Social Comparisons and Peer Effects with Heterogeneous Ability *

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Abstract

When workers' efforts are not contractible, workers may be influenced by their coworker's effort. By considering heterogeneous-skilled workers, we investigate whether the display of workers' efforts to coworkers influences wage and effort decisions. We observe that employers increase both wages and wage differences when the more able worker is observed. We find evidence of peer effect and strategic complementarity in efforts. Besides, low-ability workers are more sensitive to peer pressure than their more productive coworker and they exert lower levels of effort the more their coworkers are reciprocal. Finally, displaying workers' efforts to coworkers is detrimental to employer's payoff but enhances efficiency.

Keywords: Heterogeneous ability, Gift-exchange game, Social comparison, Peer effect

JEL Classification: C91, D03, J24, J31, J82

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1 Introduction

Although there is a long tradition in economics that emphasizes the role of financial incentives in workers' efforts,[1] the idea that these efforts are driven by more than financial incentives has received close scrutiny in recent experimental studies. These studies have shown that peer effects (i.e., how being observed influences a focal worker's behavior) might also be incentives in labor organizations (see Kandel and Lazear, 1992). In addition, social comparisons (i.e., how other workers' outcomes influence a focal worker's behavior) may have important implications in the labor market (see Cohn et al., 2014 for a recent discussion). In the present study, we consider workers with heterogeneous abilities, and we examine whether and to what extent the display of workers' efforts to coworkers affects the financial incentives provided by employers and whether peer effects and social comparisons intervene in effort decisions.

Social comparisons may arise in multi-worker settings in which workers frequently interact with one another. Some firms implement practices to favor such interactions: new physical spaces (open-plan offices, places to relax, etc.), workshop sessions or the use of new information technologies (email, chat, etc.).[2] Besides interactions between workers, the observation of coworkers' efforts, such as in businesses with assembly-line production work, may also affect the behavior of other workers and ultimately the one of employer, even when there are no technical externalities across production (i.e., there is no teamwork). Because it is impossible to prevent these interactions or the dissemination of information within firms, employers must assess the impact of observing a coworker's effort on the worker's own effort decisions when they temporarily or spatially structure the workers' task. Although there is abundant survey and case-study evidence that has highlighted the importance of wage comparisons (see Bewley, 1999, for instance) and the impact of comparing effort (see Cialdini et al., 1990, for example) on worker behav-

[1] Akerlof (1982) and Akerlof and Yellen (1990) highlight that one of the key determinants of the effort exerted by workers is the wage received. They demonstrate a positive relationship between the wage received and the effort exerted by a worker as long as the worker's wage falls below the "fair" wage (the fair wage-effort hypothesis). For a deeper discussion about the role of monetary incentives, see Gneezy et al. (2011) and Gneezy and Rey-Biel (2014).

[2] For instance, the human resources department of Google, who was named the best company to work for in America in 2013, claims to have created the "perfect" environment to favor creativity and interactions among workers. See the original article at `http://www.cbsnews.com/news/inside-google-workplaces-from-perks-to-nap-pods/`.

ior, until now, the studies that have examined this question have assumed that workers are identical. Similarly, recent experimental studies have focused on how displaying a worker's effort to coworkers affects workers' efforts when these latter have identical ability.[3] Striking lessons can be drawn from these studies: (1) reciprocity declines when effort is displayed (Gächter et al., 2012) and (2) workers are influenced by their coworkers' efforts: the effort exerted by a worker is positively related to the effort exerted by his coworker (i.e., efforts are strategic complements), although after the revision stage of effort decisions, conformity in effort tends toward low effort rather than high effort (Gächter et al., 2013; Gächter and Thöni, 2015). However, these laboratory experiments have two significant limitations that must be emphasized: (i) they assume that workers have identical abilities, and (ii) they do not analyze whether the observability of efforts among workers affects wage decisions.

The purpose of this paper is to extend this research stream by examining, in the context of workers with heterogeneous abilities, whether and how the subsequent display of a worker's effort to his coworker affects the workers' behaviors and employers' wage decisions. Under similar ability levels, employers have *a priori* no reason to discriminate among workers, and workers may easily imitate the effort exerted by their coworkers. Workers may perceive any wage difference as unfair, and such unfairness may have detrimental effects on employers' payoff and efficiency.[4] Such evidence have been found in recent laboratory experiments (Gächter et al., 2012, 2013; Gächter and Thöni, 2015). However, the story is more complex when workers differ in ability. In this setting, employers may take advantage - under some conditions - by favoring workers depending on their ability, and the existence of peer effect and social comparisons still has to be demonstrated.[5] Answering this research question is of particular interest for labor organizations. Most often, workers differ from one another in terms of their abilities. This heterogeneity may result from differences in length of employment, human capital, edu-

[3]Other laboratory experiments have analyzed how effort decisions are influenced by a coworker's wage (Charness and Kuhn, 2007; Nosenzo, 2010; Gächter and Thöni, 2010; Abeler et al., 2010; Greiner et al., 2011; Gächter et al., 2012; Cohn et al., 2014; Gross et al., 2015), but the results of these studies are not clear-cut.

[4]Here efficiency is simply understood as the sum of payoffs, not in the sense of Pareto efficiency, as in Engelmann and Strobel (2004).

[5]The results obtained in the recent experiment of Gross et al. (2015) suggest the existence of wage comparisons among heterogeneously skilled workers. They find that high-ability workers reduce their efforts if they are not paid more than their low-ability coworkers, but that the reverse is not true.

cational attainment, qualifications, skills or (more broadly) personal backgrounds. If the ability level of the observed worker (respectively observer worker) impacts the level of total output (i.e., the sum of the efforts provided), it is important for employers to determine the optimal order of workers' moves according to their respective ability when there is an opportunity to design the spatial orientation of workers in the production process or to temporarily structure the workers' task.

In the present paper we analyze whether the display of a worker's effort to his coworker influences (i) the employer's wage decisions, (ii) the behavior of heterogeneously-skilled workers and (iii) the employer's payoff as well as the overall efficiency when there are no technical externalities across production. To that end, we conduct an experiment based on the gift-exchange game that was first developed by Fehr et al. (1993) to study labor relationships under contractual incompleteness in a laboratory setting.[6] Each firm consists of an employer, a high-ability worker and a low-ability worker. Employers and workers are equally informed about each worker's ability, and the effort-cost relationships are common knowledge. In the first stage of the game, the employer selects the wage he offers to each worker. In the second stage, workers learn their wage and that of their coworker; then, each worker chooses his level of effort. We implement three experimental treatments that vary only with respect to the information provided to the workers when they choose their effort levels. In the control treatment, the workers were unable to observe the effort exerted by their coworker. In the second treatment, the more able worker observed the effort decision of the less able worker in his firm before selecting his own effort level. The order of the workers' moves was reversed in the third treatment.

We find that enabling effort comparisons among heterogeneously-skilled workers affects wage decisions by inducing employers to increase both (i) wages and (ii) the difference between the two workers' wages when the effort exerted by the more able worker is displayed. This latter wage strategy increases the targeting effect toward the more able worker. Regarding worker behavior, although the observed workers and the observer workers have heterogeneous levels of ability, we find evidence of peer effect and strategic complementarity in efforts. However, some differences are noticeable depending on

[6]See Fehr et al., 2009 for a recent review.

the ability of the observed (or observer) worker: low-ability workers (1) are more sensitive to peer pressure than their more productive counterpart and (2) they exert lower levels of effort the more their coworkers are reciprocal. Finally, displaying a worker's effort to his coworker has a detrimental effect on the employer's payoff because employers pay higher wages that are not compensated by a sufficient increase in workers' efforts. However, because the increase in workers' payoffs is sufficiently high to compensate for the decrease in employers' payoffs, displaying a worker's effort to his coworker enhances overall efficiency, especially when the more able worker is observed.

The paper is organized as follows. We provide details of our experimental design and procedure in Section 2. Our predictions are presented in Section 3 before Section 4 presents the main results. Finally, Section 5 summarizes the findings and discusses their implications for labor organizations.

2 Experimental design

Our experiment identifies the impact of the display of a worker's effort to his coworker who differs in ability on (i) employer's wage decision and (ii) workers' behaviors. We design our three-person gift-exchange game experiment in a way that reveals the impact of peer pressure and social comparisons in a context of heterogeneously-skilled workers. Three treatments are implemented to assess whether the display of a worker's effort to his coworker influences (i) and (ii) and if such influence depends on the order of workers' effort decision. Instructions of the game can be found in additional materials.

2.1 Firm composition and ability

We implement a three-person gift-exchange game. The game is repeated for 10 periods. In each period, a three-person firm is formed by randomly and anonymously matching an employer, a high-ability worker (H-worker) and a low-ability worker (L-worker).[7] Ability level is randomly assigned to workers and is fixed throughout the entire game.

[7] To limit spurious bias during the experiment, the H-worker was called the "type A worker" and the L-worker was called the "type B worker".

In the experiment, ability is the result of good or bad luck and stems from different levels of effort exerted for a given cost. Modelling differences in ability in this way allows us to approximate a situation where differences in ability may arise from educational attainment, human capital or talent. For example, a high educated worker has the opportunity to exert higher levels of effort and to be more productive than a low ability worker. By considering that the cost may represent the time spent at work, if two workers differ in ability and spend the same time at work, the quantity of work exerted by the more productive worker will be higher than that of the less productive one. Thus, in our experiment, for a given cost, the H-worker's effort is twice that of the L-worker (see Table 1).[8] These effort-cost relationships are common knowledge.[9,10]

Table 1: Effort levels and associated costs for workers according to their ability

Effort levels for H-workers	1	2	3	4	5	6	7	8	9	10
Effort levels for L-workers	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5
Cost of efforts (in experimental points)	0	1	2	4	6	8	10	12	15	18

Each period consists of two stages. In the first stage, employer chooses the wage to offer to each worker. In the second stage, workers choose the level of effort to exert. At the end of each period, both the employers and workers learn their respective payoffs in the current period.

2.2 First stage - wage decision

The employer - knowing the effort-cost relationship for each of his workers - determines the wage to offer to each worker. Each wage must be an integer between 0 and 100. He can offer the same wage to both workers or offer them different wages. The employer's

[8] The term effort is used throughout this paper, but the expression "quantity of work" was employed in the experiment, which refers to the quantity of work the worker chooses to exert to provide the employer a certain level of output. See the instructions in the additional materials.

[9] Whereas stated efforts may reduce the degree of realism, they are used instead of real efforts to induce, control and manipulate differences in ability, regardless of other personal characteristics that might affect real efforts. In addition, results from the recent experiment of Charness et al. (2016) suggest that both real and stated efforts may yield similar results in laboratory experiments.

[10] An alternative specification would be to use the same effort-cost relationship for both workers and to set different values for the parameter of productivity, as in Charness and Kuhn (2007) and Gross et al. (2015). However, our specification has the clear advantage to allow workers to perceive directly the difference in ability through the level of effort they choose.

payoff function is given by:

$$\pi_E = v \cdot (e_l + e_h) - w_l - w_h \tag{1}$$

where v denotes the marginal value product of effort that is set equal to 10, regardless of the worker's ability; e_l and e_h represent the effort levels selected by the L-worker and the H-worker, respectively. Similarly, w_l and w_h represent the wages offered to the L-worker and the H-worker, respectively. The employer's payoff function is linear and strictly increasing in efforts and decreasing in wages.

2.3 Second stage - effort decisions

In the second stage, workers learn their own wage and their coworker's wage and choose the amount of effort to supply. In addition, in some experimental treatments (see subsection 2.5), a worker learns the effort level exerted by his coworker before choosing his own effort level. The workers must choose an effort level from those displayed in Table 1. The payoff functions are given by:

$$\pi_l = w_l - c(e_l) \tag{2}$$

for the L-worker and

$$\pi_h = w_h - c(e_h) \tag{3}$$

for the H-worker. $c(e_l)$ and $c(e_h)$ denote the cost associated with the efforts exerted by the L-worker and by the H-worker, respectively. Regardless of ability, the worker's payoff is strictly increasing in his own wage but decreasing in the cost of his effort. The function $c(e_i)$ is strictly increasing and convex, with the minimum effort being costless (see Table 1). It is noteworthy that the effort produced by the worker costs him less than it benefits the employer ($i.e., c(e_i) < v \cdot e_i, \forall i = \{l, h\}$), which means that the marginal value product of effort is always higher than the marginal cost of effort, which makes maximum effort levels socially efficient. Finally, the payoff function of a worker is independent of the

wage offered to his coworker and the level of effort his coworker exerts; thus, there is no earnings interdependence between workers.

2.4 Repetition and payment

Overall, there are 10 periods of the game described above. At the end of each period, both the employers and workers learn their respective payoffs in the current period. Next, a new period begins in which the employers and workers are randomly reshuffled under the constraint that each player (employers and workers) is matched once with the same two opponents. This stranger design is common information.

Because losses are possible for the employer (by paying high wages and receiving low effort levels from workers in response, i.e., $w_l + w_h > v(e_l + e_h)$), all players begin the experiment with 400 points at a conversion rate of 50 points $=$ 1.2 Euros.[11] Finally, to avoid wealth effects and mitigate boredom in later periods, 4 out of 10 periods are randomly selected at the end of the experimental session for payment.

2.5 Experimental conditions

The game is implemented using a between-subjects design with three experimental treatments that vary along a single dimension: the observability by a worker of his coworker's effort decision. Before describing the experimental treatments, three points should be stressed. In all treatments, the following apply: (i) the effort-cost relationship of each worker, depending on his ability, is common knowledge; (ii) wages are public information within the firm, which means that workers have full information about their coworker's wage at the time they select their effort levels; and (iii) the first stage of the game is carried out under the same conditions. We implement three experimental treatments in these conditions. In the control treatment, workers have no information about their coworker's effort choice when they choose their level of effort, i.e., effort decisions are secret (S treatment). In the second treatment, the L-worker selects his effort level first; then the H-worker observes his coworker's effort choice and selects his effort level

[11] The methodology is similar to that adopted by Abeler et al. (2010) and Gächter and Thöni (2015).

thereafter (*L-H* treatment). The order of moves is reversed in the third treatment (*H-L* treatment).[12,13]

2.6 Procedure

Experimental sessions were conducted at the LABEX-EM, University Rennes 1. Participants were students with different educational backgrounds. The experiment was programmed and conducted using the Z-tree software (Fischbacher, 2007). Participants were invited using Orsee (Greiner, 2015). We conducted 3 sessions for the *S* treatment and 4 sessions for each of the two other treatments, with 18 participants per session. Overall 198 subjects participate.

Upon arrival, the subjects were randomly seated at visually separated boxes. Two groups of nine participants each were constructed, with three employers, three L-workers and three H-workers per matching group. We thus took great care to ensure that the strategies and the history experienced by each participant were never contaminated and did not contaminate decision making within the other matching groups. A total of two independent observations per session were guaranteed by the fact that no information passed between the two matching groups. Participants were randomly allocated to one of the two nine-person matching groups. The computer then randomly allocated the role of the participants, who were informed of their role at the beginning of the first period, and they retained this role throughout all 10 periods.

To guarantee public knowledge, instructions were distributed and read aloud. Next,

[12]The most natural way would be to allow a mutual observation of efforts, as Gächter and Thöni (2015) do in a context of homogeneous ability. However, this would imply a revision stage in effort decisions (i.e., a first effort decision followed by mutual observation of efforts and then a revised effort conditional on the observed efforts). To keep the experimental design as simple as possible, we did not run such an experimental treatment.

[13]Note that in our design, workers move simultaneously in the *S* treatment while they move sequentially in the *L-H* and *H-L* treatments. It may therefore be a question whether the observed difference between the control treatment and the other two treatments are due to the information generated by the sequential moves or by sequentiality as such. According to standard game theory, if workers' efforts are unobservable, a game in which workers move sequentially is strategically equivalent to a game in which they move simultaneously. Such equivalence has been questioned by several experimental studies mainly involving coordination problems (see, for example, Rapoport, 1997). In contrast, in our game, each worker has a dominant strategy corresponding to the minimum effort. As a consequence, according to Güth et al. (1998), there should not be any difference between simultaneous choices of effort and sequential choices of effort with no information (i.e., pseudo-sequentiality, Abele et al., 2004). In addition, the last setting would have the disadvantage of requiring two control treatments to take into account both the difference in ability and the order of moves. Thus, we implement a control treatment in which workers choose their level of effort simultaneously.

all participants answered several control questions. At the end of the experiment, the subjects learned their earnings and completed a brief post-experimental questionnaire to collect personal characteristics (i.e., age, gender, fields and level of study). Each session lasted up to 80 minutes, and the average participant earnings were 17 Euros.

3 Research hypotheses

Considering homo oeconomicus workers and the fact that workers receive a guaranteed wage that is not contingent upon their effort decisions, at the equilibrium they put forth the minimum amount of effort, which is costless. With the foregoing in mind, the employer will offer the minimum wage, i.e., 0, to both workers. The sub-game perfect Nash equilibrium is thus $\{w_i = 0, \forall i = \{l, h\}; e_l = 0.5; e_h = 1\}$. Although displaying a worker's effort to a coworker does not affect the equilibrium under standard assumptions of selfishness, it may have an impact if we consider the influence of peer pressure and social comparison.

Regarding employers, if they believe that workers will respond reciprocally (i.e., workers will exert a higher level of effort in response to being offered a higher wage), they should favor the more able worker because his effort is more valuable. Previous experiments have provided support for such behavior, which is known as the targeting effect or merit pay (Bandiera et al., 2007; Gross et al., 2015, respectively). Based on the assumption of a targeting effect in the *S* treatment, if employers anticipate peer effects and positive spillover effects in efforts (see infra Hypotheses 2 and 3), these two effects should be sufficient to increase the incentives of both workers to exert a high level of effort so as to provide a high final payoff to employers. These two effects act as substitutes for financial incentives. Thus, optimal wages should be lower in the two treatments with effort observability compared with the *S* treatment while keeping a higher wage offer for the more able worker.

Hypothesis 1 – Higher wages should be offered to the H-workers, but the observability of a worker's effort by his coworker should lead to lower wages for both workers.

Regarding workers, we first consider the observed ones. Numerous studies both in the lab and in the field have provided strong support to the peer effect in the context of identical workers (Eriksson et al., 2009; Mittone and Ploner, 2011, for example). We conjecture that peer effect should occur in our setting, which is based on heterogeneous abilities. In line with the findings of Falk and Ichino (2006), we assume that the peer effect should be stronger for L-workers because they are observed by the more able workers, in contrast to H-workers, who are observed by workers of lesser abilities.[14] Further if workers exert greater efforts when their efforts are observed than when their efforts are not observed regardless of the wages offered by the employer, a stronger reciprocity will develop.

Hypothesis 2 – The observability of efforts should induce observed workers, especially the less able ones, to exert higher effort levels and reciprocity compared with those found in the S treatment.

The third hypothesis refers to the effort decision of the observer workers. Observing coworkers' efforts may affect workers' effort decisions by influencing what workers perceive to constitute appropriate behavior. Some spillover effects may arise in terms of effort, cost of effort, and/or their relative values (i.e., e_i/w_i or $c(e_i)/w_i, \forall i = \{l, h\}$). By considering workers with identical ability, Gächter and Thöni (2015) have found that efforts are strategic complements, i.e., the effort exerted by the observer worker is positively correlated to the effort supplied by the observed worker. We conjecture that, despite their difference in ability, the effort exerted by an observed worker may be perceived as an example or as an appropriate behavior that induces the observer worker to act similarly.

Hypothesis 3 – The efforts exerted by observer workers should be positively related to those exerted by their coworkers. Efforts are strategic complements).

[14] Although Falk and Ichino (2006) examine the peer effect in a context of heterogeneous abilities, in their study, workers' payoff is completely independent of the output while in our gift-exchange game, the worker's payoff is strictly decreasing in the cost of his effort.

4 Results

The results are presented in four steps. First, we focus on the employers' decisions. Second, we examine the observed workers' behaviors, and third, those of the observer workers. To conclude, we analyze the overall effect of displaying a worker's effort to his coworker on employer's payoff and efficiency. The following analysis pools all the data because no significant learning effect, especially on effort decisions, has been found.[15] Finally, it is noteworthy that (1) all statistical tests are conducted at the matching group level, unless the contrary is explicitly mentioned, and (2) all results are supported by parametric analyses and robustness checks that are reported in the additional materials.

4.1 Employers' behaviors

We analyze whether the future observability of a worker's effort by his coworker affects the upstream wage decision, and if so, in what way. A prerequisite to test our first hypothesis concerns the existence of a targeting effect (i.e., $w_h > w_l$) in the *S* treatment that is confirmed by the descriptive statistics about wage decisions reported in Table 2 (two-sided T-test: $p = 0.0001$).

Table 2: Descriptive statistics for employers' wage offers by treatment

	Treatments		
	S	L-H	H-L
H-worker wage	18.07 (20.45)	22.90 (25.08)	25.97 (27.17)
L-worker wage	14.05 (17.72)	17.89 (20.26)	18.65 (20.27)
Wages difference	4.02 (15.10)	5.01 (14.62)	7.32 (19.57)

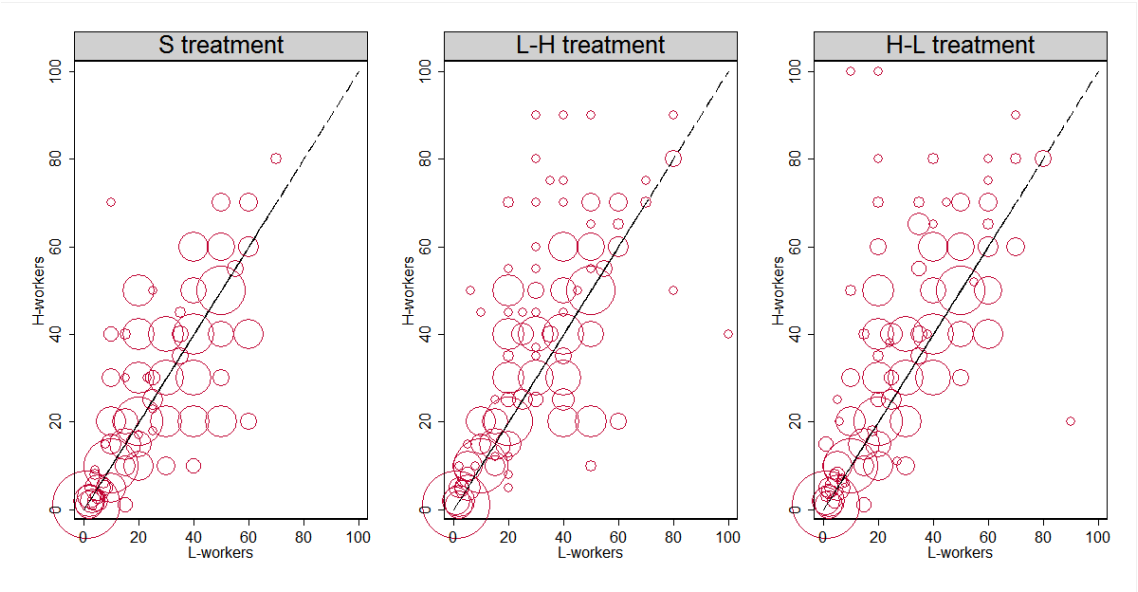
Note: The table reports the mean of the variables in experimental points and the standard deviation in parentheses.

We now turn to the impact of the observability of workers' effort. We first note that, regardless of their ability, workers receive higher wages in the experimental treatments with observability compared to the *S* treatment (For H-workers, two-sided T-tests: $p = 0.0405$ between the *S* and *H-L* treatments and $p = 0.0758$ between the *S* and *L-H* treatments; for L-workers, two-sided T-test: $p = 0.0936$ between the *S* and *L-H* treatments and $p = 0.1000$ between the *S* and *H-L* treatments). These findings contradict

[15] See the additional materials.

our Hypothesis 1 because the observability of a worker's effort by his coworker induces employers to increase, on average, their wage offers.

Figure 1: Wage decisions by treatment



Note: The size of the dots is proportional to the number of observations. The larger symbol in the bottom left corners corresponds to $w_h = w_l = 1$. The 45-degree line corresponds to equal wage decisions.

Second, we find that the increase in workers' wages has an impact on wage differences. Even if both wages increase in the *H-L* treatment compared with the *S* treatment, the increase in the H-worker's wage is stronger than that of the L-worker, which increases the difference in the two workers' wages (see Table 2; two-sided T-test: $p = 0.0868$). This larger discrepancy between wages is also observed in the right panel of Fig.1 which depicts the wage decisions in each treatment. For ease of examination, non-cooperative wage equilibrium decisions (i.e., $w_h = w_l = 0$) are not reported. This evidence indicates that the wage difference is even more pronounced when the H-worker's efforts will be displayed to his coworker. However, this finding no longer holds when the L-worker exets his effort first (two-sided T-test: $p = 0.4602$). Thus, only the future observability of the H-workers' efforts by L-workers induces employers to target their wages toward the more able workers (i.e., H-workers) to urge them to exert high effort levels. We summarize our findings for employers in Result 1.

Result 1. On average, the subsequent display of a worker's effort to his coworker

induces employers to increase (i) the wages offered to both workers and (ii) the difference in wages only when the more able worker's effort is displayed to his coworker.

4.2 Observed workers

To analyze whether observed workers are influenced in their effort decisions by the display of their effort to their coworker who differs in ability, we first examine its impact on the level of effort exerted and then on the degree of reciprocity.

4.2.1 Peer effect on effort

Table 3: Summary statistics for workers

	Treatments		
	S	L-H	H-L
w_h	18.07(20.45)	22.90(25.08)	25.96(27.17)
w_l	14.05(17.72)	17.89(20.26)	18.65(20.27)
e_h	1.99(1.63)	1.83(1.85)	2.65(2.54)
e_l	0.93(0.87)	1.26(1.13)	1.22(1.15)
$c(e_h)$	1.38(2.49)	1.26(3.13)	2.63(4.49)
$c(e_l)$	1.23(2.92)	2.30(3.92)	2.26(4.06)

Note: The table reports the mean of the variables in experimental points and the standard deviation in parentheses.

From Table 3, we note that, for a given ability, the workers who are observed exert greater effort, on average, than the workers in the *S* treatment do. This result holds regardless of worker ability.[16] This first evidence of peer effect may be explained by the higher wage received in the context of a worker's observable effort. To control for such increase in wages, we conduct double-censored Tobit regression analyses on the effort decisions to account for the lower and upper bounds of effort. The explanatory variables are the wages of both workers and the socio-demographic characteristics of the participants. To control for the wage difference between workers, we introduce the difference in wages by distinguishing between disadvantageous (i.e., the worker's wage is lower than his coworker's wage) and advantageous wage differences (i.e., the worker's wage is higher than his coworker's wage). For an observed worker i associated with a coworker j, it results two explanatory variables: A disadvantageous wage difference equal to $w_j - w_i$ if

[16] All two-sided T-tests are significant at the 5% level.

$w_i < w_j$ and 0 otherwise, and an advantageous wage difference equal to $w_i - w_j$ if $w_i > w_j$ and 0 otherwise. To examine the influence of being observed, we consider decisions in the *S* treatment and those in the treatment where the worker is observed (e.g., the *H-L* treatment for the H-workers). In the reported results, the *S* treatment is used as the reference. We include individual fixed-effects and period fixed-effects. Standard errors are clustered at the group level and account for the intra-group correlation in the error term over the 10 periods. The results are reported in Table 4 (columns 1 to 3 for L-workers and columns 5 to 7 for H-workers).

As usually observed in gift-exchange game experiments, we observe a positive and significant relationship between the wage received and the effort exerted (positive reciprocity); further, when workers receive a higher wage than their coworker (advantageous wage difference), they exert on average a higher level of effort (columns 2 & 6). This finding contradicts, in part, the one of Gross et al. (2015) who find that high-ability workers reduce their efforts if they are not paid more than their low-ability coworkers, but that the reverse is not true. Finally, we find evidence of peer effect: being observed induces workers to exert on average a higher level of effort, regardless of the ability of the observed worker (columns 1 to 3 for L-workers and columns 5 to 7 for H-workers). Even with no reputational considerations at work, a significant proportion of observed workers may feel pressure to set a good example by exhibiting higher levels of effort than they might exert if their efforts were not displayed. To examine whether the strength of peer effect differs depending on the ability of observed workers, we conduct additional regressions with the cost of effort as dependent variable. In so doing, the dependent variable is scaled to the same interval range for both types of workers. Results reported in columns 4 & 8 show that peer pressure is stronger for L-workers than for H-workers (7.846 vs. 5.644).

4.2.2 Peer effect on reciprocity

The next step consists of analyzing whether the strength of reciprocity exhibited by observed workers is also higher when their effort will be displayed compared with the *S* treatment. To this end, Table 5 reports the proportion of reciprocal workers and the strength of reciprocity by experimental treatment and the order of moves. Because only

Table 4: Estimations for the effect of the effort observability on observed workers efforts

Dependent variables	L-workers *S* & *L-H* treatments				Observed H-worker *S* & *H-L* treatments			
	Effort			Cost	Effort			Cost
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Worker wage	0.054***		0.043***	0.139***	0.124***		0.117***	0.223***
	(0.009)		(0.005)	(0.039)	(0.010)		(0.015)	(0.020)
Coworker wage	0.011**		0.011*	0.058***	0.010		0.010	0.007
	(0.005)		(0.006)	(0.0171)	(0.011)		(0.010)	(0.018)
Being observed (=1 if yes)	1.253***	0.942***	0.860***	7.846***	1.768***	2.236***	3.786***	5.644***
	(0.113)	(0.112)	(0.171)	(0.464)	(0.205)	(0.248)	(0.553)	(0.592)
Dis. wage difference		-0.019*				0.013		
		(0.010)				(0.024)		
Adv. wage difference		0.052***				0.121***		
		(0.014)				(0.012)		
Worker wage ×Being observed			0.016*				0.010	
			(0.010)				(0.018)	
Constant	0.451	1.914***	0.888***	-3.649***	-1.707***	1.147**	-1.512***	-5.746***
	(0.331)	(0.398)	(0.261)	(1.351)	(0.368)	(0.522)	(0.511)	(0.739)
Socio-demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log pseudolikelihood	-314.5729	-400.2278	-312.9126	-540.8384	-419.0081	-491.1360	–418.8315	-492.6203
Pseudo R-square	0.3800	0.2111	0.3832	0.2228	0.3223	0.2057	0.3226	0.2902
N	420	420	420	420	420	420	420	420
Left-censored observations	258	258	258	258	263	263	263	263
Right-censored observations	4	4	4	4	5	5	5	5

Notes: ***, **, * denote significance at the 1%, 5% and 10% level, respectively. Robust standard errors adjusted for clustering at the group level in parentheses. Socio-demographic controls include dummies for gender, first year student or not, economic studies or not and whether participants have a job activity. All F-test performed on socio-demographic controls are significant at the 1% level.

some workers in each matching group can be considered reciprocal, the Spearman rank correlation coefficients reported in Table 5 are computed at the individual level. They measure the strength of the relationship between the wage a worker i receives and the effort he exerts. A worker is considered as reciprocal if the Spearman rank correlation coefficient between the wage received and the effort exerted is significant at the 5% level at least. Table 5 shows that the proportion of reciprocal workers is significantly higher for workers who are observed compared with the S treatment ($\chi^2 = 42.2400, p = 0.001$ for H-workers and $\chi^2 = 86.5906, p = 0.001$ for L-workers); the strength of reciprocity exhibited by observed workers is also higher compared with the S treatment.

Table 5: Relationship between the wage received and the effort exerted

	Treatments		
	S	L-H	H-L
		Overall	
ρ	0.5661	0.6211	0.6091
Prob	< 0.001	< 0.001	< 0.001
% of reciprocal workers	66.66	64.58	52.08
		H-workers	
ρ	0.6657	0.5400	0.7440
Prob	< 0.001	< 0.001	< 0.001
% of reciprocal workers	61.11	33.33	66.66
		L-workers	
ρ	0.6456	0.7643	0.5979
Prob	< 0.001	< 0.001	< 0.001
% of reciprocal workers	72.22	95.83	37.50

Notes: ρ is the Spearman correlation coefficient and Prob the associated probability.

However, the results of the parametric analyses reported in Table 4 shed new light depending on worker ability. In columns 3 and 7, we examine whether workers respond differently to the wage received depending on whether they are observed or not by means of the variable of interaction between the worker's wage and the dummy variable for being observed. Results obtained show that, on average, being observed induces low-ability workers to be more reciprocal but not the high-ability workers. This latter result concur with those reported in Table 5 that underlines a higher increase in the proportion of observed reciprocal workers and a higher increase in reciprocity for L-workers than for H-workers when compared with the S treatment. In addition, this finding is consistent

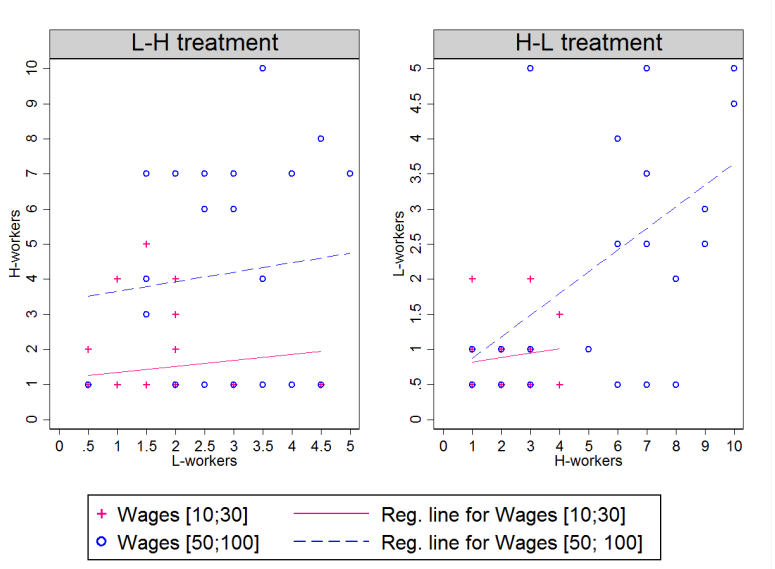
with our Hypothesis 2 and the previous results of Falk and Ichino (2006), who show that low-ability workers are more sensitive to pressure from their peers than high-ability workers. These findings are summarized below.

Result 2: Although workers differ in ability, workers are sensitive to the pressure arising from their peers; peer effect being stronger for low-ability workers.

4.3 Observer workers

We now examine whether the observer workers are influenced by the effort of their coworker when they choose their level of effort. To examine this question, Fig. 2 depicts this relationship for two wage ranges to account for the positive relationship between a worker's wage and his effort level. Simple regression lines are also drawn in Fig. 2 to depict the sign of the relationship between efforts. Fig. 2 demonstrates that the observer worker's effort is positively related to his coworker's effort, which applies to both H-workers (left panel of Fig. 2) and L-workers (right panel of Fig. 2). The Spearman rank correlation coefficients corroborate these observations ($\rho = 0.4412$, $p < 0.001$ in the *L-H* treatment and $\rho = 0.3886$, $p < 0.001$ in the *H-L* treatment).

Figure 2: Relation between workers' effort and coworkers' effort



To strengthen these observations, we conduct several econometric regressions. First, we perform double-censored Tobit regressions on effort decisions by controlling for the

wages of both types of workers, coworker's effort and the socio-demographic characteristics of participants. The Tobit estimates account for the efforts being left-censored by the minimum effort and right-censored by the maximum effort. Standard errors are clustered at the group level and account for the intra-group correlation in the error term over the 10 periods. The results are reported in Table 6. Consistent with the positive reciprocity highlighted in previous studies, the wage is a positive and strong predictor of the effort exerted for both types of workers. In addition, we note the negative and significant impact of L-workers' wage on H-workers' effort (column 5), which underlines the feelings of jealousy experienced by H-workers regarding their coworkers' wages. High wages offered to L-workers tend to discourage H-workers from working at high effort levels, all else being equal. The feelings of jealousy that are associated with relatively low efforts exerted by the L-workers may explain why observer H-workers exert lower levels of effort compared with those exerted in the *S* treatment (see Table 3). Moreover, the results are also clear regarding the link between efforts. We note that the observed worker's effort has a positive impact on the effort decision made by the observer worker. This finding holds regardless of worker ability (columns 1 & 2 for L-workers and columns 5 & 6 for H-workers). Therefore, there are positive spillover effects in efforts, such that the efforts are strategic complements (Hypothesis 3). These positive spillover effects are also observed on the level of reciprocity. In columns 4 and 8, we report the estimates of an OLS regression in which the dependent variable is the degree of reciprocity. Reciprocity is defined as the ratio between the worker's effort and his own wage. We find, on average, a strong and positive relationship between the degree of reciprocity for both types of workers. These observations provide additional support for the strategic complementarity of efforts and the positive spillover effects. This finding means that despite differences in workers' abilities, observer workers are on average influenced by the effort exerted by their coworkers.

However, even if efforts are strategic complements regardless of workers' ability, a noticeable difference depending on ability must be highlighted. We note that for L-workers, the more their coworkers are reciprocal, the lower the level of effort they exert (column 3). We find the opposite for H-workers (column 7). An explanation may be the follow-

Table 6: Estimations for the relationship between workers efforts

Dependent variables	L-workers in the *H-L* treatment				H-workers in the *L-H* treatment			
	Effort			Reciprocity	Effort			Reciprocity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wage	0.035***		0.038***		0.133***		0.124***	
	(0.011)		(0.011)		(0.001)		(0.000)	
Wage's partner	0.006				-0.035***			
	(0.008)				(0.001)			
Effort's partner	0.222**	0.356***			0.190***	0.747***		
	(0.091)	(0.129)			(0.021)	(0.017)		
Dis. temporary payoff[a]		-0.004				-0.007***		
		(0.012)				(0.002)		
Adv. temporary payoff[b]		0.045***				0.164***		
		(0.016)				(0.002)		
Partner's reciprocity			-2.434*	0.488***			2.479***	0.806***
			(1.337)	(0.115)			(0.035)	(0.147)
Constant	-0.315	0.251	2.156***	0.036*	-2.856***	-14.645***	-3.378***	0.176
	(0.716)	(0.550)	(0.814)	(0.017)	(0.031)	(0.031)	(0.022)	(0.095)
Socio-demographic controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ind. fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Prob > F	0.000	0.000	0.000	–	0.000	0.000	0.000	–
Log pseudolikelihood	-208.024	-216.289	-213.018	–	-140.232	-154.280	-132.438	–
Pseudo or adjusted R-square	0.3133	0.2860	0.1790	0.5830	0.4371	0.3807	0.4295	0.7030
N	240	240	180	170	240	240	172	167
Left-censored observations	146	146	90	–	185	185	118	–
Right-censored observations	6	6	5	–	2	2	2	–

Notes: ***, **, * denote statistical significance at the 1%, 5% and 10% level, respectively. Clustering errors at the group level in parentheses. Socio-demographic controls include dummies for gender, first year student or not, economic studies or not and whether participant has a job activity. All F-test performed on socio-demographic controls are significant at the 1% level. [a] Dis. temporary payoff means that the observer worker receives a lower wage than the final payoff obtained by the observed worker. [b] Adv. temporary payoff means that the observer worker receives a higher wage than the final payoff obtained by the observed worker.

ing. All else being constant, most of the time the L-workers receive a lower wage than the H-workers do (see the central panel of Fig. 1.) Although disadvantaged, L-workers exhibit strong reciprocity (see the bottom panel of Table 5; 95.83% of L-workers are reciprocal when they are observed). Such reciprocity induces H-workers, who are favored by employers, to exert a high level of effort. The high level of effort supplied allows them to reward the employer for his wage offer, and acting differently may be perceived as inappropriate by H-workers. This last result attenuates the negative impact of the L-worker's wage on the H-worker's effort (column 5).

Result 3: Although workers differ in ability, efforts are strategic complements. However, low-ability workers exert, on average, lower levels of effort the more their coworkers are reciprocal.

4.4 Employers' payoff and efficiency

To conclude, the results of our experiment provide a basis to investigate whether it is beneficial for a firm to allow workers to observe their coworkers' behaviors and whether one order of moves is better than another. For that purpose, in the final part, we analyze the impact of displaying workers' efforts to coworkers on total output, employers' payoffs and efficiency. An examination of Table 3 reveals that the effort levels are higher in the experimental treatments with observable efforts regardless of the order of moves (two-sided T-tests: $= 0.0332$ for H-workers between the *S* and *H-L* treatments and $p < 0.001$ for L-workers between both the *S* and *H-L* and the *S* and *L-H* treatments). The single exception is the observer H-workers who put forth similar levels of effort to those exerted by H-workers in the *S* treatment (two-sided T-test: $p = 0.4646$) which leads them to experience lower costs than L-workers in the *L-H* treatment. However, in all treatments, the display of the worker's effort to his coworker increases the total output (i.e., the sum of workers' efforts): 13% increase in the *L-H* treatment and 42% increase in the *H-L* treatment.

Nonetheless, because employers offer higher wages when workers can observe their coworkers' behavior (see Table 2 and Result 1), these settings will benefit the employer only if the increase in total output is sufficiently high.

Table 7: Final payoffs, total output and efficiency

	Treatments		
	S	L-H	H-L
π_h	16.69(19.01)	21.64(23.36)	23.33(24.10)
π_l	12.82(16.10)	15.61(17.94)	16.42(18.67)
π_E	−4.79(23.88)	−9.88(30.08)	−5.93(29.43)
Total output[a]	2.73(2.20)	3.09(2.53)	3.87(3.16)
Efficiency[b]	24.72(19.18)	27.37(19.83)	33.82(24.89)

Note: [a] Total output corresponds to the sum of workers efforts. [b] Efficiency corresponds to the sum of final payoffs obtained by each member of the firm. The table reports the mean of variables in experimental points and the standard deviation in parentheses.

Table 7 shows that the employer's payoff is lower in the experimental treatments in which workers' efforts are observed by their coworkers. This result means that, in this context, workers do not sufficiently increase their effort levels to compensate for the higher wages that employers offer. The decrease in employers' payoffs is only significant in the *L-H* treatment (see Table 7; two-sided T-test: $p < 0.0001$). The following explanation can be provided. From Table 3, we note that in the *L-H* treatment, observed L-workers increase their efforts relative to the *S* treatment, while observer H-workers do not. Further, only 33.33% of H-workers are reciprocal in this setting (see the central panel of Table 5). Consequently, the overall workers' efforts are insufficient to compensate for the cost borne by the employer as a result of the high level of wages that he is offering.

It follows that allowing workers to observe their coworkers' behavior has a detrimental effect on employers' payoffs, primarily because employers pay higher wages that are not compensated by a sufficient increase in total output. Put differently, encouraging workers' interactions might actually cause the incentive effect set by the employer to backfire and may be detrimental for his payoff thereafter. Conversely, workers' final payoffs are higher, on average, in settings with observability than in the *S* treatment. This result holds regardless of the order of moves and the workers' ability (all two-sided T-tests are significant at the 5% level for H-workers and at the 10% level for L-workers).

Because the increase in workers' payoffs is sufficiently high to compensate for the decrease in employers' payoffs, displaying a worker's effort to his coworker has efficiency-enhancing effects in the *H-L* treatment (two-sided T-test: $p = 0.0067$). It follows that when employers have the opportunity to design the spatial orientation of workers in the

production process or to temporarily structure the workers' tasks, they should favor a setting that allows the more able workers to be observed because this enhances both total output and efficiency.

Result 4: Allowing workers to observe their coworker is detrimental to the employer's payoff, but it enhances efficiency particularly when the more able worker is observed.

5 Conclusion

Despite the undeniable difference in ability among workers within a firm and the opportunity for a worker to observe his coworker's behavior before deciding upon his own effort, we are unaware of other attempts to experimentally study how displaying a worker's effort to his coworker affects both employers' and workers' decisions in this context.

The results obtained in our experiment reveal that showing a worker's effort to his coworker leads to an increase in both wages and wage differentials, particularly when the more able worker is observed. A potential explanation may be the following: employers offer higher wages in the hope that workers are less selfish (i.e., they exert higher effort levels) when they are observed by their coworker. This result is even more remarkable when the more able worker cannot be negatively influenced by the effort exerted by his lower-productive coworker. Future studies that elicit employers' beliefs and motives could provide some support to this explanation. Regarding workers, despite they differ in ability, we find evidence of peer effect and strategic complementarity in efforts. However, some differences are noticeable depending on the ability of the observed (or observer) worker: low-ability workers (1) are more sensitive to peer pressure than their more productive counterpart and (2) they exert lower levels of effort the more their coworkers are reciprocal. Overall, allowing a worker to observe his coworker's behavior has a detrimental effect on employer's payoff, because employers pay higher wages that are not compensated by a sufficient increase in workers' efforts. However, because the increase in workers' payoffs is sufficiently high to compensate for the decrease in em-

ployers' payoffs, displaying a worker's effort to his coworker has efficiency-enhancing effects, especially when the more able worker is observed. These findings have important implications for optimal workplace organization. Specifically, when employers have the opportunity to design the spatial orientation of workers in the production process or to temporarily structure the workers' task, they should favor the observability of the more able workers because this setting generates a strong efficiency-enhancing effect. However, employers have to keep in mind that regardless of the order of moves, a setting with observable efforts is detrimental to employer's payoff relative to a setting without observability.

Our experiment provides initial insights into how allowing the observability of efforts among workers who differ in ability impacts (1) wages and efforts decisions and (ii) consequently, the efficiency of the firm. Nonetheless, one limitation in the present study involves the attribution of ability. In our experiment, workers were randomly selected to be high- or low-ability workers. Being a low-ability worker may be perceived as unfair by participants, which may subsequently affect their decisions. Further, to increase the external validity of our results and thereby inform human resource policy, it would be interesting to test the robustness of our findings when ability is determined through the actual skill of participants, such as based on the results of a real-effort stage as Gross et al. (2015) do. In the same spirit, the employer must take as given whether the more or less able worker moves first. It would be interesting to investigate what happens when the employer can determine the order of moves.

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