74(3), 897-935.

Niederle, M., and L. Vesterlund (2007). "Do Women Shy Away from Competition? Do Men Compete too Much?" *The Quarterly Journal of Economics*, 122(3), 1067-1101.

Singer, J., and J. Willett, (1993). "It's about Time: Using Discrete-Time Survival Analysis to Study Duration and the Timing of Events," *Journal of Educational Statistics*, 18(2) 155-195.

Slonim, R., and E. Garbarino (2006). "Increases in trust and altruism from partner selection: experimental evidence," *Experimental Economics* 11(2), 134-153.

Stark, O., and J.E. Taylor (1991). "Migration Incentives, Migration Types: The Role of Relative Deprivation," *The Economic Journal* 101, 1163-1178.

Zeiliger R. (2000). "A Presentation of Regate, Internet Based Software or Experimental Economics," http://www.gate.cnrs.fr/~zeiliger/regate/RegateIntro.ppt., GATE, Lyon.

Table 1. Summary statistics by treatment

Treatment	Single	NCVF	NCPF	CPF
Quitting time (in seconds)				
- all participants	3007.19	2539.73	2476.19	3167.19
	(1480.44)	(1542.70)	(1538.83)	(1414.44)
- first quitters	2178.56	1889.62	1790.77	2765.08
	(1342.26)	(1488.76)	(1490.14)	(1574.27)
- second quitters	3774.44	3189.85	3161.62	3569.62
	(1083.78)	(1351.30)	(1301.88)	(1157.67)
Within-pair difference in quitting	1593.52	1300.23	1370.85	804.54
time	(1295.38)	(1337.25)	(1312.99)	(1221.59)
% quitting as soon as allowed	15.38	11.54	26.92	3.85
% quitting at the end	3.85	11.54	7.69	11.54
% quitting together	19.66	23.08	23.08	53.85
Average score in preliminary period (3 minutes)				
- all participants	3.35 (2.33)	2.62 (2.30)	2.5 (2.25)	2.58 (1.60)
Average score in compulsory time (15 minutes)				
- all participants	23.77 (11.22)	22.77 (9.18)	22.04 (11.55)	24.42 (8.24)
- first quitters	22.68 (9.46)	19.08 (5.99)	20.38 (12.12)	23.15 (9.87)
- second quitters	24.77 (12.19)	26.46 (10.51)	23.69 (11.18)	25.69 (6.37)
Average final score				
- all participants	100.69 (77.63)	82.96 (65.32)	81.08 (70.52)	115.19 (75.94)
- first quitters	67.36 (65.22)	50.15 (50.16)	55.77 (64.19)	101.54 (91.34)
- second quitters	131.56 (72.57)	115.77 (63.56)	106.38 (69.67)	128.85 (57.15)

Note: NCVF for no communication vague feedback treatment, NCPF for no communication precise feedback treatment, and CPF for communication precise feedback treatment Quitting together means that the two co-workers quit within a minute.

Table 2. Determinants of productivity in the compulsory work time
OLS regressions with robust standard errors clustered at the pair level

Dependent variable: Score in the 15' work time	Models (1)	(2)	(3)	(4)	(2')	(3')	(4')
Constant	16.04 (1.31)***	14.72 (2.41)***	15.42 (1.38)***	14.66 (2.43)***	15.01 (3.09)***	15.13 (1.55)***	14.86 (3.38)***
All peer treatments		1.54 (1.92)		1.03 (2.00)	1.16 (3.26)		0.31 (3.38)
Communication only treatment			1.91 (1.79)	1.57 (1.85)		3.49 (2.50)	3.46 (2.63)
Ability	3.26 (0.043)***	3.30 (0.44)***	3.26 (0.44)***	3.29 (0.45)***	3.22 (0.67)***	3.33 (0.48)***	3.20 (0.69)***
Ability * peer treatments					0.12 (0.86)		0.26 (0.95)
Ability * Communication only treatment						-.60 (0.84)	-0.72 (0.97)
Male	-3.06 (1.39)**	-3.00 (1.43)**	-2.84 (1.40)**	-2.84 (1.41)**	-3.01 (1.45)**	-2.69 (1.43)*	-2.69 (1.47)*
R^2	0.439	0.443	0.445	0.447	0.443	0.444	0.444
N	104	104	104	104	104	104	104

Note: Robust standard errors are in parentheses. *** means significant at the 0.01 level, ** at the 0.05 level, and * at the 0.10 level.

Table 3. Frequency and percent of people at risk from previous time who are still working

Treatment	End of compulsory period	At 25 minutes	At 40 minutes	At 71 minutes
Single	26 (100%)	19 (73%)	18 (95%)	11 (61%)
NCVF	26 (100%)	16 (62%)	11 (69%)	8 (73%)
NCPF	26 (100%)	16 (62%)	11 (69%)	8 (73%)
CPF	26 (100%)	22 (85%)	18 (81%)	14 (78%)
All peer treatments	78 (100%)	54 (69%)	40 (74%)	30 (75%)
All participants	104 (100%)	73 (70%)	58 (79%)	41 (71%)

Table 4: Determinants of Workers *Continuing to Work*
Probit (non-parametric discrete choice hazard) estimates
(Standard errors clustered at the individual)

Model	Singles Only 1	All Pairs Only 2	All Pairs Compared to Single 3	No Com. Compared to Single 4	CPF Compared to Single 5	Marginal Effects 5M	CPF Compared to No Com. Compared to Single 6	Marginal Effects 6M
Constant	1.12*** (0.42)	0.98*** (0.38)	1.12*** (0.42)	1.12*** (0.42)	1.12*** (0.42)		1.12*** (0.42)	
Singles Condition								
Normalized Productivity / Minute	0.57* (0.30)		0.57* (0.30)	0.57* (0.30)	0.57* (0.30)	0.12* (0.76)	0.57* (0.30)	0.193* (0.078)
Co-worker working	10^{-15} (10^{-8})		10^{-15} (10^{-8})	10^{-15} (10^{-8})	10^{-15} (10^{-8})	10^{-15} (10^{-8})	10^{-15} (10^{-8})	10^{-16} (10^{-9})
Min 40 | Working at Minute 25	0.98* (0.56)		0.98* (0.56)	0.98* (0.56)	0.98* (0.56)	0.167* (0.084)	0.98* (0.56)	0.174* (0.085)
Min 71 | Working at Minute 40	-0.71* (0.40)		-0.71* (0.40)	-0.71* (0.40)	-0.71* (0.40)	-0.175* (0.120)	-0.71* (0.40)	-0.181* (0.121)
Peer Conditions		*All*	*All*	*NCVF & NCPF*			*All*	*All*
Normalized Productivity / Minute		0.95*** (0.20)	0.38 (0.36)	0.20 (0.36)			0.20 (0.36)	0.045 (0.086)
Co-worker working		0.48* (0.28)	0.48* (0.28)	0.15 (0.31)			0.15 (0.31)	0.031 (0.059)
Min 25 | Working At Min 14 = all			-0.14 (0.56)	-0.25 (0.57)			-0.25 (0.57)	-0.073 (0.149)
Min 40 | Working at Minute 25		-0.15 (0.30)	-1.27** (0.61)	-1.33** (0.63)			-1.33** (0.63)	-0.451** (0.214)
Min 71 | Working at Minute 40		-0.40 (0.36)	0.17 (0.50)	0.15 (0.53)			0.15 (0.53)	0.030 (0.103)
Comm. only (CPF)								
Normalized Productivity / Minute					3.15*** (0.84)	0.663*** (0.286)	2.94*** (0.80)	0.646*** (0.240)
Co-worker working					2.78** (1.13)	0.147** (0.062)	2.63** (1.17)	0.153** (0.059)
Min 25 | Working At Min 14 = all					2.15* (1.13)	0.136* (0.060)	2.40** (1.12)	0.145** (0.057)
Min 40 | Working at Minute 25					-0.16 (0.77)	-0.036 (0.185)	1.18* (0.62)	0.128* (0.053)
Min 71 | Working at Minute 40					1.34** (0.68)	0.125*** (0.060)	1.20* (0.63)	0.128* (0.052)
Conditions	Single	NCVF, NCPF, CPF	All	Singles, NCVF, NCPF	Single, CPF		All	All
Log-likelihood	-676.4	-69.80	-746.2	-729.5	-683.6	-683.6	-736.7	-736.7
N	1,638	172	1,810	1,744	1,704	1,704	1,810	1,810

Note: Robust standard errors are in parentheses. *** means significant at the 0.01 level, ** at the 0.05 level, * at the 0.10 level.

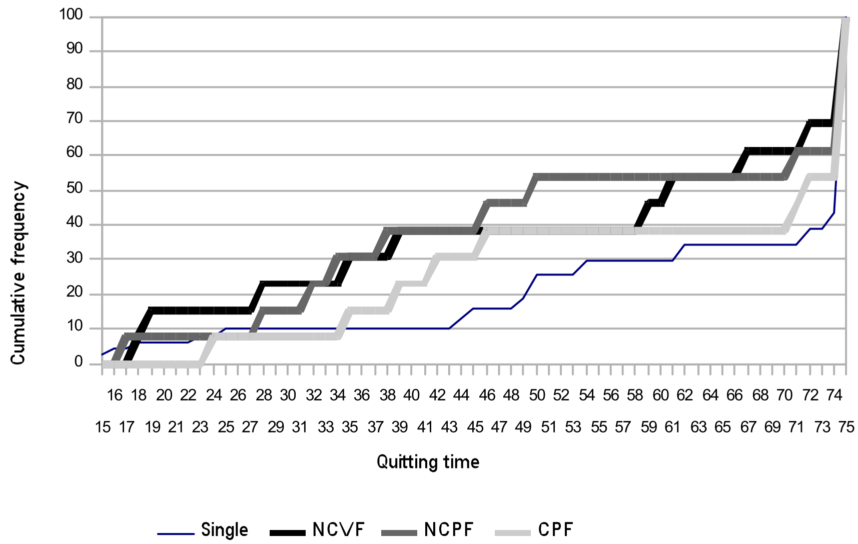


Fig.1a. Cumulative frequency of quitting time of the first quitter, per treatment

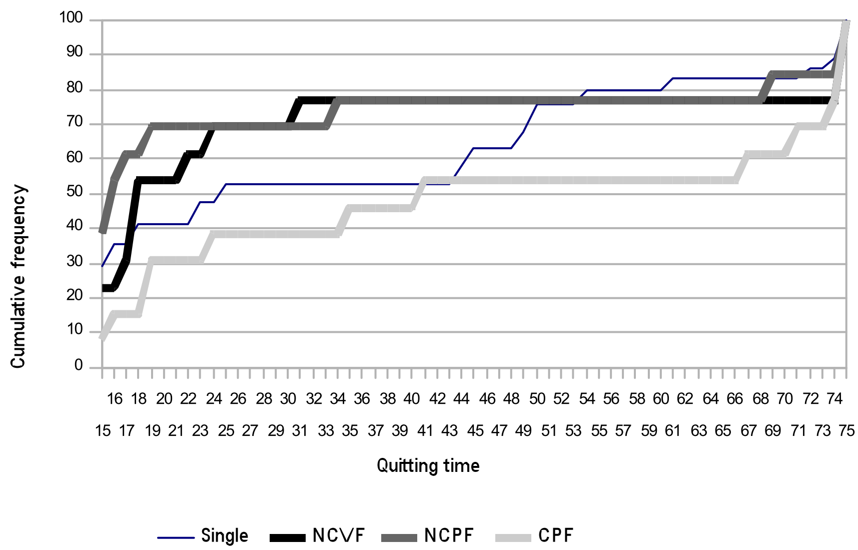
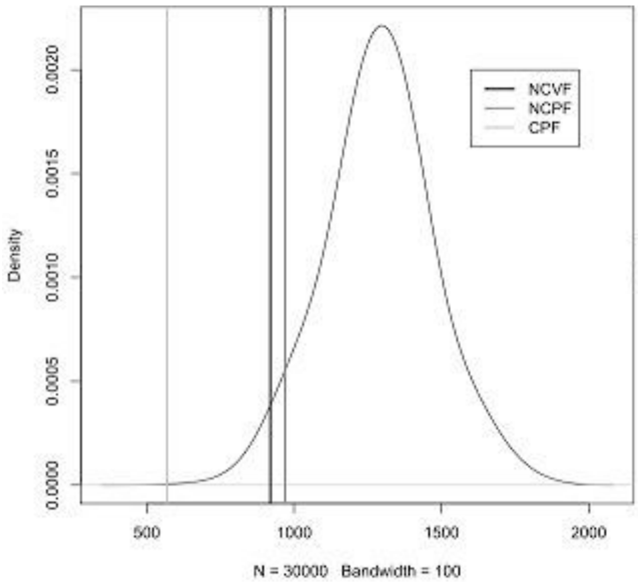


Fig.1b. Cumulative frequency of quitting time of the second quitter, per treatment



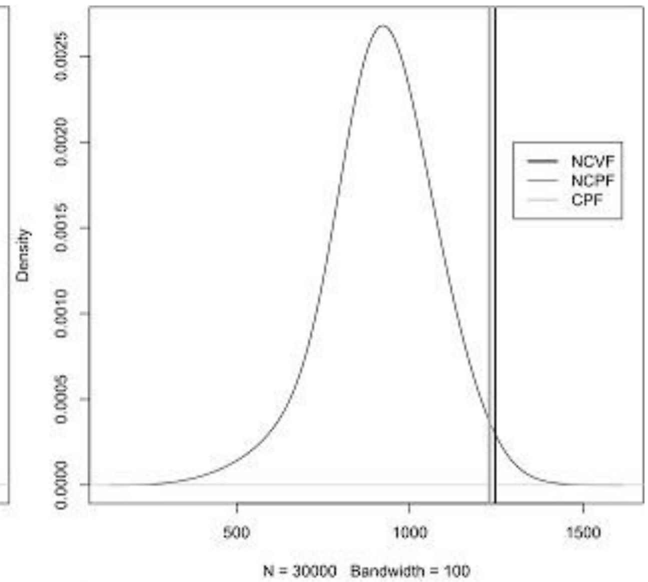


Fig. 2a. Within-pair S.D. in quitting time Fig. 2b. Between-pair S.D. in quitting time between true pairs in the peer treatments and the hypothetical pairs in the Single treatment

APPENDIX A. INSTRUCTIONS

The original of these instructions were written in French. In the instructions of each pair treatment, we put in italics the paragraphs that differ from the instructions of the Single treatment. In the original instructions, italics were not used.

Appendix A1. Instructions for the Single treatment

You are about to participate in an experiment during which you can earn money. Just imagine that you were hired for a temporary job. The job consists in performing a task. You will be paid for each unit of output produced as explained below. Your earnings during this experiment are expressed in points, with:

30 points = 1 Euro

Description of the task

The task consists of adding up numbers and multiplying the result by three to produce units of output. Precisely, you have to add up four two-digit numbers that are randomly generated and to multiply the result by three, like in the following example:

Example: *12*
53
66
24

You have to add up these numbers, that is 12+53+66+24, and multiply the result by three. In this example, you produce one unit of output if your answer is 465, and you do not produce any unit if your answer is different.

You must make these calculations in your head. The use of paper, pencil, or calculator is forbidden.

Then, you enter your answer in your computer and you validate it. You are immediately informed on whether your answer is correct or not. If your answer is correct, your score increases by one unit. If your answer is wrong, your score does not change. Whatever your answer is correct or wrong, a new series of numbers appears automatically on your screen.

Determination of payoffs

You are paid 300 points for this task regardless of your score. In addition, you earn 1 point for each unit produced (*i.e.* for each correct answer). You do not lose any point if you submit a wrong answer.

Timing

We ask you to perform the task during a minimum of 15 minutes. However, you can work longer. Beyond the first 15 minutes, you have to decide when to stop the task. However, you cannot work longer than 75 minutes.

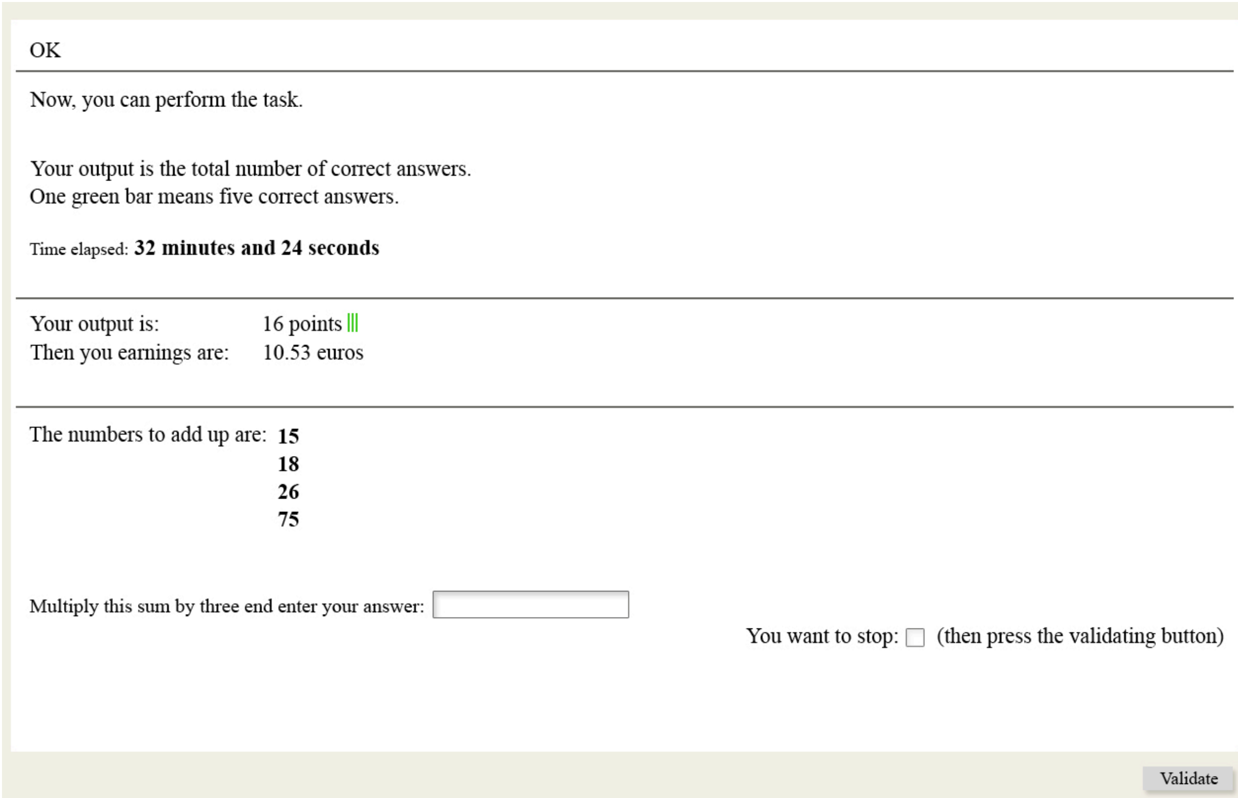
When you decide to stop, press the « stop » button on your screen. You will be asked to confirm or not you choice. If you confirm this choice, it is definitive.

Once you have validated your decision to stop, the amount of your payoff is automatically transferred to the person in charge of the payments. You can leave the room and proceed directly to the payment room to fill out a post-experimental questionnaire, to get paid, and to pick up your belongings. The person in charge of the payment is not aware of the content of the experiment.

Information on your screen

On your screen, you are continuously informed on the time elapsed from the beginning of the task, on your current output (*i.e.* the current number of correct answers), and on your current total earnings.

Moreover, your score is represented graphically by means of a cursor that lengthens as soon as you have submitted a new set of five correct answers (one bar = five correct answers), as indicated in the following screenshot.



OK

Now, you can perform the task.

Your output is the total number of correct answers.
One green bar means five correct answers.

Time elapsed: **32 minutes and 24 seconds**

Your output is: 16 points |||
Then you earnings are: 10.53 euros

The numbers to add up are: **15**
18
26
75

Multiply this sum by three end enter your answer:

You want to stop: ☐ (then press the validating button)

Validate

Preliminary task

Before starting, you are required to add up series of four two-digit numbers and multiply the result by three as fast as you can during three minutes. You will be paid 10 points for each correct answer submitted during these three minutes with one chance out of two, and you will be paid 0 point with one chance out of two.

At the end of the experiment, in the payment room, you will toss a coin. If you toss tail, you will be paid 10 points for each correct answer submitted during this preliminary task, in addition to your other earnings. If you toss head you earn nothing in addition to your other earnings.

If you have any question regarding these instructions, please ask them now. After the preliminary task, the experimentalist will leave the room definitively.

Appendix A2. Instructions for the No Communication - Vague Feedback treatment

You *and another participant* are about to participate in an experiment during which you can earn money. Just imagine that you were hired for a temporary job. The job consists in performing a task. You will be paid for each unit of output produced as explained below. Your earnings during this experiment are expressed in points, with:

30 points = 1 Euro

Description of the task

The task consists of adding up numbers and multiplying the result by three to produce units of output. Precisely, you have to add up four two-digit numbers that are randomly generated and to multiply the result by three, like in the following example:

Example: *12*
53
66
24

You have to add up these numbers, that is 12+53+66+24, and multiply the result by three. In this example, you produce one unit of output if your answer is 465, and you do not produce any unit if your answer is different.

You must make these calculations in your head. The use of paper, pencil, or calculator is forbidden.

Then, you enter your answer in your computer and you validate it. You are immediately informed on whether your answer is correct or not. If your answer is correct, your score increases by one unit. If your answer is wrong, your score does not change. Whatever your answer is correct or wrong, a new series of numbers appears automatically on your screen.

Determination of payoffs

You are paid 300 points for this task regardless of your score. In addition, you earn 1 point for each unit produced (*i.e.* for each correct answer). You do not lose any point if you submit a wrong answer. *The other participant's score does not account for your earnings.*

Timing

We ask you to perform the task during a minimum of 15 minutes. However, you can work longer. Beyond the first 15 minutes, you have to decide when to stop the task. However, you cannot work longer than 75 minutes.

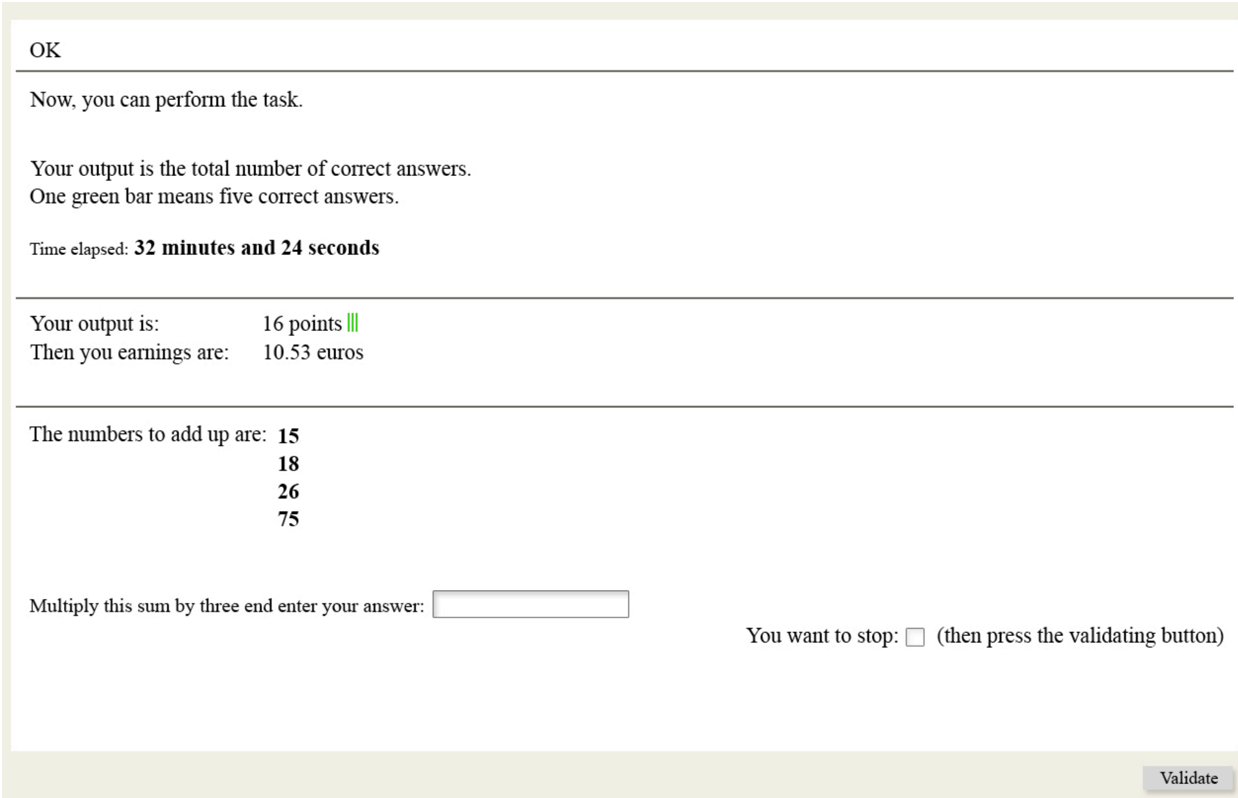
When you decide to stop, press the « stop » button on your screen. You will be asked to confirm or not you choice. If you confirm this choice, it is definitive.

Once you have validated your decision to stop, the amount of your payoff is automatically transferred to the person in charge of the payments. You can leave the room and proceed directly to the payment room to fill out a post-experimental questionnaire, to get paid, and to pick up your belongings. The person in charge of the payment is not aware of the content of the experiment.

Information on your screen

On your screen, you are continuously informed on the time elapsed from the beginning of the task, on your current output (*i.e.* the current number of correct answers), and on your current total earnings.

Moreover, your score is represented graphically by means of a cursor that lengthens as soon as you have submitted a new set of five correct answers (one bar = five correct answers), as indicated in the following screenshot.



Preliminary task

Before starting, you are required to add up series of four two-digit numbers and multiply the result by three as fast as you can during three minutes. You will be paid 10 points for each correct answer submitted during these three minutes with one chance out of two, and you will be paid 0 point with one chance out of two.

At the end of the experiment, in the payment room, you will toss a coin. If you toss tail, you will be paid 10 points for each correct answer submitted during this preliminary task, in addition to your other earnings. If you toss head you earn nothing in addition to your other earnings.

No participant is informed on the other participant's score.

Communication

Throughout the session it is strictly forbidden to speak or to exchange signs with the other participant, otherwise you might be excluded from the session and from any payment. Indeed, a microphone is located next to you and is connected with the experimentalist.

When you decide to stop the task and to quit the room, the same rules apply: do not talk to the other participant. Please leave room without speaking and proceed directly to the payment room.

If you have any question regarding these instructions, please ask them now. After the preliminary task, the experimentalist will leave the room definitively.

Appendix A3. Instructions for the No Communication - Precise Feedback treatment

You *and another participant* are about to participate in an experiment during which you can earn money. Just imagine that you were hired for a temporary job. The job consists in performing a task. You will be paid for each unit of output produced as explained below. Your earnings during this experiment are expressed in points, with:

30 points = 1 Euro

Description of the task

The task consists of adding up numbers and multiplying the result by three to produce units of output. Precisely, you have to add up four two-digit numbers that are randomly generated and to multiply the result by three, like in the following example:

Example: *12*
53
66
24

You have to add up these numbers, that is 12+53+66+24, and multiply the result by three. In this example, you produce one unit of output if your answer is 465, and you do not produce any unit if your answer is different.

You must make these calculations in your head. The use of paper, pencil, or calculator is forbidden.

Then, you enter your answer in your computer and you validate it. You are immediately informed on whether your answer is correct or not. If your answer is correct, your score increases by one unit. If your answer is wrong, your score does not change. Whatever your answer is correct or wrong, a new series of numbers appears automatically on your screen.

Determination of payoffs

You are paid 300 points for this task regardless of your score. In addition, you earn 1 point for each unit produced (*i.e.* for each correct answer). You do not lose any point if you submit a wrong answer. *The other participant's score does not account for your earnings.*

Timing

We ask you to perform the task during a minimum of 15 minutes. However, you can work longer. Beyond the first 15 minutes, you have to decide when to stop the task. However, you cannot work longer than 75 minutes.

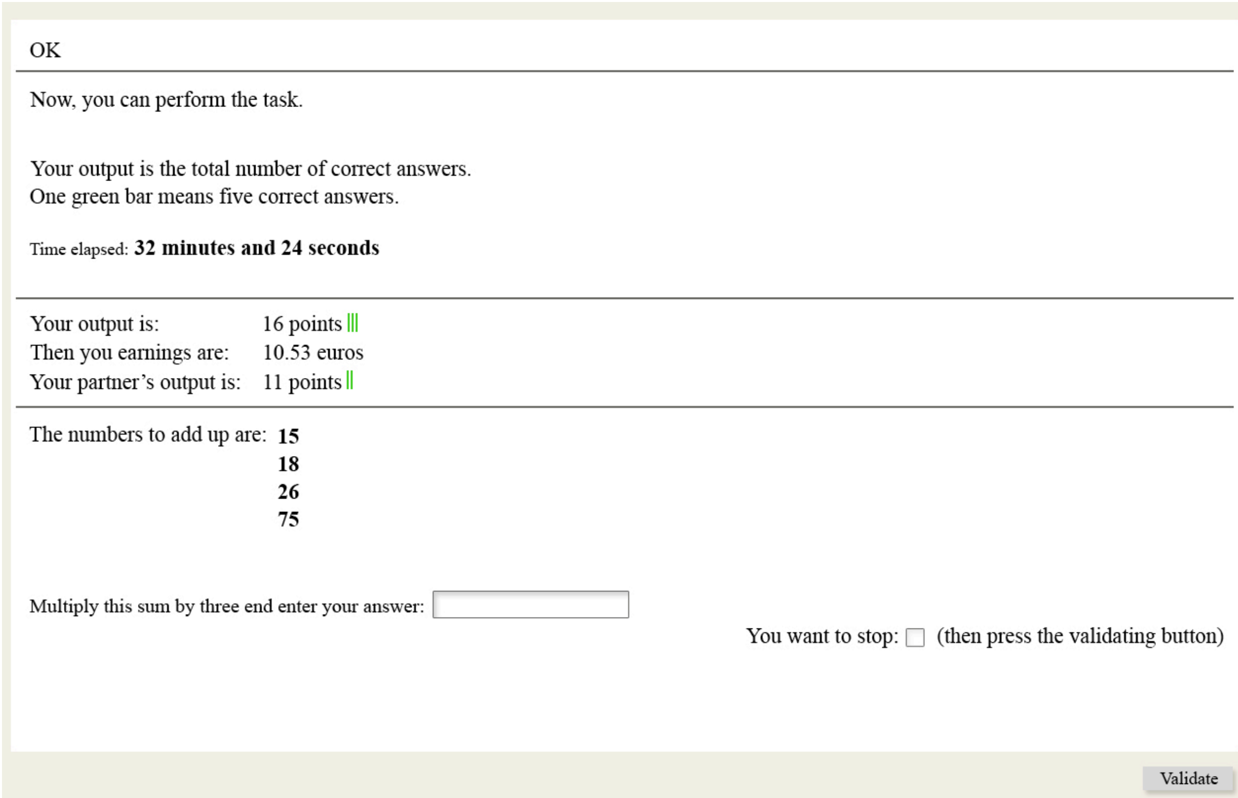
When you decide to stop, press the « stop » button on your screen. You will be asked to confirm or not you choice. If you confirm this choice, it is definitive.

Once you have validated your decision to stop, the amount of your payoff is automatically transferred to the person in charge of the payments. You can leave the room and proceed directly to the payment room to fill out a post-experimental questionnaire, to get paid, and to pick up your belongings. The person in charge of the payment is not aware of the content of the experiment.

Information on your screen

On your screen, you are continuously informed on the time elapsed from the beginning of the task, on your current output (*i.e.* the current number of correct answers), and on your current total earnings.
Moreover, your score is represented graphically by means of a cursor that lengthens as soon as you have submitted a new set of five correct answers (one bar = five correct answers), as indicated in the following screenshot.

You are also informed of the current score of the other participant (his current number of correct answers) and a cursor lengthens as soon as he has submitted a new set of five correct answers.



Preliminary task

Before starting, you are required to add up series of four two-digit numbers and multiply the result by three as fast as you can during three minutes. You will be paid 10 points for each correct answer submitted during these three minutes with one chance out of two, and you will be paid 0 point with one chance out of two.

At the end of the experiment, in the payment room, you will toss a coin. If you toss tail, you will be paid 10 points for each correct answer submitted during this preliminary task, in addition to your other earnings. If you toss head you earn nothing in addition to your other earnings.

No participant is informed on the other participant's score during the preliminary task.

Communication

Throughout the session it is strictly forbidden to speak or to exchange signs with the other participant, otherwise you might be excluded from the session and from any payment. Indeed, a microphone is located next to you and is connected with the experimentalist.

When you decide to stop the task and to quit the room, the same rules apply: do not talk to the other participant. Please leave room without speaking and proceed directly to the payment room.

If you have any question regarding these instructions, please ask them now. After the preliminary task, the experimentalist will leave the room definitively.

Appendix A4. Instructions for the Communication – Precise Feedback treatment

You *and another participant* are about to participate in an experiment during which you can earn money. Just imagine that you were hired for a temporary job. The job consists in performing a task. You will be paid for each unit of output produced as explained below. Your earnings during this experiment are expressed in points, with:

30 points = 1 Euro

Description of the task

The task consists of adding up numbers and multiplying the result by three to produce units of output. Precisely, you have to add up four two-digit numbers that are randomly generated and to multiply the result by three, like in the following example:

Example: *12*
53
66
24

You have to add up these numbers, that is 12+53+66+24, and multiply the result by three. In this example, you produce one unit of output if your answer is 465, and you do not produce any unit if your answer is different.

You must make these calculations in your head. The use of paper, pencil, or calculator is forbidden.

Then, you enter your answer in your computer and you validate it. You are immediately informed on whether your answer is correct or not. If your answer is correct, your score increases by one unit. If your answer is wrong, your score does not change. Whatever your answer is correct or wrong, a new series of numbers appears automatically on your screen.

Determination of payoffs

You are paid 300 points for this task regardless of your score. In addition, you earn 1 point for each unit produced (*i.e*. for each correct answer). You do not lose any point if you submit a wrong answer. *The other participant's score does not account for your earnings.*

Timing

We ask you to perform the task during a minimum of 15 minutes. However, you can work longer. Beyond the first 15 minutes, you have to decide when to stop the task. However, you cannot work longer than 75 minutes.

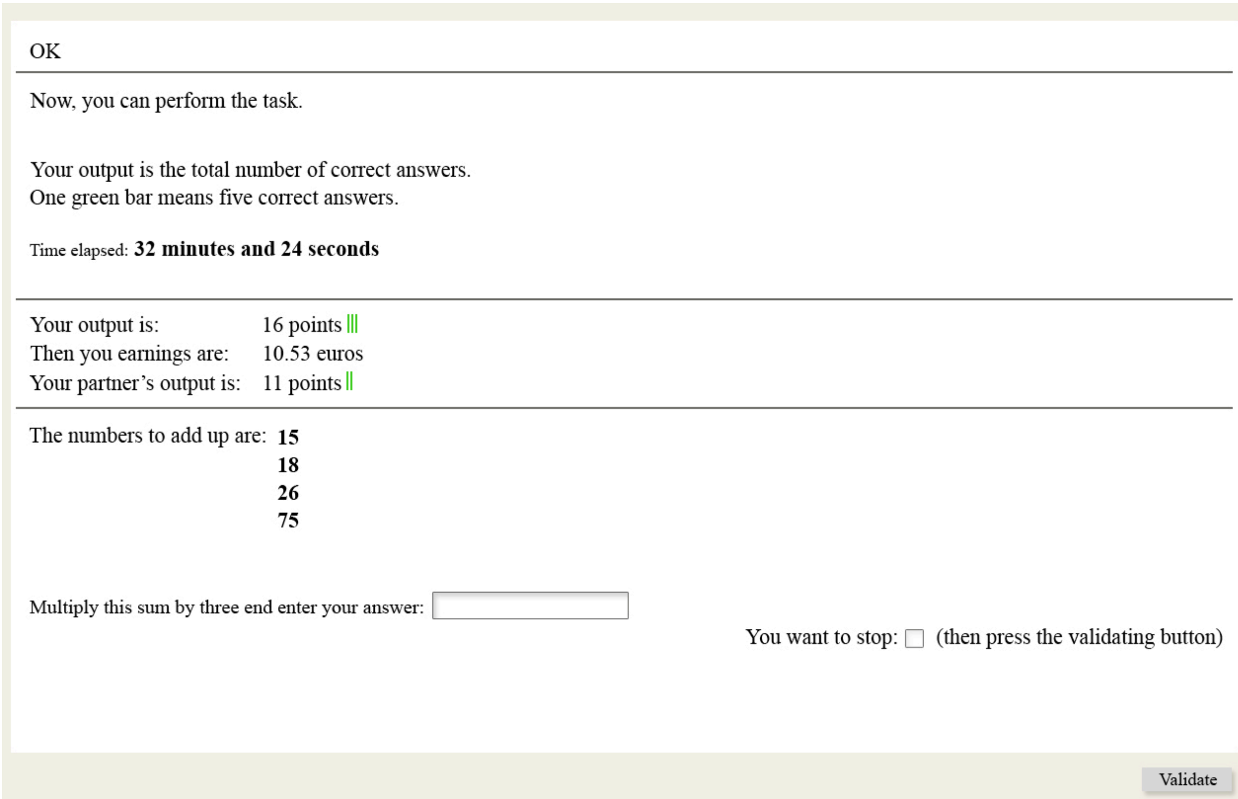
When you decide to stop, press the « stop » button on your screen. You will be asked to confirm or not you choice. If you confirm this choice, it is definitive.

Once you have validated your decision to stop, the amount of your payoff is automatically transferred to the person in charge of the payments. You can leave the room and proceed directly to the payment room to fill out a post-experimental questionnaire, to get paid, and to pick up your belongings. The person in charge of the payment is not aware of the content of the experiment.

Information on your screen

On your screen, you are continuously informed on the time elapsed from the beginning of the task, on your current output (*i.e*. the current number of correct answers), and on your current total earnings.
Moreover, your score is represented graphically by means of a cursor that lengthens as soon as you have submitted a new set of five correct answers (one bar = five correct answers), as indicated in the following screenshot.

You are also informed of the current score of the other participant (his current number of correct answers) and a cursor lengthens as soon as he has submitted a new set of five correct answers.



Preliminary task

Before starting, you are required to add up series of four two-digit numbers and multiply the result by three as fast as you can during three minutes. You will be paid 10 points for each correct answer submitted during these three minutes with one chance out of two, and you will be paid 0 point with one chance out of two.

At the end of the experiment, in the payment room, you will toss a coin. If you toss tail, you will be paid 10 points for each correct answer submitted during this preliminary task, in addition to your other earnings. If you toss head you earn nothing in addition to your other earnings.

No participant is informed on the other participant's score during the preliminary task.

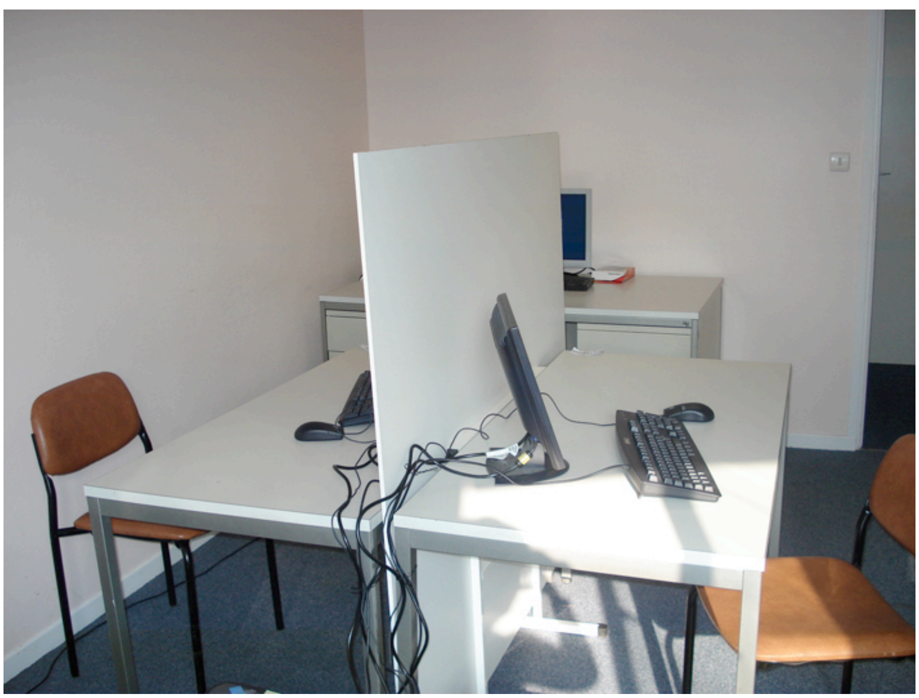
Communication

Throughout the session you are allowed to communicate with the other participant as much as you like. The communication is recorded but is not listened to directly. The recording will not allow anyone to identify you.

If you have any question regarding these instructions, please ask them now. After the preliminary task, the experimentalist will leave the room definitively.

APPENDIX A. THE LABORATORY

Picture 1. The desks in the Single treatment and in the peer treatments with communication (CPF treatment)



Picture 2. The desks in the peer treatments with no communication (NCVF and NCPF treatments)

APPENDIX C. KAPLAN-MEIER SURVIVAL ESTIMATES OF THE QUITTING TIME BY TREATMENT