Socializing at Work: Evidence from a Field Experiment with Manufacturing Workers*

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Abstract

Through a field experiment at a seafood-processing plant, I examine how working alongside friends affects employee productivity and how this effect is heterogeneous with respect to an employee's non-cognitive skills. This paper presents two main findings. First, worker productivity declines when a friend is close enough to socialize with. Second, workers who are higher on the conscientiousness scale show smaller productivity declines when working alongside a friend. Calculations show that a median worker is willing to pay 4.5 percent of her wage to work with friends. *JEL* Codes: C93, J24, J31, M54, O14.

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1 Introduction

This paper investigates how working alongside friends affects employee productivity and whether this effect varies as a function of a worker's personality skills. I designed and implemented a field experiment that randomly assigned workers to work stations in a seafood-processing plant in Vietnam. I exploit this exogenous variation to estimate the effect of having socially tied coworkers nearby on worker productivity. I then examine the difference in this effect across workers with heterogeneous personality skills using self-reported measures of workers' personalities collected as part of the baseline survey.

Peer influence on worker productivity has been widely studied in both theoretical and empirical literature. Kandel and Lazear (1992) suggest that shame or social norms could be motives for workers to change effort levels in the presence of their peers. Recently, a number of empirical studies document evidence of peer pressure or social incentives affecting worker productivity (Falk and Ichino, 2006; Mas and Moretti, 2009; Bandiera et al., 2010; Herbst and Mas, 2015). This paper focuses on a specific peer group, friends, which I define as peers whom workers are socially connected to in the workplace. Working with friends may create a sense of competition or assist in coping with boredom, leading to greater motivation. Alternatively, the presence of a friend could also lead to goofing off during work and to workers becoming less productive. Understanding which effect prevails in an actual work environment is empirically challenging but, nonetheless, important for organizing human resources in the workplace.

In addition, the influence of peers can be heterogeneous with respect to differences in individual personalities. Studies consistently show strong relevance between personality factors and job performance (Schmidt and Hunter, 1998; Barrick et al., 1998, 2003; Callen et al., 2015) and labor market outcomes (Heckman and Rubinstein, 2001; Heckman et al., 2006). Accordingly, in light of evidence of peer effects on job performance, a natural question to ask is how the effects depend on one's personality characteristic or trait.

This field experiment was conducted in collaboration with the management of a seafood-processing plant. The plant hires female processing workers whose main task is to fillet fish in

rooms while standing at work tables. Compensation is a combination of a fixed daily wage plus a piece rate based on each worker's individual output. Prior to the experiment, workers could choose their work positions at the start of the workday. I focus on friendship ties between these processing workers.

During the five-month experiment period (August 2014 to December 2014), processing workers were randomly assigned to different work positions each day. This created random variation in the presence of friends at various spatial proximities to the worker. The outcome data on daily worker productivity and data on work positions were collected from the firm's employee records database. Prior to the experiment, data on each worker's friendship ties at the plant, their personality characteristics, and other background data were collected through a baseline survey.

As the first main result, I find that when a friend is working alongside there is an average six percent drop in worker productivity. Yet, I find no effect when friends are working at positions that are observable but further away (for example, at the same table but not immediately adjacent). One explanation for the negative effect only when friends are immediately adjacent to each other is that friends are socializing, such as engaging in chit-chat and gossip, and this is possible only when they are within close distances. Since workers are paid partially based on individual performance, the productivity loss implies an average four percent decline in the daily wage when a friend is present alongside them.

In the second main result, I find that the magnitude of the productivity loss associated with working alongside friends depends on the worker's level of conscientiousness. Specifically, I observe a nine percent loss in productivity among low-conscientiousness workers (scored less than one standard deviation below the average) when a friend is working alongside but only a two percent loss among high-conscientiousness workers (scored more than one standard deviation above the average). Moreover, observations on worker positions prior to random assignment indicate that the likelihood of working alongside a friend is fifty percent higher in low-conscientiousness workers compared to high-conscientiousness workers.

Previous studies suggest that workers willingly forgo money or time to work together with their

peers (Hamilton et al., 2003; Bloom et al., 2015).[1] To gauge workers' willingnesses to pay from wages to work with friends, I use a simple structural model to estimate each worker's consumption value of working with friends. I find that 87 percent of workers positively value working alongside their friends. Converting consumption value to wages shows that a median worker is willing to pay 4.5 percent of her wage — in the form of forgone productivity — to work with friends. Willingness to pay to work with friends is negatively associated with a worker's job tenure and conscientiousness.

The main contribution of this paper is twofold. First, identification is based on a random assignment process. As a result, whether a worker is assigned to work near her friend on a given day is exogenously determined. While this is not the first study to exploit random assignments in the workplace it contributes to the relatively small number of such studies.[2] Second, it explores heterogeneity in workplace social interactions with respect to worker personalities. It is not unreasonable to expect workers with non-identical personality attributes to respond and to interact with their peers in dissimilar ways. Yet, to the best of my knowledge, this is the first study to investigate the relationship between peer effects and personalities.

This study joins a number of field experiments that investigate social interactions and worker behavior.[3] Most notably, Bandiera et al. (2005, 2007, 2009, 2013) implement field experiments to study how social connections within a firm affect worker performance across a wide array of incentive schemes in the context of a U.K. fruit farm. In that same context, Bandiera et al. (2010) exploit a quasi-random feature of assigning workers to different fields and document pacing behaviors between socially tied workers; workers slow down when working alongside lower-ability friends and speed up when working alongside higher-ability friends.[4] While the nature of the task

[1] Hamilton et al. (2003) find at a garment manufacturing plant that workers choose to engage in team production, in which workers of the same team have stations adjacent to each other, despite earning less than what they would earn from working individually. Bloom et al. (2015) find from a working from home experiment that workers are willing to pay, in terms of commute time, to work in the office rather than at home. They document qualitative evidence that workers value socializing with coworkers. These findings relate to a compensating differentials model in which a worker is willing to accept a lower benefit for a favorable non-pecuniary job attribute (Rosen, 1986).

[2] Guryan et al. (2009) exploits random group assignments in professional golf tournaments. The authors find no evidence of peer influence on golf performances.

[3] Bandiera et al. (2011) provide a general overview of the literature on field experiments in firms.

[4] The authors further explain that the behavior is driven by incentives to socialize with their partners and not

performed by workers in the fruit farm setting and the task performed by processing workers at the current fish plant can be quite similar in that they are routine and individualistic, unlike that with field work, worker positions at this plant are fixed throughout the day.[5]

This study also relates to the emerging literature on the economics of non-cognitive skills (Borghans et al., 2008; Almlund et al., 2011). Notably, Heckman et al. (2010) and Conti et al. (2012) evaluate an intervention program and find that the program positively impacted employment and earnings outcomes largely through changes in participants' personalities. In a field experiment in Pakistan, Callen et al. (2015) find that health sector workers with higher scores on the Big Five personality factors are more likely to exhibit better job performance than workers with lower scores.

This paper proceeds in six parts. Section 2 describes the field context and experimental design. Section 3 presents the data and descriptive statistics. Section 4 outlines the conceptual framework that guides the empirical analysis. Section 5 presents the empirical strategy and main estimates of the effect of working with friends on productivity. Section 6 delivers the conclusion of this paper.

2 Field Context and Experimental Design

2.1 Field Context

For this study, I partnered with a seafood processing plant in Vietnam. The plant manufactures canned and pouched seafood products, which are mainly exported to U.S. markets. One of the main tasks in producing seafood products is a semi-processing job, in which tasks range from gutting to filleting fish. The plant hires processing workers who specialize in this task. I studied these workers who were, at the time of the study, regular employees at this plant.

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because of social preferences such as inequality aversion. In a recent study, Amodio and Martinez-Carrasco (2017) investigate productivity spillovers in an egg production plant, at which worker compensation is largely based on a fixed wage, and find that working next to a friend mitigates free-riding behavior generated from working next to high producing coworkers.

[5]Cornelissen et al. (2017) show that peer effects, in general, differ across occupation types. For instance, when considering the full set of jobs available at a local municipal level, the authors find peer effects only among jobs that involve routine tasks.

The plant has three teams of processing workers that specialize in the filleting process, with each team working in a separate processing room (Figure 1). Filleting takes place on rectangular work tables that are identical in size and are positioned side by side (Figure 2). Each table is typically occupied by four processing workers although up to six workers are allowed at one table.

Workers process fish individually and, for compensatory reasons, the management records each individual worker's output (i.e., fish fillet). Fillets are placed on individual trays, which are weighed at one side of the room using an electronic scale and recorded by a designated worker. Weighed trays are then placed on racks for quality inspections. Trays that pass inspection are sent to the next production stage, whereas rejected trays are returned to the worker for supplementary work. Therefore, the output measure in the firm's data set is quality-adjusted individual output.

Work material (i.e., steamed fish) arrive at the processing room in large tray carts. Managers distribute the trays to tables based on the number of workers at each table. Workers jointly process the stock of fish allocated to their table. Thus, externalities may arise from other workers at the table if there are constraints on fish supplied to a table. Accordingly, one of the main duties of managers is to reallocate fish across tables according to each table's work speed. In a companion paper, Park (2016) shows that a one percent increase in the average ability of workers at the table is associated with a one percent increase in the per-capita quantity of fish allocated to that table; other dimensions of table characteristics, such as job tenure or age of workers at a table, are found to be insignificant predictors of fish allocation. These findings are reassuring regarding the importance of the production technology when interpreting the results.

Compensation during the study period was fixed to a two-part wage system: a base wage and a performance wage. The base wage is determined by whether a worker is on site as workers are not paid for days they are absent. The performance wage is based on a piece rate per kilogram of fish processed. As a result, compensation pertains to the individual worker's attendance and output. Wages are paid on a monthly basis.

Before the intervention, workers were able to choose their work positions at the start of each workday. In general, within a processing room, there was no restriction on where workers should

be positioned or who they could work with. This allows me to observe to some extent whom workers chose to work with prior to the experiment. The intervention was not revealed until the first day of implementation.

2.2 Randomization of Worker Positions

The field experiment was designed to randomly assign workers to work stations each day. For this purpose, I developed a code for generating random sequences tailored to the capacity of each processing room. Each worker was given a unique ID number and the work stations in a room were numbered from 1 to N, where N is the total number of processing workers in that room. For each room and workday, a random sequence of length N was generated and workers were assigned to their respective positions according to the order of their number in that sequence. Figure D-1 in Appendix D provides a sample of worker position assignment forms for each processing room. To ensure compliance, workers were instructed not to switch nor fill in empty work stations.

Human resources staff at the management office used the code to generate the sequences and recorded the resulting worker positions normally a week before the actual assignment.[6] On days with processing work, processing managers first came to the office to collect their room's assignment form and then arranged worker positions according to this form. Human resources staff made daily visits to the processing rooms to record actual worker positions.

3 Data and Descriptive Statistics

3.1 Employee Records Data

The firm's employee records database records daily information on the tasks performed, work time, which measures the number of minutes spent processing fish, and the weight of fish processed by each individual worker. Using this database, I construct each worker's daily productivity, measured

[6]This was intended to account for possible new hires and job turnovers during the experiment period. Nonetheless, there were no new hires and only 4 job turnovers during the randomization period.

in kilograms of fish processed per hour.

As part of the study, worker positions were recorded for six months. Specifically, human resources staff visited processing rooms and recorded the ID number of the worker occupying each work station. The firm started recording worker positions six weeks prior to the randomization phase and continued until the end of the study period. I combined the work station records with the employee records data to produce a data set that consists of 104 workers and approximately 7,800 worker-workday observations.

3.2 Survey

A baseline survey was administered two weeks prior to the start of the randomization. It consisted of three modules: socioeconomic status, social ties, and personality measures.[7] In the first module, each worker was asked about her socioeconomic background, experience in searching and applying for her current job, and her experience as a processing worker. The second module asked each worker to report on their social ties within her processing room and, for each reported social tie, the details of the relationship, such as the duration of the relationship, whether the tie had been formed prior to working at this plant, and the frequency of activities shared inside and outside of the workplace.[8] The last module was a Vietnamese-translated version of the Big Five Inventory (BFI), which is a self-report inventory with 44 short-phrase questions designed to measure the five-factor analytically derived personality dimensions: extraversion, agreeableness, conscientiousness, neuroticism, and openness.[9] To collect qualitative information on each worker's post-intervention preference with regard to working with friends, an endline survey was conducted during the third

[7]Upon completion, workers were paid 30,000 Vietnamese Dong (approximately $1.50) as a token of appreciation for participating in the survey.

[8]I only find three family ties among workers in the same processing room and, due to the small sample size, count these as friendship ties. The results are robust to dropping family ties from the friendship sample.

[9]The questionnaire, originally from John et al. (1991) and John et al. (2008), was translated in Vietnamese and back translated in English by a professional translation company. Both versions were additionally checked by a native Vietnamese with experience in Vietnamese-English translations. The original version of the BFI is available for research purposes at `http://www.ocf.berkeley.edu/~johnlab/bfi.php`. The Vietnamese-translated version of the BFI is available from the author upon request.

week of December, 2014.[10]

Table 1 presents the summary statistics on survey participation for both surveys. Overall, processing workers who regularly attended work during the survey periods were the main targets. Two workers did not participate in the baseline survey because of long absences and, therefore, were excluded from the data set. Approximately, 10 percent of the workers, or 11 out of 112, who participated in the baseline survey left their jobs during the study period, although 7 of these 11 workers had quit prior to the commencement of the experiment: the other 4 workers left their jobs during the five-month experimental period.[11]

3.3 Descriptive Statistics

Table 2 provides summary statistics on the socioeconomic status of each worker and the job search experience. Processing workers at this plant were all females as the management only hired females for this particular job. At the time of the baseline survey, the average worker in my sample had 19 months of tenure at her current job and 33 months of experience in fish processing. Three-quarters of the surveyed workers had learned about job openings through their friends, and nearly 20 percent of the surveyed workers reported to had received help from a friend currently working at the plant when applying for this job.

Table 3 describes the frequency of friendships reported in the baseline survey. The median worker reported having four friends in her processing room. One worker reported to have no friends in her processing room. The median worker was mentioned as a friend four times. Summary characteristics of reported friendships are shown in the top panel of Table 4. Among all reported friendships, 56 percent are mutual, 15 percent had formed prior to the current job, and the average duration of a friendship was approximately 19 months.[12] The bottom panel reports survey responses with respect to the frequency of activities shared with friends during the previ-

[10] Participants were paid 20,000 Vietnamese Dong (about $1.00) as a token of appreciation.

[11] These were involuntary job separations due to the firm's internal decisions.

[12] Although not shown in this table, 98 percent of the reported friendships were formed at least a month before the collection of the worker position data in the pre-experimental period.

ous 3 months. The survey questionnaire used a 5 point scale for all activities, except exchange of money, although the actual word descriptions varied across items.[13] Overall, workers reported to often interact with their friends both inside and outside the workplace. In the main analysis, I define a friendship to exist between two workers if either one of the workers reported the other as a friend. As a robustness check, I show that the main results are robust to using only mutually reported friendships.

Table 5 presents summary statistics on the Big Five personality factors along with a correlation matrix of worker characteristics that are used throughout the empirical analysis. The first two columns show each variable's mean and standard deviation. The next five columns represent the Big Five correlation matrix which show high correlations between four personality traits; extraversion, agreeableness, conscientiousness, and neuroticism. While the Big Five factors were initially constructed to be orthogonal to each other, between-factor correlations are commonly found in empirical studies of the Big Five factors (Anderson et al., 2011). It is therefore reasonable to include all five factors in regression specifications as control variables.

The bottom four rows provide summary statistics on worker's own ability (measured as estimated worker fixed effects; details provided in Appendix A), the average ability of friends, number of friends, and number of mutually reported friends. Among the Big Five, extraversion shows the highest correlation with own ability ($\rho = 0.34$). Note that own ability is also highly correlated with the average ability of friends ($\rho = 0.66$) suggesting that workers are likely to have friends that have, on average, abilities similar to themselves. Interestingly, ability also has the highest correlation with number of friends ($\rho = 0.19$). Though, when restricted to mutual reports, extraversion shows the highest correlation with number of friendship ties ($\rho = 0.13$).

The previous table suggests the possibility that friends are more likely than non-friends to share similar characteristics, such as ability or personalities. To test this idea, I estimate a dyadic model of friendship using workers own and friends' characteristics. Specifically, I estimate a reduced-form regression that predicts the existence of a friendship between two workers, i and j, using the

[13] Survey questionnaire sheet is available from author upon request.

following specification:

$$F_{ij} = \alpha + \xi |x_i - x_j| + \zeta z_{ij} + u_{ij} \tag{1}$$

where F_{ij} is equal to one if there exists a friendship between i and j, x_i and x_j are characteristics of i and j, and z_{ij} is a vector of additional attributes between i and j which does not take the absolute difference form. Note that equation (1) is specified in a way such that a dyadic relationship is undirectional. That is, all regressors are symmetric.

Table 6 reports estimates of equation (1) using a linear probability model in columns 1 and 2 and a logit model in columns 3 and 4. Columns 1 and 3 use as the dependent variable all reports of friendships. Both columns suggest that two workers are significantly more likely to report each other as a friend the closer they are to each other in age, experience on current job, ability, and, among the Big Five personality dimensions, extraversion. Estimates on the other four personality factors are statistically insignificant and close to zero. Refining the definition of a friendship only to mutual reports does not significantly change the results (shown in columns 2 and 4). Although not reported in this paper, inclusion of dyadic-averaged characteristics, for instance, the average ability of workers in a dyad, does not alter the qualitative findings.

4 Conceptual Framework

To guide the empirical analysis, I first present a model of effort choice embedded with social ties and skills, in which the skills take the form of processing skills and personality skills. Then, I introduce the literature on the Big Five personality factors and present hypotheses on the relationship between each personality skill and worker outcomes on job performance and the effect of working with friends on individual productivity.

4.1 Effort Choice, Friendships, and Skills

Denote e as the worker's choice of effort for production. The productivity of worker i, y_i, is measured in kilograms of fish processed per hour. For simplicity, assume that the productivity of worker i is given by $y_i = e_i$. As in the empirical setting, I assume that workers are paid a combination of a fixed base wage plus a piece rate. Workers derive utility from wage, $W()$, where $W_e > 0$ and $W_{ee} < 0$.

Workers are considered to be heterogeneous in their fish processing skills, θ, and personality skills, denoted by a k-length vector $N, N = \{\nu_1, \ldots, \nu_k\}$.[14] Denote $C(e, \theta, N, f)$ as the worker's cost function from exerting effort level e, where f is an indicator of the presence of friends.[15] Assume $C_e > 0$ and $C_{ee} > 0$ such that the cost of effort is increasing and the marginal cost of effort is also increasing in the current level of effort.[16] The worker's utility maximizing effort level in each state with regard to the presence of friends could therefore be characterized as follows,

$$e^{nf} \in \arg\max_e W(e) - C(e, \theta, N, nf) \tag{2}$$

$$e^{f} \in \arg\max_e W(e) - C(e, \theta, N, f) \tag{3}$$

where e^{nf} denotes the optimal effort in the absence of friends and e^f denotes the optimal effort in the presence of friends.

Unclear is how the presence of friends influences the worker's optimal effort. If working with friends motivates a worker and drives down the cost of exerting effort ($C_e(nf) > C_e(f)$), then we would observe $e^{nf} < e^f$. On the other hand, if working with friends result in greater effort costs due to idle chats or spread of negative work behavior from friends ($C_e(nf) < C_e(f)$), effort level

[14] In general, processing skills and personality skills are likely to influence each other and as a result be correlated. For instance, processing ability may influence personality characteristics if better processing ability leads to being more sociable. Conversely, high conscientiousness may positively affect training motivation and acquire better processing skills.

[15] As in Almlund et al. (2011), the optimal effort level also depends on non-cognitive factors. Here, however, I introduce non-cognitive factors as parameters of cost (N) rather than as part of the production function to represent the idea that the cost of exerting effort may depend on an individual worker's personality.

[16] By definition, workers with higher levels of processing skills, θ, and personality characteristics, N, exert effort at a lower cost.

will be higher when working without friends, $e^{nf} > e^{f}$. In the main empirical part of this paper, I compare e^{nf} and e^{f} within a worker based on randomized assignments of friendships and provide an estimate of the influence of friends on worker productivity.

4.2 Heterogeneous Effects on Worker Effort

Next, I consider worker heterogeneity in behavioral responses to the presence of friends. Using the model framework, the difference in the marginal cost of effort between the two states $C_e(nf) - C_e(f)$ can vary as a function of worker characteristics, such as production skill or non-cognitive skills. Studies provide evidence that one's production skill, or ability, has crucial influence on the job performances of coworkers who work nearby (Mas and Moretti, 2009; Bandiera et al., 2010). In an agricultural field setting, Bandiera et al. (2010) find that the effect of the presence of friends significantly depends on the relative ability between friends working alongside each other in the same field, and that this is due to pacing work in line with friends of different abilities. In the current context, work positions are fixed and work speed pacing may be unnecessary if it is for the sake of socializing. Alternatively, if workers' preferences are shaped by social concerns, such as aversion to inequity (Andreoni and Miller, 2002; Charness and Rabin, 2002), it is still possible for workers to adjust their work speed according to that of their friends. Thus, work speed pacing will arise under the following condition on marginal cost of effort: $C_e(f, \theta_i > \theta_j) > C_e(f, \theta_i < \theta_j)$, where θ_i is own production skill and θ_j is friend's production skill.

Heterogeneous effects may arise if it is peer pressure from high ability friends rather than any friend that is affecting productivity.[17] For example, workers may experience social pressure when a high ability friend is working nearby compared to when a low ability friend is present: $C_e(f, \theta_j = \theta_{high}) < C_e(f, \theta_j = \theta_{low})$. In this case, the effect of working with friends on productivity will be greater (or less negative) the more able one's friend is.

Non-cognitive skills, or personality characteristics, may play an important role in determining

[17] I investigate peer pressure in the usual coworker ability framework in a companion paper (Park, 2016).

social interaction behaviors.[18] For example, workers who are more talkative, which is positively measured by extraversion, may have a stronger preference to socialize in the presence of friends relative to workers with low measures of extraversion. If socializing has a negative effect on worker performance, this effect can be expected to be more negative on the performance of workers with high extraversion than on that of workers with low extraversion: $C_{e,\varepsilon}(f) > 0$, where ε denotes extraversion. Conversely, if socializing has a positive influence on performance then the higher the extraversion the greater the increase in one's performance from working with friends: $C_{e,\varepsilon}(f) < 0$.

Studies on personality and job performance single out conscientiousness as a strong and positive predictor of job performance across a wide array of occupation groups (Barrick et al., 1998, 2003; Callen et al., 2015). Not surprisingly, conscientiousness is constructed to measure one's ability to exert self-control and self-discipline. According to this definition, individuals with high conscientiousness are expected to cope better with potential distractions from the presence of their friends. This can be written out in marginal cost terms as $C_{e,c}(f) < 0$, where c denotes conscientiousness.

The personality psychology literature does not provide compelling evidence as to whether agreeableness and openness are predictors of job performance.[19] Neither does it provide evidence of a strong association between neuroticism – reverse measure of emotional stability – and job performance (Barrick and Mount, 1991; Bono and Judge, 2003). As a result, I am unable to formulate predictions as to how these three personality measures correlate with social interactions effects in the workplace.

[18] For a brief introduction to the taxonomy of the Big Five personality factors, I refer to reader to John et al. (2008).

[19] With regard to economic preferences, Dohmen et al. (2008) find positive correlations between agreeableness, as well as openness, and social preferences, such as trust and positive reciprocity. Experimental studies find that other types of economic preferences, such as time-preference or risk-preference, are not significantly associated with the Big-Five factors but rather work as complements in determining life time outcomes (Dohmen et al., 2010; Kautz et al., 2014).

5 The Effect of Working with Friends

This section presents the empirical framework followed by the estimation results on the effect of working with friends. The goal is to provide a compelling empirical strategy that identifies the effect of working with friends and its mechanism regarding friendships at work. In the last part of this section, I focus on investigating heterogeneous effects of working with friends with respect to the worker's production skill and personality skills.

5.1 Econometric Specification

To identify the effect of working with friends on individual productivity, I exploit within-worker variations in productivity and spatial proximity to friends across workdays caused by the randomized position assignments. The idea of spatial proximity in the current context is illustrated in Figure 2(a) which presents a diagram with work stations at three tables. Areas enclosed by the dotted lines represent work spaces that are spatially contiguous to workers B and L, respectively. This spatial area surrounding a worker is of interest because it is not unreasonable to expect social interactions to arise between workers that are next to or facing each other. Also, work tables are arranged closely side-by-side rendering table boundaries irrelevant in determining spatial contiguity.

Next, I divide one's surrounding space into finer categories depending on the proximity and orientation of a work station to the worker's reference position. In Figure 2(b), for example, work stations that are spatially contiguous to workers B and L are shaded in three different degrees of darkness to represent the different levels of proximities and orientations to workers B and L. In accordance, I adopt the following terminology throughout the remainder of the paper.

Definition 1. A and B are in *high proximity* if A and B work at positions alongside each other.

Definition 2. A and B are in *medium proximity* if A and B work at positions that are directly oriented toward each other.

Definition 3. A and B are in *low proximity* if A and B work at positions that are contiguous and diagonally oriented toward each other.

As depicted in Figure 1, workers are required to wear face masks inside the processing rooms which makes it difficult for a worker to communicate with others unless they are close to each other. One's observability, however, is not severely obstructed by wearing a mask. I use this natural variation in communicability and lack thereof in observability across different proximities to identify the mechanism in effect. Specifically, social interactions may arise from indirect interactions, such as motivation or social preferences (e.g. inequity aversion), or because of direct interactions, such as helping each other's work or socializing. While both indirect and direct interactions require a worker to be able to observe her friend, the latter additionally requires that the two workers be physically close to each other, or have *high proximity*. Therefore, if it is direct interactions that is driving the result then we would expect the magnitude of the effect to decrease as proximity with a friend falls. In contrast, the effect would persist even under *low proximity* if observability alone is the medium of social interactions affecting performance.

First, to check if the presence of friends at spatially contiguous positions has any affect at all on a worker's productivity, I estimate the following panel data specification:

$$y_{irt} = \beta \cdot \text{Contiguous}_{irt} + X_{irt} + \theta_i + \lambda_{rt} + \varepsilon_{irt} \tag{4}$$

where y_{irt} is the log productivity (log of kilograms of fish processed per hour) of worker i in room r on day t. Contiguous_{irt} is an indicator variable equal to one if worker i has at least one friend working at a spatially contiguous position in room r on day t, and zero otherwise. X_{irt} contains information on the number and mean ability of coworkers (excluding worker i) working at positions spatially contiguous to worker i in room r on day t, and θ_i and λ_{rt} are the worker and room$\times$day fixed effects, respectively. The worker fixed effect accounts for unobserved time-invariant worker characteristics while the room$\times$day fixed effect accounts for time-varying productivity shocks occurring at the room$\times$day level. The latter type of shock may be especially relevant to this setting

as each processing room is associated with a different production line, each of which has its own pre-processing and post-processing facilities operated by different groups of workers.[20] The error term for individual i in room r on day t is represented by ε_{irt}. The sole parameter of interest in equation (4) is the coefficient on the variable Contiguous, β. Under this model specification, β can be interpreted as the effect of a friend's presence on worker productivity. Yet, because contiguous is a broad-ranging measure of proximity it is difficult to discern the mechanism behind the effect of friends — both direct and indirect social interactions may occur when working near a friend.

For that reason, I proceed to my main specification that takes into account different levels of proximity between friends:

$$y_{irt} = \gamma_L \cdot \text{Low Prox}_{irt} + \gamma_M \cdot \text{Med Prox}_{irt} + \gamma_H \cdot \text{High Prox}_{irt} + X_{irt} + \theta_i + \lambda_{rt} + \varepsilon_{irt} \qquad (5)$$

where Low, Med and High Prox are indicator variables equal to one if there is at least one friend working at low, medium, and high proximity, respectively. All other variables are defined as above. In equation (5), γ_L is the effect on a worker's productivity from having a friend working at a spatially contiguous position but with low proximity. γ_M is the effect on productivity from the presence of a friend working at medium proximity and γ_H is the effect on productivity from the presence of a friend working at high proximity.

A panel data regression of equation (5) may generate biased estimates if the error term, ε_{irt}, is correlated with the presence of friends at a specific proximity. For instance, self-selection bias in the form of workers choosing to work alongside friends on days when they feel less productive would negatively bias the estimate of the impact of working alongside friends on productivity. On that account, as underscored by Manski (2000), the randomization of worker-workstation assignments offers an advantage in identifying social interaction effects in the current context.

Although randomization of position assignments helps overcome the problem of workers self selecting into certain proximities to friends, proximity variables can yet be considered to be en-

[20] Regressions results from including alternative fixed-effect specifications are separately reported as part of a robustness check.

dogenous given that they can only be realized if the worker actually showed up on the day of assignment. This would be problematic if work attendance is both correlated with the position assignment and some unobserved determinant of worker productivity. For instance, if workers were informed about the position assignments in advance, which is a clear breach of protocol, or if the days that they work close to their friends were predictable, workers might show up even on days when they are under-motivated or fatigued if a friend is assigned to work at close proximity but not under a position assignment with no friend working nearby. I check for this possibility by regressing worker attendance on assigned proximities and find no statistically significant relationship suggesting that there was no leakage of information on position assignments.[21]

In general, correlations between unobserved determinants of worker productivity and realized worker position could potentially bias the estimate of interest. Accordingly, for the main specification, I use an instrumental variables strategy that exploits variation in the assigned proximities to friends. The idea is to instrument three endogenous variables (worker is observed working with friend at low, medium, or high proximity) with three exogenous variables (worker is assigned to work with friend at low, medium, or high proximity). Assuming randomized work station assignments, assigned proximity variables should be exogenous to any unobserved factor determining a worker's daily productivity.

In light of the importance of the assumption of random assignment, I use information on workers and work stations during the experiment period to conduct a numerical exercise that can formally show how random the assigned proximities are compared to a simulated distribution of randomly generated proximities.[22] Specifically, I generate 1,000 replications of randomly generated position assignments for the entire experiment period. If the randomization of worker-workstation assignments was successful, then the probability of being assigned to work with a friend observed in the data set and the average probability obtained from 1,000 replications should be within a reasonable distance.

[21] Regression results are available from author upon request.

[22] In Park (2016), I use the same data set used in this paper and show that it passes the routine test of exogeneity between a worker's and her peer's characteristics.

The first two columns of Table 7 each report the probability of having at least one friend present at each level of proximity that a worker was assigned to (column 1) and observed (column 2) during the experiment. On average, a worker was assigned to work at a spatially contiguous position with at least one friend around half of the time (0.54). With respect to each proximity, the probability of being assigned with at least one friend at low, medium, and high proximity was, on average, 0.27, 0.18, and 0.24, respectively. Observed probabilities are lower than assigned probabilities across all proximities mainly because of worker absence — if one of the workers in a friendship pair is absent then the other worker is observed as not working with a friend — rather than because of working in non-assigned positions.

The third column shows the average probability of working with a friend taken from 1,000 replications of worker-workstation assignments for the entire randomization period. Simulated probabilities are slightly smaller than the assigned probabilities but larger than the observed probabilities. For example, the simulated probability of working with a friend at low proximity is 0.23 which differs by -0.04 and $+0.02$ from the assigned and observed probability, respectively. To statistically assess whether the difference between assigned and simulated probabilities is acceptable under conventional significance levels, I construct, for each worker, 95% and 99% confidence intervals using the sample mean and standard deviation from the 1,000 replications. The proportion of workers that have an assigned probability outside each worker-specific confidence interval is reported in the last two columns. The last column reports that 91 percent and 98 percent of the worker sample have assigned probabilities at low and high proximity, respectively, that lie within the 99% confidence interval. Overall, the results of this exercise suggest that the randomization of work station assignments was successful.

Before proceeding to the main estimation results, here I present descriptive findings on the relationship between working with friends and job performance. Figure 3 presents daily plant-level statistics on worker productivity and the probability of working alongside a friend during the six month study period. Before the experiment the average worker produced about 7 kilograms of fillet per hour and worked alongside a friend more than half of the time. With the start of the

experiment, the probability of working next to a friend falls to less than 20 percentage points while daily average productivity jumps by around 10 percent. While suggestive of a negative impact of friends on productivity, it is well known that this in itself cannot serve as evidence of a causal relationship. One reason would be due to possible observer effects, also known as the Hawthorne effects (Levitt and List, 2011). Next, I present results from estimating equations (4) and (5).

5.2 Estimation Results

Table 8 reports Ordinary Least Squares (OLS) estimates based on equations (4) and (5). Columns 1 and 2 use data from the pre-experimental period and find that the presence of at least one friend at a contiguous and, more specifically, a high-proximity position is associated with declines in worker productivity. Columns 3 and 4 each estimate equations (4) and (5) using the experimental period data. The estimates from the experimental period are relatively smaller than those from the pre-experimental period. This is possible if, before the experiment, workers were choosing to work with their closest friends leading to stronger effects, as the experiment only captures the productivity change associated with the presence of an average friend.

Next, I present IV estimates based on assigned proximities to friends. The top panel of Table 9 presents first stage results. Each level of realized proximity is strongly related to the assignment to that level of proximity. The F-statistics from the tests of joint significance of the three instruments are reported at the bottom of the panel. The statistics are sufficiently large to remove concerns about weak instruments.

The bottom panel reports the second stage results. The estimates in column 1 suggest that workers are on average 5.6 percent less productive when at least one friend is present at a high-proximity position relative to when no friend is present at high proximity. As a benchmark, the 5.6 percentage-point effect size corresponds closely to the estimated ability difference between a worker at the 75th percentile and a worker at the 50th percentile. Surprisingly, the estimates for other proximities are insignificant and close to zero. Friends seem to affect productivity only when they are adjacent to each other. In the current context, unlike communicability, observability

does not vary much across proximities. Thus, what is likely driving the productivity drop are interactions that arise when in close proximity rather than observations on peers' performance.

Column 2 introduces a worker's hourly wage as the dependent variable in equation (5). Given that workers are partially compensated on a piece rate scheme the results in column 1 imply that workers should earn less when working with friends in high proximity. Not surprisingly, the estimate indicates that on average workers lose about 4 percent of their hourly wage when working with their friends at high proximity. When converted into monthly terms, this is commensurate to loss of a full day's wage. In comparison, Bandiera et al. (2010) report an average worker losing 10 percent of her earnings when a lower ability friend is present on the same field, whereas earnings are reported to increase by 10 percent with the presence of a higher ability friend. I also show in the next section that the productivity drop is smaller the higher the ability of the friend however, unlike Bandiera et al. (2010), the effect on productivity and wage remains negative.

An interesting question related to the counterfactual timeline of this study is how much wage loss workers incurred prior to the experiment and, without the intervention, probably would have continued to do so. For this purpose, I perform a back-of-the-envelope calculation by multiplying worker-specific estimates on wage loss when a friend is at high proximity with the probability of working alongside a friend during the pre-experiment period.[23] I find that before the experiment an average worker incurred an overall wage loss of about 3 percent from working alongside a friend. For a more structural approach, in section 5.4, I draw on a probabilistic choice model to estimate how much wage workers are willing to forgo to socialize. I find that an average worker is willing to forgo roughly 5 percent of her wage.[24]

In Appendix B, I conduct various robustness checks on estimating the effect of working with friends on productivity. First of all, I take into account of possible spillovers from friend pairs

[23]The effect size of working with friends on wage may arguably depend on the frequency of working with friends. For example, we can expect workers to talk with their friends less on a given day if they were able to work together for several consecutive days relative to working alongside, say, only once a week. Nevertheless, I do not find a significant difference in the IV estimates between days when it is the second or third consecutive day of working with a friend and days when it is the first day of working with a friend following a spell of no friends for at least two days.

[24]The higher estimate of willingness to forgo than the back-of-the-envelope calculation can be explained through the feature of the structural model that controls for the additional utility increase (in the form of exerting less effort) when working next to a friend which is not taken into account in the back-of-the-envelope calculation.

that are nearby but unconnected to the focal worker since the presence of friend pairs may impact the productivity of other workers in the vicinity. Next, I test how the results depend on whether the friend is at the same table and whether the worker's position is a corner position since work stations at the corner of the rooms may naturally be more worker friendly relative to work stations in the middle. I also include different sets of fixed effects across several specifications. Results are presented in table B-1. In sum, the estimates on high proximity vary between -0.051 and -0.069 and are all statistically significant at the 1 percent level. In Table B-2, I show that the proximity estimates are nearly unchanged when friends are defined using only bilateral reports or when I limit friendships to those that formed prior to start working at their current job or those observed to work apart during the pre-experiment period. This last set of results suggests that the self reports collected in this study are likely representing one's social network in the workplace rather than a simple listing of recent "chat buddies".[25]

5.3 Heterogeneous Effects on Productivity from Working with Friends

In this section, I explore whether workers with different skills respond differently to the presence of their friends. Specifically, guided by the framework in section 4.2, I examine heterogeneous effects with respect to two crucial skills of human capital: production skill and personality skills.

5.3.1 Production Skill

First, I examine whether the effect of working with friends is heterogeneous to the reference worker's production skill or that of her friends. For this purpose, I build on the approach of Mas and Moretti (2009) and use estimates of worker fixed effects, as a measure of production skill. The estimation strategy is described in more detail in Appendix A. The standardized ability estimates of workers at the 25th and 75th percentile are -0.073 and 0.071, respectively, implying an ability differential of about 15 percent.[26]

[25]It is rather important to make this distinction because the question of this paper is not how chatting affects productivity but how working with friends — as in socially connected coworkers — affects productivity.

[26]Fixed effects estimates are available from the author upon request.

To check for heterogeneous effects, I extend equation (5) to include interactions terms between proximity and production skill:

$$y_{irt} = \sum_{K=L,M,H} \gamma_K \cdot \text{K Prox}_{irt} + \xi_K \cdot \text{K Prox}_{irt} \times \widehat{\theta}_j + X_{irt} + \theta_i + \lambda_{rt} + \varepsilon_{irt} \tag{6}$$

where $\widehat{\theta}_j$ denotes the estimated production skill of worker j. I adopt the instrument variables strategy from the previous section and instrument for both the proximity variable and the interaction term. Here, for succinctness, I only report estimates related to high proximity positions. Full reports on the regression estimates, including parameter estimates for low and medium proximities, are provided in Table D-1 of Appendix D.

Column 1 of Table 10 reports coefficient estimates associated with the high proximity parameter (γ_H) and the interaction term (ξ_H) using the production skill of the focal worker ($i = j$). The estimate for the high proximity interaction term is positive but statistically insignificant. Column 2 checks whether worker productivity is differentially affected by the ability of friends in high proximity positions. The estimate is statistically significant and indicates that working alongside a friend with an ability corresponding to the 75th percentile on the ability distribution is associated with a productivity decline of 4.6 percent, whereas working alongside a friend at the 25th percentile is associated with a decline of 7.3 percent. Thus, working with a low ability friend is associated with a 59 percent larger productivity drop compared to working alongside a high ability friend.

There may be several reasons behind the finding that high-ability friends are less detrimental to one's productivity compared to low-ability friends. One possible explanation is that high-ability workers talk less than low-ability workers and, therefore, when working next to friends who do not talk much there is less of an effect on a worker's productivity. Another explanation is that high-ability workers motivate their peers and that balances out part of the negative effect associated with the presence of a friend. Yet, lack of productivity increase from high ability friends in lower proximities make this view less favorable. Transfer of skills between friends from high- to low-

ability can also serve as an explanation but, nonetheless, difficult to reconcile with workers' job durations.

In columns 3 and 4, I test for heterogeneity using the ability difference in relative and absolute terms between friends. Both of the coefficient estimates on interaction terms are largely insignificant and close to zero. Consequently, I find no evidence of work pacing in the context of processing work.

5.3.2 Personality Skills

Next, to estimate heterogeneous effects with respect to personality skills, I replace production skill in equation (6) with a vector of worker *i*'s standardized scores on the Big Five personality measure. As before, I instrument for all proximity variables and interaction terms. I report only high proximity estimates here. Coefficient estimates for other proximities are shown in Table D-2 of Appendix D.

Estimates are reported in Table 11. Column 1 shows that, among the five factors, conscientiousness is statistically significant and has a positive sign. The estimate size suggests that if conscientiousness is one standard deviation below the sample mean then working alongside a friend is associated with a 9.4 percent decline in productivity while if conscientiousness is one standard deviation above then it is only associated with a 1.6 percent drop. For comparison, this eight percentage point differential corresponds to about four-fifths of a standard deviation of estimated worker ability or production skill.

By construction of the Big Five measures, conscientiousness measures self-discipline and goal-orientedness. However, there might be other worker characteristics correlated with self-reported conscientiousness and with determinants of social interactions in the workplace. For instance, as shown in Table 5, conscientiousness is positively related with production skill. Accordingly, in columns 2 and 3, I include interaction terms between proximity and worker characteristics (age, job experience, production skill) as control variables. The estimated coefficient on conscientiousness is almost identical to that in column 1. Columns 4 and 5 restrict the friendship set to mutual reports

and present qualitatively similar estimates compared to the previous three columns.

5.4 Willingness to Pay from Wages to Work with Friends

The findings presented so far indicate that workers are, on average, six percent less productive when friends are working alongside. Converted into wages, this translates into a loss of four percent in daily wage. This raises an important question: To what extent would workers be willing to forgo part of their wages to work with their friends? Furthermore, how does one's willingness to pay to work with friends correlate with one's characteristics? In this section, I briefly lay out the framework of the structural approach aimed at estimating workers willingness to pay from wages to work with friends and present the main results. Details of the model and estimation strategy are provided in Appendix C.

The conceptual framework is based on the idea of compensating differentials, introduced by Rosen (1986), in which workers are willing to forgo wage in exchange of desirable work attributes — in this context, working with friends. If workers are indeed willing to pay to work with friends then we should observe workers choosing to work alongside friends even at the cost of earning lower wages. I assume that workers have heterogeneous intrinsic valuations on working with friends and therefore separately estimate each worker's consumption value of working with friends using a random utility model in which a worker decides the probability of working next to a friend given her wage and cost of effort. For estimation, I combine data on worker positions from the pre-experiment period and productivity estimates of working with friends during the experiment period. A worker's willingness to pay is then derived from the estimated consumption value by converting it into wages using a back of the envelope calculation.

Figure C-2 presents the empirical cumulative distribution function of estimates of worker's consumption value of working with friends. Overall, 13 out of 98 workers show a negative value on working alongside friends. A histogram of workers' willingnesses to pay from wages to work with friends is presented in Figure 4. The median worker is willing to pay 4.5 percent of her wage to work alongside friends. For comparison, Hamilton et al. (2003) report garment factory workers

switching from individual to team production at the cost of forgoing approximately 8 percent of their wage. In their setting, team production enabled workers to socialize with their teammates but also allowed specialization of production tasks.

To understand heterogeneity of willingness to pay with respect to individual characteristics, I run separate ordinary least squares regressions of WTP on production skill and personality skills, along with other background characteristics. The regression results are reported in Table 12. Column 1 indicates that WTP to work with friends is negatively associated with job experience and being married. Column 2 shows a negative sign on the estimate for worker's production skill but it is not statistically significant. Column 3 suggests that workers with high conscientiousness scores are likely to have lower WTP to work with friends. Surprisingly, I do not find a significant association between WTP and extraversion. A possible explanation is that extroverts are equally happy to work with friends or without friends.

6 Conclusion

In collaboration with the management, I designed and implemented a field experiment at a seafood-processing plant in Vietnam. The experiment randomly assigned workers to different work positions on a daily basis for five months. I find that workers are less productive on days when a friend is assigned to work alongside. However, I find no effect on days when a friend is assigned to other positions that are similarly observable but are farther from the worker. These findings suggest that workers socialize with their friends when they are in close proximity. Calculations based on structural estimates suggest that workers are willing to pay 4.5 percent of their wages to work next to their friends.

My findings also suggest that the extent to which friends impact a worker's productivity is heterogeneous with respect to a particular personality factor, conscientiousness. Workers with high conscientiousness are less influenced when friends are alongside and have lower WTP to work with friends. These results are robust to controlling for other worker characteristics, such

as age, job tenure, and production skill. While it is beyond the scope of this study, it would be interesting to explore complementarities between task type and personality skill.

It is worthwhile to mention that one should take into consideration the technology of the production and incentive structure when extrapolating these results to other organizational contexts. That is, social relationships in the workplace may not always be detrimental to job performance nor to a firm's profit. Studies find that the presence of social relationships can enhance performance when friends can provide incentives to speed up (Bandiera et al., 2010) or if friends can serve as a source of social pressure in work environments with incentives to free ride on one's peer (Bandiera et al., 2013; Amodio and Martinez-Carrasco, 2017).

I also emphasize that there might be benefits to workplace socializations that have not been captured in this study. Socializing with peers may be a channel of information flows (Cowgill et al., 2009) or facilitate technology transfers in the workplace (Lavy and Sand, 2015). Furthermore, interviews during the endline survey suggest that many consider working alongside a friend as a non-pecuniary benefit. Accordingly, as pointed out by Rosen (1986), the firm may had been enjoying lower levels of worker absences and job turnovers prior to this study by allowing workers to socially interact with their friends at work.

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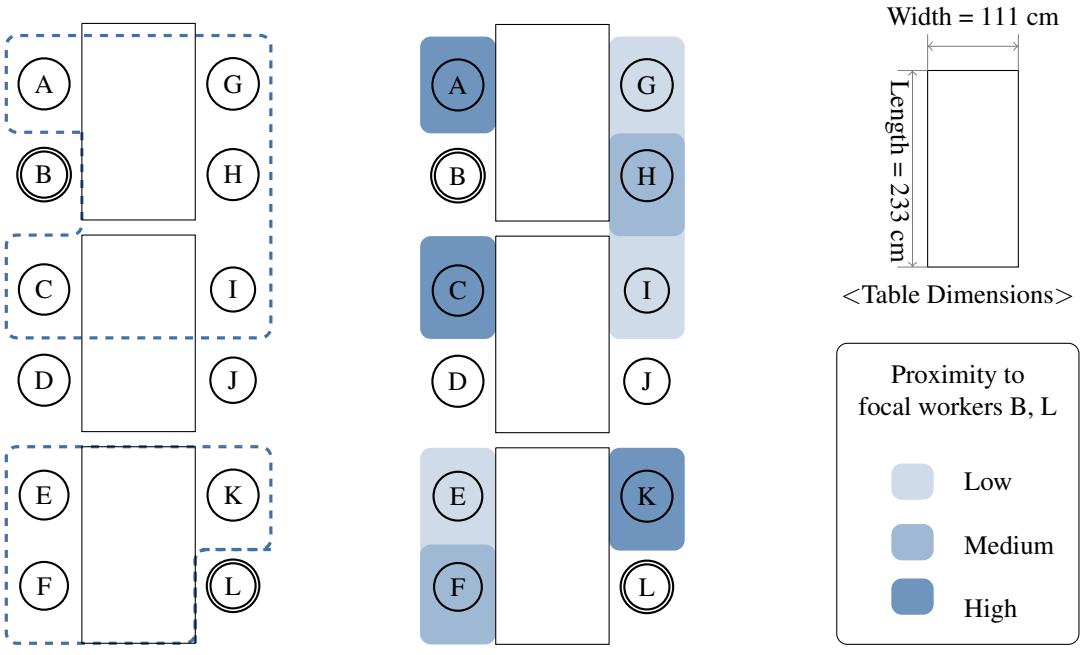
Figure 1: Exhibit of Processing Rooms

(a) Processing Room 1 (b) Processing Room 2

Figure 2: Spatial Contiguity and Proximity



(a) Spatial Contiguity (b) Spatial Proximity

Note: Panel (a) - Areas enclosed by dotted lines represent work spaces that are spatially contiguous with worker B and L, respectively. Note that worker B is at an interior position and, therefore, contiguous with more work spaces than worker L, who is at a corner position. Panel (b) - Work positions with different levels of proximity to a focal worker (B or L) are shaded in different brightnesses. Among work spaces that are contiguous with the focal workers, the closest positions are shaded in dark blue (e.g. D and J) and positions with the least proximity are shaded in light blue (e.g. G and I). Positions that are not spatially contiguous with either worker B or L are not shaded (e.g. D and J).

Figure 3: Worker Positions and Productivity across Time

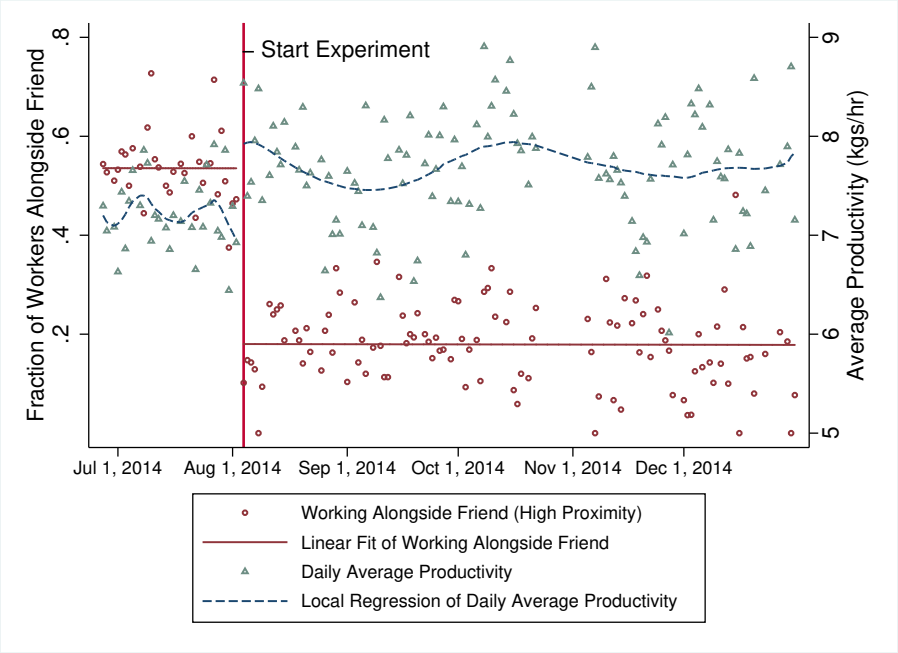
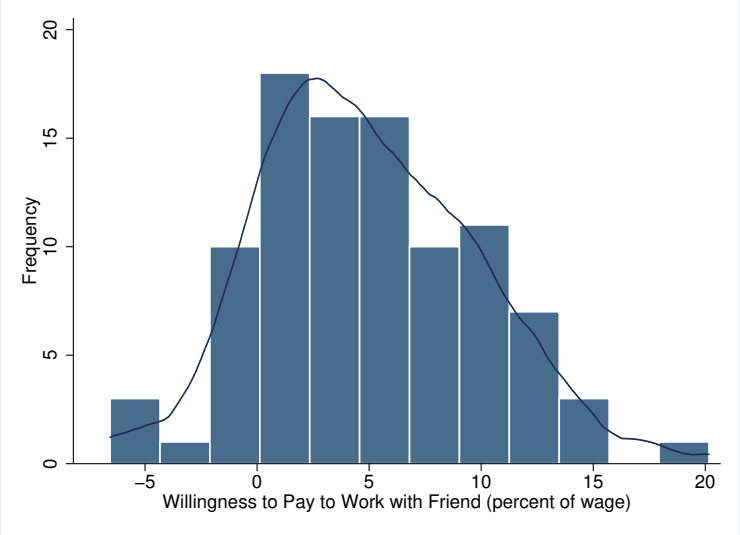


Figure 4: Willingness to Pay from Wages to Work with Friends



Note: A worker's willingness to pay (WTP) is obtained by converting the worker's estimated consumption value of working with friends ($\hat{s}_i$) in wage terms (z_i). Formally, I solve for z_i in

$$2\left(\sqrt{\text{Wage}_i^{nf}} - \sqrt{\text{Wage}_i^{nf}(1-z_i)}\right) = \hat{s}_i$$

for each worker, where utility from wage is assumed to be a CRRA type with the relative risk parameter equal to $\frac{1}{2}$.

Table 1: Summary on Survey Participation

	Target Pop. Size	Total Surveyed	Participation from Target Pop.	Participation Rate
Baseline	114	119	112	98%
Endline	105	101	101	96%

Note: For the baseline survey, Target Population Size is the number of processing workers employed at the company at the time of survey. For the endline survey, target population size is the number of processing workers, including those who quit during the study period, who participated in the baseline survey and worked under randomized position assignments. Total Surveyed is the number of workers surveyed during each survey period. In the baseline survey, there were participation from workers who were not processing workers. Our survey team misunderstood the employee list from the firm. As a result, we mistakenly surveyed these workers. Participation from Target Population is the number of processing workers that participated in each of the surveys. Participation Rate is calculated from (Participation from Target Pop.)/(Target Pop. Size).

Table 2: Summary Statistics - Socioeconomic Variables

Variable	Mean	Variable	Mean
Panel A. Socioeconomics		Panel B. Job Search Experience	
Female	1	Learned about job opening through	
Married	0.68	Friend	0.71
Completed secondary school	0.48	Family member	0.21
Age (years)	31.61	Ex-coworker	0.13
	(9.34)	Job advertisements	0.06
Tenure at current job (months)	19.44	Received help when applying to job	0.40
	(16.87)	Conditional on help received	
Experience in fish processing (months)	32.76	Helper is currently working at plant	0.91
	(32.65)	Relationship with helper	
Lives in house with		Friend	0.52
Water pipe connection	0.72	Family member	0.33
Tiled floors	0.69	Ex-coworker	0.13
Cable TV	0.56	Type of Help	
Refrigerator	0.54	Information on job opening	0.64
Internet connection	0.11	Information on job details	0.27
Owns motorcycle	0.59	Recommendation to manager	0.05

Source: Data on survey module 1 from 114 processing workers.

Table 3: Frequency counts on the number of friends reported and the number of times mentioned as a friend by another surveyed worker

Panel A		Panel B	
Number of friends reported by worker	Frequency	Number of times mentioned as a friend	Frequency
0	1	0	1
1	2	1	9
2	8	2	15
3	30	3	29
4	32	4	20
5	27	5	17
6	7	6	12
7	4	7	8
8	1	8	1
Mean	4.01	Mean	3.81
Median	4	Median	4
S.D.	1.35	S.D.	1.74

Source: Data on survey module 2 from 114 processing workers.

Table 4: Characteristics of Reported Friendships

Panel A. Basic characteristics of reported friendships

	Mean (S.D.)
Total number of reported friendships in sample†	287
It is a mutually reported friendship	0.56
Friendship formed before employment at current job	0.15
Respondent learned processing skills from reported friend	0.42
Respondent lives with reported friend	0.06
Weekly time spent with reported friend outside workplace (hours)	2.21
	(3.76)
Duration of friendship (months)	18.94
	(18.33)
Respondent's subjective rating of closeness with reported friend	3.79
(on a five-point scale with 5 being very close)	(0.97)

Panel B. Summary statistics on shared activities in reported friendships

	Frequency in the past three months‡				
Shared activities	Very often (1)	Often (2)	Some-times (3)	Rarely (4)	Almost never (5)
Go shopping together	17.1	9.4	8.0	12.2	53.3
Talk during break or lunch times	34.8	31.7	16.4	6.6	10.5
Work together at same table	40.1	34.2	13.9	3.1	8.7
Help each other at work	37.1	30.4	14.7	5.6	12.2
Give personal advice to this person	23.7	17.1	17.8	12.5	28.9
Receive personal advice from this person	22.3	14.6	16.0	13.3	33.8
Lent or borrowed money from one other		7.3	15.7	22.0	55.0

† Mutually reported friendships are counted as one friendship.

‡ All items, except *lent or borrowed money from one other*, which uses a four point scale, use a five point response scale. In the survey sheet, response semantics differed across items to account for natural differences in the frequency of activities. For the questions, *how often did you go shopping together*, *how often did you give advice on personal matters*, and *how often did you receive advice on personal matters* workers could choose from (1) more than once a week (2) once a week (3) once every two weeks (4) once a month (5) less than once a month. For questions *how often did you talk to each other during break or lunch*, *how often did you work together at same table*, and *how often did you help each other's work*, workers could choose from (1) more than once a day (2) once a day (3) once every two days (4) once a week (5) less than once a week. For the question *how many times did you lend or borrow money with each other*, workers could choose from (1) more than 5 times (2) 2-5 times (3) once (4) never.

Table 5: Summary Statistics and Correlations

Variable	Mean	S.D.	Correlation Matrix								
			Extra.	Agree.	Consc.	Neuro.	Open.	Own Ability	Friends Ability	Friends	Mutual Friends
Extraversion	3.58	0.56	1.00								
Agreeableness	4.07	0.71	0.36	1.00							
Conscientiousness	3.84	0.60	0.36	0.63	1.00						
Neuroticism	2.61	0.71	-0.40	-0.51	-0.49	1.00					
Openness	2.75	0.60	0.27	-0.03	0.01	0.07	1.00				
Own Ability	0.00	0.11	0.34	0.15	0.12	-0.17	0.10	1.00			
Friends' Ability	0.00	0.08	0.41	0.28	0.16	-0.27	0.25	0.66	1.00		
Num. of Friends	4.73	1.80	0.10	0.10	0.06	0.02	0.11	0.19	0.15	1.00	
Num. of Friends - Mutual	2.89	1.32	0.13	0.01	-0.06	0.06	0.05	0.12	0.05	0.54	1.00

Note: Data on Big Five personality factors are from survey module 3. Worker's Own Ability is a standardized coefficient estimate of individual worker fixed effects. Friends' Ability is the average of friends' own abilities. Number of Friends - Mutual is the number of friendships that are bilateral reports.

Table 6: Dyadic Regression of Friendship

	Dependent variable (= 1 if yes):			
	All Reports	Mutual Reports	All Reports	Mutual Reports
	Linear Prob. Model		Logit Model	
Variable:	(1)	(2)	(3)	(4)
Absolute difference between x_i and x_j, $\lvert x_i - x_j \rvert$				
Age	$-0.005***$	$-0.003***$	$0.947***$	$0.946***$
	(0.001)	(0.001)	(0.012)	(0.016)
Years on Job	$-0.022***$	$-0.014***$	$0.810***$	$0.821**$
	(0.007)	(0.006)	(0.057)	(0.069)
Ability	$-0.302***$	$-0.357***$	$0.026***$	$0.000***$
	(0.067)	(0.052)	(0.023)	(0.001)
Extraversion	$-0.030***$	$-0.014*$	$0.745***$	$0.827*$
	(0.008)	(0.007)	(0.067)	(0.091)
Agreeableness	-0.007	-0.009	0.944	0.905
	(0.011)	(0.009)	(0.094)	(0.111)
Conscientiousness	-0.001	0.003	0.971	0.985
	(0.011)	(0.009)	(0.101)	(0.118)
Neuroticism	0.001	0.003	1.006	1.036
	(0.009)	(0.007)	(0.085)	(0.103)
Openness	-0.008	-0.005	0.934	0.935
	(0.009)	(0.007)	(0.077)	(0.099)
Observations	1,808	1,808	1,808	1,808

Note: In columns (1) and (3), dependent variable is equal to one if at least one worker reported the other as a friend. In columns (2) and (4), dependent variable is equal to one if the friendship is mutually reported. In both cases, the relationship is symmetric. Columns (3) and (4) report odds ratios. All regressions also include two indicator variables – symmetries of marital status and secondary school completion – but estimates are not reported in this table. Robust standard errors are provided in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 7: Proximity to Friends during Experiment Period

	Probability (Proximity = X)			Proportion of sample outside	
$X =$	Assigned	Observed	Simulated	95%CI	99%CI
Contiguous	0.54 (0.18)	0.46 (0.16)	0.48 (0.18)	0.22	0.09
Low Prox	0.27 (0.12	0.21 (0.10)	0.23 (0.12)	0.19	0.09
Med Prox	0.18 (0.09)	0.15 (0.07)	0.14 (0.07)	0.28	0.13
High Prox	0.24 (0.12)	0.19 (0.09)	0.23 (0.11)	0.08	0.02

Note: The first three columns of this table present assigned, observed (realized), and simulated probabilities of having at least one friend at different levels of proximities throughout the experiment period. Assigned probabilities are calculated by taking the mean of each assigned proximity-specific indicator variable over all worker-day observations (n = 7,290). Observed probabilities are the mean probabilities of actually working with a friend at each proximity. Standard deviations are presented in parentheses. Simulated probabilities are obtained from 1,000 replications of random assignments of workers to work positions. Proportion of sample outside 95% and 99% confidence intervals indicate, for a given proximity, the fraction of workers whose assigned probability during the experiment period lies outside the worker-specific confidence interval constructed using the mean and standard deviation obtained from simulating random position assignments.

Table 8: Baseline Results - OLS Estimates

	Dependent Var.: log(productivity)			
	Pre-Experiment		Experiment	
	(1)	(2)	(3)	(4)
Contiguous	$-0.046***$		$-0.022***$	
	(0.017)		(0.007)	
Low Prox		-0.002		-0.001
		(0.015)		(0.006)
Med Prox		-0.012		-0.008
		(0.015)		(0.012)
High Prox		$-0.063***$		$-0.053***$
		(0.015)		(0.010)
Adjusted R^2	0.65	0.66	0.43	0.44
observations	1,839	1,839	5,731	5,731

Note: All regressions include worker fixed effects, room×day fixed effects, and control variables at the individual spatial level, including the number of workers working at contiguous positions and the mean of their average productivities. Standard errors are two-way clustered by worker and day. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 9: IV Estimates

First stage results			
	Endogenous variables		
Instruments	Low Prox	Med Prox	High Prox
Assigned Low Prox	0.801***	−0.002	0.004
	(0.013)	(0.005)	(0.006)
Assigned Med Prox	0.002	0.822***	−0.014**
	(0.006)	(0.015)	(0.006)
Assigned High Prox	−0.003	0.001	0.798***
	(0.006)	(0.005)	(0.014)
F-statistic	1359.26	1010.41	1116.95
IV/2SLS			
Variable	log(prod.)	log(wage)	
Low Prox	−0.001	−0.017	
	(0.006)	(0.012)	
Med Prox	−0.003	−0.008	
	(0.010)	(0.014)	
High Prox	−0.056***	−0.040**	
	(0.009)	(0.016)	
observations	5,731	5,731	

Note: Dependent variables in the bottom panel are the worker's log productivity (kilograms/hour) and log hourly wage (daily wage/hour). All regressions include worker fixed effects and room×day fixed effects and control variables at the individual spatial level. Standard errors are two-way clustered by worker and room×day. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 10: Heterogeneous Effects - Production Skill

	Dependent variable: log(productivity)			
Variable	(1)	(2)	(3)	(4)
High Prox	$-0.058***$	$-0.059***$	$-0.049***$	$-0.054***$
	(0.009)	(0.010)	(0.010)	(0.011)
×Own Ability	0.070			
	(0.083)			
×Friend's Ability		$0.186**$		
		(0.090)		
×Moreable			-0.016	
			(0.013)	
×Moreable × |Own Ability - Friend's Ability|				-0.099
				(0.156)
×Lessable × |Own Ability - Friend's Ability|				0.015
				(0.121)
Observations	5,731	5,731	5,731	5,731

Note: Dependent variable is the worker's log productivity (kilograms/hour). All regressions include worker and room×day fixed effects along with the externality variables at the individual spatial level (e.g. friends working next to each other, $\sum_{j \in \mathscr{C}(i)} \text{High Prox}_j$). Bootstrapped standard errors are in parentheses. Standard errors are two-way clustered by worker and room×day level and corrected for sampling variability of the estimated ability term using a Bayesian parametric bootstrap procedure. In column 1 and 2, proximity variables are interacted with estimates on worker's own ability and friend's ability at each proximity, respectively. Column 3 uses an indicator variable equal to one if the reference worker has higher ability than her friends at each proximity, and zero otherwise. Column 4 uses a measure of absolute difference in ability with respect to that of her friends at each proximity. All regressions include a full set of interactions of proximity variables and each ability measure, although not presented in this table. Full table available in Appendix D. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 11: Heterogeneous Effects - Personality Skills

Friendship based on:	IV Estimates - Dependent variable: log(productivity)				
	All Reports			Mutual Reports	
	(1)	(2)	(3)	(4)	(5)
High Prox	−0.055∗∗∗	−0.075∗∗	−0.057∗∗∗	−0.061∗∗∗	−0.086∗∗∗
	(0.009)	(0.030)	(0.009)	(0.009)	(0.029)
× Extraversion	−0.004	−0.005	−0.007	0.007	0.001
	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)
× Agreeableness	0.001	0.000	−0.001	0.000	0.000
	(0.008)	(0.008)	(0.008)	(0.010)	(0.010)
× Conscientiousness	0.039∗∗∗	0.040∗∗∗	0.040∗∗∗	0.027∗∗∗	0.028∗∗∗
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
× Neuroticism	0.010	0.006	0.011	0.003	0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
× Openness	−0.001	0.000	−0.003	0.001	0.002
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
× Age		0.000			0.000
		(0.007)			(0.001)
× Job Tenure		0.001			0.001
		(0.001)			(0.001)
× Ability			0.028		0.040
			(0.059)		(0.075)
× Friend's Ability			0.170∗∗		0.203
			(0.084)		(0.135)
Observations	5,731	5,731	5,731	5,731	5,731

Note: Dependent variable is the worker's log productivity (kilograms/hour). The measure for non-cognitive skills is the worker's standardized score of each personality factor. Scores are standardized using the sample mean and standard deviation. All regressions include room×day fixed effects, proximity variables (including low and medium), proximity variables interacted with Big Five factors, externality variables, and controls at the individual spatial level. Standard errors are two-way clustered by worker and room×day and provided in parentheses. Significance levels are corrected to account for testing five hypotheses, one for each of the five personality dimensions, using the Holm-Bonferroni method. All regressions include interactions with a full set of proximity variables although not presented in this table. Full table available in Appendix D. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table 12: Relationship between WTP to work with friends and worker characteristics

	Willingness to Pay from Wages to Work with Friends (% of wage)		
	(1)	(2)	(3)
Age	0.404	0.427	0.195
	(0.386)	(0.383)	(0.304)
$(\text{Age})^2$	−0.006	−0.006	−0.003
	(0.005)	(0.005)	(0.004)
Months on job	−0.352∗∗∗	−0.346∗∗∗	−0.330∗∗
	(0.128)	(0.121)	(0.133)
$(\text{Months on job})^2$	0.005∗∗	0.005∗∗	0.005∗
	(0.003)	(0.002)	(0.003)
Married	−2.298∗	−2.487∗∗	−1.674∗
	(1.238)	(1.228)	(0.986)
Secondary education	0.662	0.267	0.109
	(0.940)	(0.929)	(0.821)
Number of friends reported	−0.731		
	(0.517)		
Weekly hours spent with friends	0.085		
	(0.203)		
Production Skill ($\hat{\theta}_i$)		−6.024	
		(5.521)	
Extraversion			0.025
			(0.116)
Agreeableness			−0.037
			(0.124)
Conscientiousness			−0.517∗∗∗
			(0.116)
Neuroticism			−0.017
			(0.103)
Openness			−0.063
			(0.092)
Observations	96	96	96
Adjusted R^2	0.19	0.14	0.35

Note: The dependent variable is the willingness to pay, as percentage of wage, to work with friends. Bootstrapped standard errors with 300 replications are presented in parentheses. * $p < .10$, ** $p < .05$, *** $p < .01$.

A Estimation of Worker Ability

To estimate workers' abilities, or permanent productivities, I build on the approach of Mas and Moretti (2009) by exploiting information on workers' positions and social ties to take into account of the fact that a worker's productivity may be affected by the composition of coworkers at contiguous positions and her social relationship with these coworkers. Thus, I estimate the θ_i terms using the following specification:

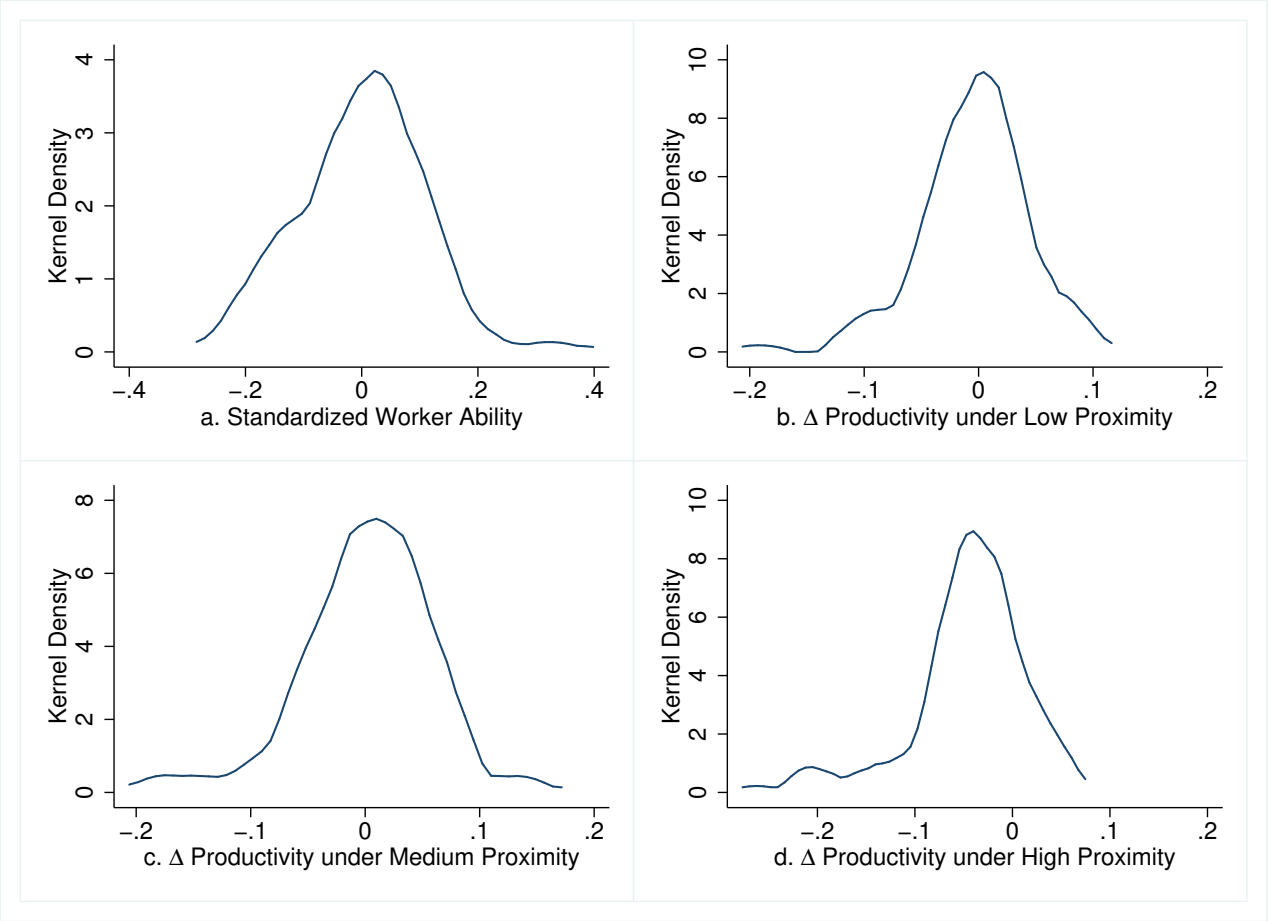
$$y_{ird} = \theta_i + \mathbb{V}'\mathscr{C}_{-ird} + \pi N_{ird} + \phi F_{ird} + \lambda_{rd} + \varepsilon_{ird} \tag{7}$$

where θ_i denotes worker fixed effects; N_{ird} denotes the number of workers that are spatially contiguous to worker i on a given day; F_{ird} denotes the vector of dummy variables that indicate the presence of the focal worker's friend at specific proximities (low, medium, and high proximity); λ_{rd} is a vector of all possible combinations of the room and day.

The term $\mathscr{C}_{-ird}$ accounts for worker-specific influences on coworker productivity. $\mathscr{C}_{-ird} = \{I_1, \ldots, I_{i-1}, I_{i+1}, \ldots, I_k\}$ is a set of dummy variables, one for each worker that shares the same processing room with worker i. Each $I_{j \neq i}$ is equal to one if worker j is working at the same table with worker i and zero, otherwise. The vector $\mathbb{V}$ contains k parameters, one for each worker $1, \ldots, k$. This allows consistency between equation (7) and (5) because the peer effects function, X_{irt} in equation (5), is absorbed by $\mathscr{C}_{-ird}$. Note that this approach is analogous to that used by Arcidiacono et al. (2017) where the authors estimate player specific effects on their teammates' scoring chances in a professional basketball context. In this setting, the idea is to account for productivity effects from the presence of friends that could differ across workers as well as across physical proximities between the worker and her friends.

Figure A-1 plots estimates on worker's ability with respect to the presence of friends at each proximity. Panel A presents kernel density estimates of worker ability, standardized at the room level, when there is no friend at a contiguous position. Panels B, C, and D each plots kernel density estimates of change in worker productivity when a friend is present in low, medium, and high proximity positions, respectively, relative to when no friend is present. The density distribution shown in panel D supports the findings in the main analysis of this paper that workers are less productive when a friend is at high proximity.

Figure A-1: Kernel Density Estimates of Worker Ability Depending on Proximity to Friends



Note: All density estimates use an Epanechnikov kernel with 'optimal' bandwidths. Panel A uses ability estimates $(\hat{\theta}_i)$ standardized with respect to the room average. Panel B, C, and D each plots kernel density estimates of the change in individual worker productivity when working with a friend at the corresponding proximity relative to when working without a friend. For example, a worker who is equally productive when there is a friend at low proximity and when there is no friend will show up in Panel B as having a value of zero on the horizontal axis. A negative value indicates that the worker is less productive in the presence of a friend at the corresponding proximity relative to when there is no friend nearby.

B Robustness Checks

While specification (5) in the main text provides a simple formula for characterizing how the presence of friends at different proximities affects worker productivity it may be worthwhile to explore how the presence of unconnected friend pairs (i.e. no direct friendship exists between the focal worker and workers in the friend pair) working in close proximity may affect the focal worker's productivity. A friend pair may be disruptive to others if they engage in chats during work. Goofing off with one another may also spawn negative attitudes in nearby workers. Failure to take into account potential spillovers from other friend pairs may result in misinterpretation of the effect of friends on productivity.

To allow for possible externalities from other friend pairs, I include variables that indicate whether any of the workers, excluding the focal worker, at contiguous positions have a friend working in specific proximities. This can be written as

$$\begin{aligned} y_{irt} &= \gamma_L \cdot \text{Low Prox}_{irt} + \gamma_M \cdot \text{Med Prox}_{irt} + \gamma_H \cdot \text{High Prox}_{irt} \\ &\quad + \sum_{j \in \mathscr{C}(i)} (\delta_L \cdot \text{Low Prox}_{jrt} + \delta_M \cdot \text{Med Prox}_{jrt} + \delta_H \cdot \text{High Prox}_{jrt}) \\ &\quad + X_{irt} + \theta_i + \lambda_{rt} + \varepsilon_{irt} \end{aligned} \tag{8}$$

where Low Prox_{jrt}, Med Prox_{jrt}, and High Prox_{jrt} are indicator variables equal to one if worker j in room r on day t has a friend working at low proximity, medium proximity, and high proximity, respectively. These externality variables are summed over the set of workers at spatially contiguous positions to worker i, denoted by $\mathscr{C}(i)$. Then, δ_L is the externality on productivity from an additional contiguous worker, which may not necessarily be in low proximity to the focal worker, working with a friend at low proximity.[27] Similarly, δ_M and δ_H are the externalities arising from an additional worker at a contiguous position working at medium proximity and high proximity to her friend, respectively. If both workers of a friend pair are working nearby, this is counted as two rather than one. In this way, a friend pair with both workers being spatially contiguous to the focal worker could be considered twice as influential as when only one worker from the friend pair is contiguous to the focal worker.

Column 1 of Table B-1 provides IV estimates for own proximity variables ($\gamma_L, \gamma_M, \gamma_H$) and contiguous workers' proximity variables ($\delta_L, \delta_M, \delta_H$). Estimates on own proximity variables are almost unchanged.[28] However, the estimate on other workers' high-proximity variable suggests that working at positions near a high-proximity friend pair is associated with a 2 percent loss in productivity. This implies that the presence of high-proximity friends negatively affects other workers, which is possible if a friend pair distracts their surrounding peers. In contrast, friend pairs in low- or medium- proximity positions have no influence on their peer's productivity. The result is significant with the standard errors being clustered two ways by worker and room$\times$day level to allow for arbitrary correlations of the error terms across workers in the same room and day. Failure

[27] In general, it is possible to have one externality variable for each proximity of contiguous worker (to focal worker) and proximity of contiguous worker to friend (of contiguous worker) pair. This would result in nine externality variables. I only consider the proximity of the contiguous worker to her friend to simplify the equation.

[28] Taken together with the significant estimate on contiguous workers' high proximity variable, this indicates that the variation in a worker's proximity to own friends is orthogonal to the variation in contiguous coworker's proximity to friends.

to account for this is especially problematic when the regressors of interest ($\delta_L, \delta_M, \delta_H$) are also correlated across workers within the room×day level, which is known to lead to an over-rejection of the true null hypothesis (Wooldridge, 2003; Angrist and Pischke, 2009).[29]

Next I perform a series of robustness checks. Column 2 includes interaction terms between each proximity variable and an indicator variable that is equal to one if the friend's position is at the same table, and zero otherwise. At each level of proximity, the interaction term captures the difference in the productivity effects from the presence of a friend at the same table relative to the presence of a friend at a different table. If workers were to behave differently depending on whether the friend is at the same table or not — possibly due to the input allocation process — the coefficient on any of the interaction terms would be nonzero. In column 2, coefficient estimates are shown to be close to zero.

Because some work stations, in particular, stations at the corner of the rooms, only have one adjacent work station, if these work stations naturally provide higher productivity then this would create a spurious negative correlation between the presence of friend and productivity. The estimates in column 3 indicate that the main finding is not driven by correlations associated with working in a corner position. In columns 4-6, I include different sets of fixed effects to test the robustness of the main result to different specifications. Column 4 uses table×day fixed effects instead of room×day fixed effects and finds larger declines in productivity when a friend is in high proximity. Columns 5 and 6 show that including work station fixed effects in the main specification makes a minimal difference in the estimates. Column 7 assesses whether the effect on worker productivity from working with a friend changes over the five month experimental period. The estimate on the interaction term, High Prox×Month, indicates that the effect neither intensified nor abated during the experiment.

Next, I examine whether and to what extent the estimate of the effect of working with friends depends on how friendship is defined between two workers. The purpose of this exercise is to test the robustness of the self-reported friendship measure that is widely used in this study. In general, I rerun the IV regression used in Table 9 using different definitions of friendships.

The estimation results are reported below in Table B-2. For comparison, column 1 shows the IV estimates presented in Table 9. Column 2 presents results using only reciprocal connections in the sense that workers i and j are friends if they both reported each other. The estimates are close to those in column 1. Column 3 uses only reported friendships and excludes those that are mutual to gauge how the effect differs when the report is not reciprocal. That is, if worker i reported j but j did not report i then j appears as i's friend but i would not appear as j's friend. Note that the median worker in the sample had one such relationship. The size of the estimate on High Prox is smaller than the previous two columns but still remains statistically significant. In contrast, as shown in column 4, when friendship is defined to exist only when a worker receives but not reports that same worker, the estimate loses significance.

In column 5, I estimate the proximity coefficients using only friendships that have formed prior to their current job. The effect size is slightly larger than when using all friendships. This suggests that workers are less productive when working next to a friend that they have known before their current job than when working next to a friend they have met on the job. It is also possible that

[29]To see why the regressors are correlated, if worker i has a friend pair working at a contiguous position, then that friend pair also appears in the regressors of all other workers that are contiguous to the friend pair. The room×day cluster correlation for other workers' proximity variables at low, medium, and high proximity is 0.12, 0.07, and 0.12, respectively.

the self-reports are just a list of coworkers who work nearby and happen to chat often. To partially address this concern, in the last column, I limit friendships to those that have been rarely observed working contiguously to each other before the experiment but was reported by at least one worker during the baseline survey on friendships. In this way, friends here are the ones that a worker has been less likely to work nearby and arguably less likely to have been reported just because they often chat with each other during work. The coefficient estimate for working in high proximity is negative and statistically significant, although the magnitude is about 9 percent smaller than the benchmark estimate in column 1. The result indicates that even among friendships that have been observed to work nearby less often prior to the experiment, there is a significant negative effect on productivity when they are assigned to work alongside each other.

The attrition rate during the experiment period was low: 101 of the 105 workers were still working at the end of the experiment. Nonetheless, the mean absence rate during the experiment was 21.4% which creates a missing data problem.[30] In order to examine the robustness of my main result, I use the bounding approach of Lee (2009) to construct lower and upper bounds for the effect of working alongside friends. Taking the weighted average of individual estimates based on number of observations, I obtain a lower bound of -0.0287 and an upper bound of -0.0944, compared to the IV estimate of -0.056 in Table 9. The lower bound is only relevant, however, if workers were able to anticipate their assignments and decided not to show up on days when none of their friends were assigned to work alongside them and they were expecting to be less productive than other days. However, this is unlikely, since, as mentioned above, assignment to friend is not a significant predictor of work attendance.

[30]The mean absence rate during the six weeks before the experiment was 21.8%. I found no significant difference in average worker attendance rates between the two periods (p-value = 0.65). Moreover, although there is a 2.1% difference in the absence rate during the experiment period between when a worker is assigned to work next to a friend (19.8%) and when there is no friend assigned next to the worker (21.9%) the difference is neither statistically significant nor is friend assignment a predictor of work attendance (results not reported here).

Table B-1: Robustness Checks

	IV Estimates - Dependent Variable: log(productivity)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Low Prox	0.001	−0.008	0.001	0.001	0.000	0.001	0.026∗∗
	(0.006)	(0.012)	(0.006)	(0.010)	(0.006)	(0.010)	(0.011)
Med Prox	−0.003	−0.003	−0.006	0.023∗	−0.002	0.026∗∗	−0.002
	(0.010)	(0.010)	(0.011)	(0.012)	(0.010)	(0.012)	(0.019)
High Prox	−0.058∗∗∗	−0.051∗∗∗	−0.060∗∗∗	−0.069∗∗∗	−0.057∗∗∗	−0.069∗∗∗	−0.057∗∗∗
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.012)	(0.015)
$\sum_{j\in\mathscr{C}(i)}$ Low Prox$_j$	−0.001	−0.001	−0.001	0.002	0.000	0.002	0.000
	(0.003)	(0.003)	(0.003)	(0.005)	(0.003)	(0.005)	(0.003)
$\sum_{j\in\mathscr{C}(i)}$ Med Prox$_j$	−0.002	−0.001	−0.001	0.011∗∗	−0.001	0.012∗∗∗	−0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$\sum_{j\in\mathscr{C}(i)}$ High Prox$_j$	−0.010∗∗	−0.010∗∗	−0.010∗∗	−0.017∗∗∗	−0.010∗∗	−0.017∗∗∗	−0.010∗∗
	(0.005)	(0.004)	(0.004)	(0.006)	(0.005)	(0.006)	(0.004)
Low Prox × Same Table		0.011					
		(0.013)					
High Prox × Same Table		−0.010					
		(0.010)					
Low Prox × Corner Position			0.003				
			(0.013)				
Med Prox × Corner Position			0.012				
			(0.016)				
High Prox × Corner Position			0.021				
			(0.013)				
Low Prox × Month							−0.014∗∗
							(0.006)
Med Prox × Month							−0.001
							(0.007)
High Prox × Month							−0.001
							(0.007)
Include X_{irt}?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Room × Day FE?	Yes	Yes	Yes	No	Yes	No	Yes
Table × Day FE?	No	No	No	Yes	No	Yes	No
Workstation FE?	No	No	No	No	Yes	Yes	No

Note: X_{irt} is a vector of control variables at the individual spatial level, which includes the number of workers working at contiguous positions and the mean of their average productivities. Same Table is an indicator variable equal to one if the friend at the respective proximity is at the same table with the reference worker, and zero otherwise. Corner position indicates whether the worker was assigned to a corner position. Month represents a linear monthly time trend. Standard errors are two-way clustered by worker and room×day. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table B-2: Does the estimate depend on how friendship is defined?

	IV Estimates - Dependent variable: log(productivity)					
Friendship exists if	Report or receive	Both Report	Report but not receive	Receive but not report	Formed before current job	Work apart (pre-exper.)
Variable	(1)	(2)	(3)	(4)	(5)	(6)
Low Prox	−0.001	0.005	−0.020	0.003	−0.004	0.002
	(0.006)	(0.008)	(0.015)	(0.013)	(0.013)	(0.009)
Med Prox	−0.003	−0.007	0.010	0.001	−0.012	0.003
	(0.010)	(0.014)	(0.012)	(0.012)	(0.018)	(0.009)
High Prox	−0.056***	−0.057***	−0.046***	−0.027	−0.060***	−0.051***
	(0.009)	(0.010)	(0.015)	(0.020)	(0.014)	(0.013)
Mean (# Friendships)	4.94	2.90	1.12	0.92	1.27	2.52
Median (# Friendships)	5	3	1	1	1	2
Observations	5,731	5,731	5,731	5,731	5,731	5,731

Note: Column 1 defines two workers as friends if either one reported the other. In column 2, a friendship exists only if two workers reported each other. Columns 3 and 4 are set differences between the set of friends reported by the worker (outgoing) and the set of reports received from other workers (incoming). In column 5, two workers are defined as friends if either one reported the other and if their social connection formed before starting work at their current job: duration of friendship $>$ current job tenure. Column 6 uses either reported or received friends but only those who rarely worked near each other during the pre-experiment period. All regressions include room$\times$day fixed effects, externality variables, and controls at the individual spatial level. Standard errors are two-way clustered at the worker and room$\times$day level. * $p < .10$, ** $p < .05$, *** $p < .01$.

C Willingness to Pay to Work With Friends

This section describes the structural analysis of estimating workers' willingnesses to pay from wages to work with friends. To this purpose, I draw on a probabilistic choice model in which workers decide whether or not to work with friends. I then estimate each worker's utility value of working with friends using data from both the experiment period and the pre-experiment period. To take into account of the difference in worker effort between when working with friends and when working without friends, I include in the estimation model a cost of effort function for each worker and state (when working with friends and when working without friends). Once I derive the utility value for each worker I convert it into wage units using a compensating differentials framework. With regard to how sensitive the estimates are to the assumption of friendship, I conduct a robustness check later in the section.

C.1 Conceptual framework on the selection of working with friends

First, I model how the worker selects whether or not to work with friends using a binary choice framework. The goal is to build a model that allows estimation of each individual worker's consumption value of working with friends. Let y_i^f and y_i^{nf} denote worker i's utility maximizing productivity levels derived from equations (2) and (3), respectively. Suppose workers have heterogeneous intrinsic valuations for working with friends: worker i derives a constant utility, s_i, from working with friends. I specify worker i's utility from working with, and without, friends using the following random utility model:

$$u_i^f = w_i^f - c_i^f + s_i + \varepsilon_i^f \tag{9}$$

$$u_i^{nf} = w_i^{nf} - c_i^{nf} + \varepsilon_i^{nf} \tag{10}$$

where

$$w_i^f = W(h+\rho \cdot y_i^f),\ w_i^{nf} = W(h+\rho \cdot y_i^{nf}),\ c_i^f = C(y_i^f, \theta, N, f),\ c_i^{nf} = C(y_i^{nf}, \theta, N, nf) \tag{11}$$

and ε_i^f and ε_i^{nf} are mean-zero stochastic error terms. Fixed hourly wage and piece rate wage are each denoted by h and ρ, respectively. Denote F_i as the indicator variable equal to one if worker i is working with a friend and, zero otherwise. Then worker i chooses the presence of friends according to

$$F_i = \begin{cases} 1 & \text{if } u_i^f > u_i^{nf} \\ 0 & \text{otherwise.} \end{cases} \tag{12}$$

An implication of the theory of compensating wage differentials is that workers are willing to forgo wage in exchange of desirable work attributes that are nonpecuniary and consumed as part of the work (Rosen, 1986). In the current context, the attribute of interest is working with friends. Wage is a function of individual productivity. If working with friends has a negative impact on productivity then working with friends entails a monetary cost in the amount of the forgone potential wage. Yet, if workers consider working with friends as a desirable attribute then we would observe workers choosing to work with friends even in the presence of negative impacts on productivity and, therefore, lower earnings.

This model implicitly assumes that workers are knowledgeable about their utility differences between the two states and that they are rationally deciding whether or not to work with friends. In fact, either of these assumptions may fail. Unfortunately, I currently do not have sufficient data to independently test these assumptions. Later in this section, I return to this issue by investigating how the probability to work with friends varies across subgroups with different levels of education, work experience, and personality skills. Differences in selection behavior along these attributes could be indicative of why some workers choose to work with their friends more often than their counterparts.

C.2 Model Assumptions and Estimation Strategy

For estimation, I make the following model assumptions. Since effort is not directly observable I substitute effort with productivity, measured as kilograms of fish processed per hour. Assume that the wage benefit function is of the following CRRA type,

$$W(y) = \frac{(h + \rho \cdot y)^{1-\delta}}{1-\delta} \tag{13}$$

where h is the fixed wage (per hour), ρ is the piece rate (per kilogram), and y is productivity (kilograms per hour). I set δ to $\frac{1}{2}$. A sensitivity analysis, which is available from the author upon request, shows that the result is robust to a range of values for $\delta < 1$. Cost function is a quadratic function of productivity,

$$C(y, \theta, f) = \begin{cases} \frac{1}{2}\theta^{f} y^2 & \text{if friend is present alongside the worker,} \\ \frac{1}{2}\theta^{nf} y^2 & \text{otherwise} \end{cases} \tag{14}$$

where θ^{f} and θ^{nf} are cost of effort parameters dependent on whether or not a friend is present nearby, respectively. I substitute θ^{f} with the inverse of the estimate on the worker fixed effect when working alongside friends, $1/\hat{\theta}_i^{H}$, and θ^{nf} with the inverse of the estimate on the worker fixed effect when working without friends, $1/\hat{\theta}_i$. This way the cost of effort parameters are interpreted as the reciprocals of the worker's permanent productivity, or skill, when working alongside friends and when working without friends, respectively.

I use a random utility model assuming that error terms, $(\varepsilon_i^{f}, \varepsilon_i^{nf})$, are distributed i.i.d according to a Type-1 extreme value distribution. Then, from equations (9)-(12), I obtain the probability of worker i working alongside a friend as follows,

$$\Pr(\mathrm{F}_i = 1) = \Lambda(s_i - x_i) \tag{15}$$

where Λ is the cdf of the logistic distribution and x_i is the difference in wage and effort costs between the two states $((w_i^{nf} - c_i^{nf}) - (w_i^{f} - c_i^{f}))$. The parameter of interest is s_i which is worker i's consumption value of working with friends. The right hand side of equation (15) indicates a worker's preference based on the cost and benefit she incurs. Identification is based on the difference between the hypothetical probability of working alongside friends, drawn from the utility difference (x_i), and the actual observed probability during the experiment period $(\Pr(\mathrm{F}_i = 1))$. The

maximum likelihood estimator for s_i in equation (15) is obtained in explicit form as

$$s_i = x_i + \text{logit}\left(\frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}}\right) \tag{16}$$

where $\mathrm{I}_{\{F_{it}=1\}}$ is an indicator variable equal to one if on day t worker i has a friend at high proximity, and zero otherwise.[31]

Calculating s_i in equation (16) requires knowledge on x_i, and $F_{i1},\ldots,F_{iT}$. I use individual worker data from the experiment period to derive estimates on x_i's.[32] For data on the probability of working alongside friends, $F_{i1},\ldots,F_{iT}$, I use worker position records from the pre-experiment period. However, because the number of positions in the processing room is fixed, this may have imposed a constraint on the worker's choice set of available positions. For instance, a worker may have wanted to work alongside a friend but in case there is no empty position she may not have been able to. Accordingly, I adjust a worker's observed probability by the difference between 0.5, which is the median of the logistic distribution, and the predicted probability of working alongside a friend assuming that positions were randomized during this period.[33] The idea is to use each worker's predicted probability based on randomization and the number of friends present in the room as the benchmark value (which is what would be the observed probability if a worker were

[31]To see this, the log-likelihood function for worker i is

$$\log \mathscr{L} \propto \left(\frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}}\right)\cdot \log\Lambda(s_i - x_i) + \left(1 - \frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}}\right)\cdot \log(1-(\Lambda(s_i-x_i)) \tag{17}$$

and the first order condition is

$$\frac{d\ log\mathscr{L}}{d\ s_i} = \left(\frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}}\right)\cdot \frac{\lambda(s_i-x_i)}{\Lambda(s_i-x_i)} - \left(1 - \frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}}\right)\cdot \frac{\lambda(s_i-x_i)}{1-\Lambda(s_i-x_i)} = 0. \tag{18}$$

Rearranging equation (18), I obtain

$$\frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}} = \Lambda(s_i - x_i). \tag{19}$$

Under the assumption that the scale parameter of the logistic distribution is one, I can derive s_i as

$$s_i = x_i + \text{logit}\left(\frac{1}{T}\sum_{t=1}^{T} \mathrm{I}_{\{F_{it}=1\}}\right) \tag{20}$$

since logit function is the inverse of the cdf of the logistic distribution.

[32]Specifically, since x_i is unobservable I approximate x_i with $\hat{x}_i$ which is the difference in mean net utility, excluding valuation on working with friends, between when working with friends and when working without friends at high proximity. That is,

$$\hat{x}_i = \frac{1}{T_{nf}}\sum_{t=1}^{T_{nf}} \left\{2\left(h+\rho\cdot y_{it}\right)^{\frac{1}{2}} - \frac{1}{2}\theta_i^{nf}\left(y_{it}\right)^2\right\} - \frac{1}{T_f}\sum_{k=1}^{T_f} \left\{2\left(h+\rho\cdot y_{ik}\right)^{\frac{1}{2}} - \frac{1}{2}\theta_i^{f}\left(y_{ik}\right)^2\right\} \tag{21}$$

where $t = 1,\ldots,T_{nf}$ denote days without friends at high proximity and $k = 1,\ldots,T_f$ denote days with friends at high proximity.

[33]To derive the predicted probability, I run 500 simulations of randomly assigning workers to positions for all workdays in the pre-experiment period. I exclude days on which there was no friend present in the room.

to be indifferent) instead of using the unconditional median (0.5).

Table C-1 provides summary statistics on the unadjusted observed probability of working with at least one friend at various levels of proximity during the pre-experiment period. Column 1 reports the mean probability of working with at least one friend in each of the proximities when at least one friend was present at the room. On average, workers are working next to at least one friend in high proximity half of the time, or in 9 out of 18 workdays. Column 2 reports the mean of predicted probabilities derived from 500 simulations of worker positions assuming random assignment. I find significantly large differences between observed and randomized probabilities.

Since I do not observe differences in productivity when friends are working at low or medium proximities relative to when no friend is present, I only focus on workers selecting into working with friends at high proximity. Figure C-1 plots cumulative distribution functions of both observed and predicted probabilities of the presence of at least one friend at high proximity in the pre-experiment period. The cumulative distribution function obtained from observed data lies largely to the right of the cumulative distribution function generated by simulations of random worker positions. A Kolmogorov-Smirnov test of equality significantly rejects at the 1 percent level that the two distributions are equal. Overall evidence suggests that workers had a tendency to work with friends in high proximity — alongside each other.

C.3 Worker's Consumption Value of Working with Friends

Figure C-2 presents the empirical cumulative distribution function of estimates of worker's valuation on socializing with friends. Overall, 13 out of 98 workers show a negative value on working alongside friends. Interestingly, workers with negative estimates on value of socializing are less likely to work with their friends than what is predicted under random assignment even when they are more productive when working alongside friends compared to when no friend is alongside.

Next, I use estimates on each worker's consumption value of working with friends to obtain a back-of-the-envelope calculation of the percentage of wage that workers are willing to pay to work with friends. The idea is to derive the amount of wage loss, as a percent of wage when working without friends, that leaves a worker indifferent between working without friends and working alongside friends, in which the estimated term $\hat{s}_i$ captures the worker's consumption value of her friends presence. Figure 4 presents a histogram of the percentage of wage that workers are willing to forgo to socialize with friends. Tthe median worker is willing to forgo 4.5 percent of her wage.[34] Workers in the top quartile of the distribution are willing to forgo at least 8 percent of their wage.

To test robustness, I check whether the estimates are sensitive to how friendship is defined. Currently I define two workers as friends if either one of them reported the other as a friend in the baseline survey. While 55 percent of the reported friendships were mutually reported, 45 percent were unilateral reports. Including unilaterally reported friendships may lead to an overestimation of worker's value of working with friends if only the respondent worker enjoys the presence of the friend she reported in the survey while the reported friend does not. To be conservative, I restrict the friendship sample to mutually reported friendships and repeat the estimation strategy presented in the previous section. Figure C-3 presents the empirical CDF of workers' consumption values using

[34]For comparison, in the garment factory setting of Hamilton et al. (2003), high productivity workers under individual production switched to team production at the cost of forgoing approximately 8 percent of their wage. Team production enabled workers to socialize with coworkers in their team but, at the same time, accompanied others changes as well; for instance, standing instead of sitting in chairs and specialization into different tasks.

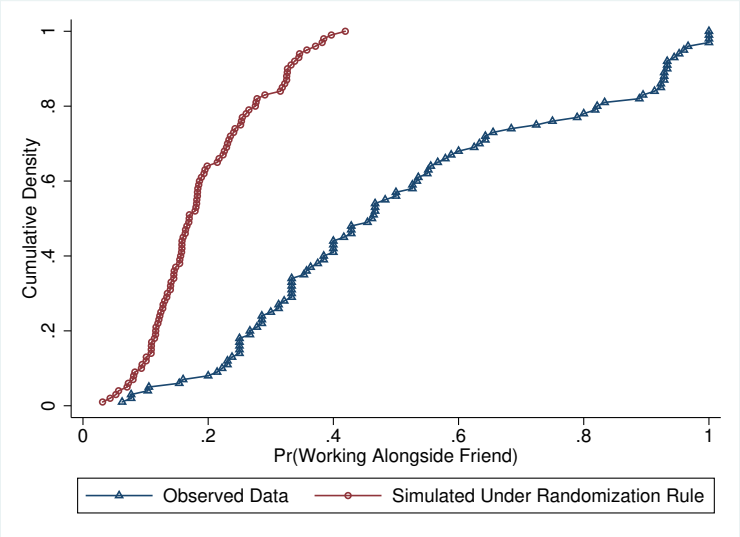
only mutually reported friendships. The Kolmogorov-Smirnov equality of distribution test fails to reject that the unrestricted (all friendships) and the restricted (mutual friendships) distributions are equal (p-value = 0.994). This suggests that the estimates in Figure C-2 are not sensitive to how friends are defined.

Table C-1: Proximity to Friends during Pre-Experiment Period

Proximity (=1 if yes)	Mean (S.D.)		Difference (1) - (2)	P-value
	Observed (1)	Simulated (2)		
Contiguous	0.87	0.41	0.45	0.00
	(0.17)	(0.17)	(0.02)	
Low Prox	0.49	0.19	0.29	0.00
	(0.25)	(0.11)	(0.03)	
Med Prox	0.51	0.12	0.39	0.00
	(0.24)	(0.06)	(0.02)	
High Prox	0.51	0.19	0.32	0.00
	(0.27)	(0.09)	(0.03)	
Total workdays	32			

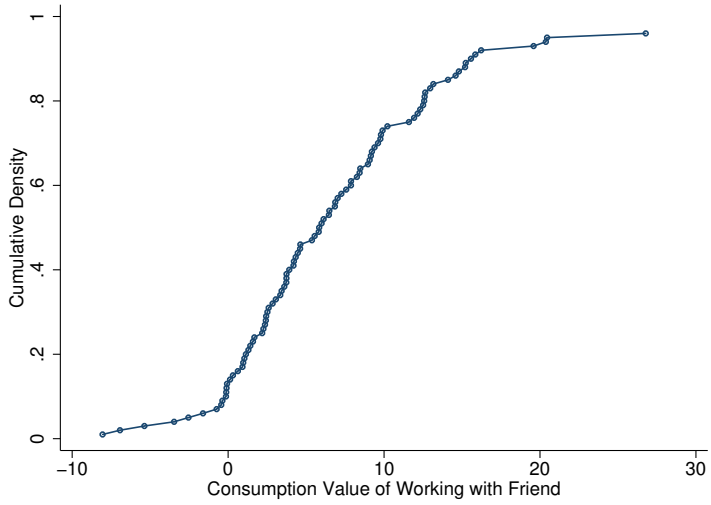
Note: Statistics reported in column 2 are obtained from 500 simulations based on a random assignment rule using the number of friends and coworkers present in the processing room for each worker and day. Columns 1 and 2 report standard deviations in parentheses. Column 3 reports standard errors from t-tests of difference in parentheses. One sided p-values are reported in the last column.

Figure C-1: Cumulative Distribution Functions of the Probability of a Friend at High Proximity Positions



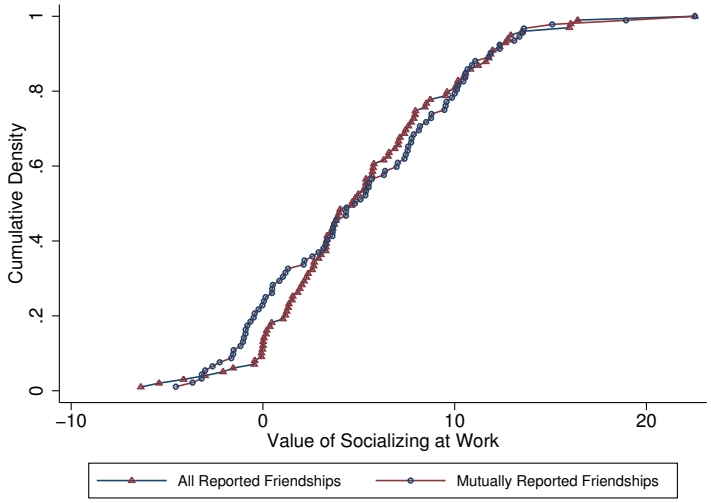
Note: Counterfactual data is from 500 simulations of worker positions with random assignment during the pre-experiment period. A comparison of the two distributions using the Kolmogorov-Smirnov equality of distribution test rejects that the two distributions are equal (*p-value* = 0.00).

Figure C-2: Cumulative Distribution Function of Estimates on Consumption Value of Working with Friends



Note: This figure plots the cumulative distribution function of the estimate of s_i in equation (16).

Figure C-3: Empirical CDF of Workers' Value of Working with Friends (Mutually Reported Friends)



Note: Estimates on mutually reported friendships are derived only using friendships that are reported from both sides of the relationship. A Kolmogorov-Smirnov equality of distribution test fails to reject that the two distributions are equal (*p-value* = 0.316).

D Additional Tables & Figures

Table D-1: Heterogeneous Effects - Production Skill

	IV - Dependent variable: log(productivity)			
Variable	(1)	(2)	(3)	(4)
Low Prox	0.001	0.001	0.000	0.001
	(0.006)	(0.006)	(0.012)	(0.013)
×Own Ability	0.064			
	(0.066)			
×Friend's Ability		0.251		
		(0.170)		
×Moreable			0.001	
			(0.017)	
×Moreable×|Own Ability - Friend's Ability|				−0.013
				(0.163)
×Lessable×|Own Ability - Friend's Ability|				0.016
				(0.160)
Med Prox	−0.003	−0.004	−0.002	−0.007
	(0.010)	(0.010)	(0.010)	(0.014)
×Own Ability	−0.035			
	(0.085)			
×Friend's Ability		−0.025		
		(0.068)		
×Moreable			−0.002	
			(0.010)	
×Moreable×|Own Ability - Friend's Ability|				0.026
				(0.104)
×Lessable×|Own Ability - Friend's Ability|				0.041
				(0.097)
High Prox	−0.058***	−0.059***	−0.049***	−0.054***
	(0.009)	(0.010)	(0.010)	(0.011)
×Own Ability	0.070			
	(0.083)			
×Friend's Ability		0.186**		
		(0.090)		
×Moreable			−0.016	
			(0.013)	
×Moreable × |Own Ability - Friend's Ability|				−0.099
				(0.156)
×Lessable × |Own Ability - Friend's Ability|				0.015
				(0.121)
Observations	5,731	5,731	5,731	5,731

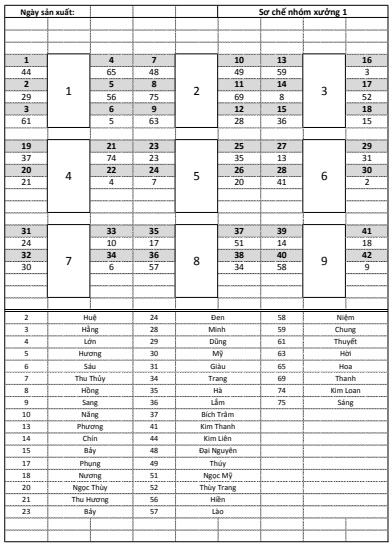
Note: Dependent variable is the worker's log productivity (kilograms/hour). All regressions include worker and room×day fixed effects along with all externality variables at the individual spatial level. Standard errors are two-way clustered by worker and room×day level and corrected for the sampling variability of the estimated ability term using a Bayesian parametric bootstrap procedure. In column 1 and 2, proximity variables are interacted with estimates on worker's own ability and friend's ability at each proximity, respectively. Column 3 uses an indicator variable equal to one if the reference worker has higher ability than her friends at each proximity, and zero otherwise. Column 4 uses a measure of absolute difference in ability with respect to that of her friends at each proximity. * $p < .10$, ** $p < .05$, *** $p < .01$.

Table D-2: Heterogeneous Effects - Personality Skills

	IV Estimates - Dependent variable: log(productivity)				
Friendship based on:	All Reports			Mutual Reports	
Variable	(1)	(2)	(3)	(5)	(6)
Low Prox	0.000	−0.004	−0.001	0.006	−0.023
	(0.005)	(0.023)	(0.005)	(0.007)	(0.018)
× Extraversion	0.008	0.008	0.007	0.007	0.005
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
× Agreeableness	−0.006	−0.006	−0.006	−0.001	0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
× Conscientiousness	0.013	0.012	0.012	0.011	0.007
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)
× Neuroticism	0.008	0.009	0.009	0.009	0.011
	(0.006)	(0.006)	(0.007)	(0.008)	(0.008)
× Openness	0.005	0.005	0.005	−0.001	−0.001
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
× Age		0.000			0.001
		(0.001)			(0.001)
× Job Tenure		0.000			−0.001
		(0.001)			(0.001)
× Ability			0.026		0.083
			(0.072)		(0.072)
× Friend's Ability			0.226		0.064
			(0.185)		(0.211)
Med Prox	−0.002	0.000	−0.002	−0.004	−0.009
	(0.010)	(0.033)	(0.010)	(0.013)	(0.043)
× Extraversion	−0.014	−0.014	−0.014	−0.018	−0.014
	(0.008)	(0.008)	(0.008)	(0.010)	(0.010)
× Agreeableness	−0.007	−0.008	−0.008	−0.003	−0.001
	(0.008)	(0.007)	(0.008)	(0.009)	(0.008)
× Conscientiousness	0.010	0.009	0.010	0.008	0.007
	(0.008)	(0.008)	(0.008)	(0.014)	(0.015)
× Neuroticism	−0.006	−0.007	−0.006	−0.001	−0.003
	(0.009)	(0.009)	(0.009)	(0.014)	(0.015)
× Openness	0.005	0.005	0.005	0.002	0.001
	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
× Age		0.000			0.000
		(0.001)			(0.001)
× Job Tenure		0.000			0.000
		(0.001)			(0.001)
× Ability			−0.008		−0.117
			(0.065)		(0.132)
× Friend's Ability			0.008		−0.041
			(0.051)		(0.105)
Worker FE?	Yes	Yes	Yes	Yes	Yes
Observations	5,731	5,731	5,731	5,731	5,731

Note: This table reports estimates not reported in table 11. Dependent variable is the worker's log productivity (kilograms/hour). The measure of non-cognitive skills is the worker's standardized score for each personality factor. Scores are standardized using the sample mean and standard deviation. The Big Five Index is obtained as a equally weighted average of the five standardized scores, reverse scoring for Neuroticism. All regressions include room×day fixed effects and externality variables, and controls at the individual spatial level. Standard errors are two-way clustered by worker and room×day level. Regression results from dropping worker fixed effects and using different degree of polynomials of worker covariates show similar results to that reported here. * $p < .10$, ** $p < .05$, *** $p < .01$.

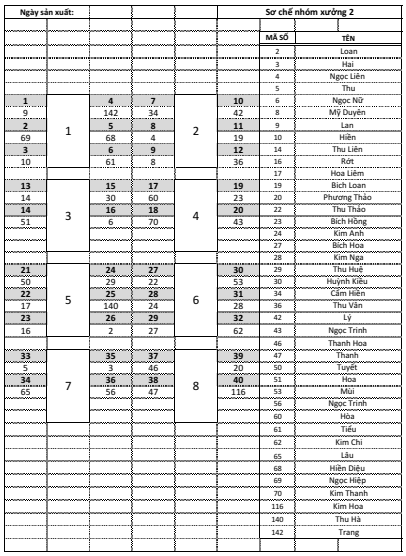
Figure D-1: Worker Position Assignment Forms



Ngày sản xuất:					Sơ chế nhóm xưởng 1				
1		**4**	**7**		**10**	**13**		**16**	
44	1	65	48	2	49	59	3	3	
2		**5**	**8**		**11**	**14**		**17**	
29		56	75		69	8		52	
3		**6**	**9**		**12**	**15**		**18**	
61		5	63		28	36		15	
19		**21**	**23**		**25**	**27**		**29**	
37	4	74	23	5	35	13	6	31	
20		**22**	**24**		**26**	**28**		**30**	
21		4	7		20	41		2	
31		**33**	**35**		**37**	**39**		**41**	
24	7	10	17	8	51	14	9	18	
32		**34**	**36**		**38**	**40**		**42**	
30		6	57		34	58		9	

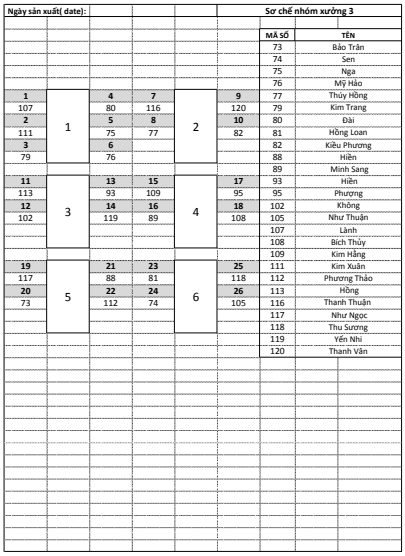
2	Huệ	24	Đen	58	Niêm
3	Hằng	28	Minh	59	Chung
4	Lớn	29	Dũng	61	Thuyết
5	Hương	30	Mỹ	63	Hời
6	Sáu	31	Giàu	65	Hoa
7	Thu Thủy	34	Trang	69	Thanh
8	Hồng	35	Hà	74	Kim Loan
9	Sang	36	Lắm	75	Sáng
10	Năng	37	Bích Trâm		
13	Phương	41	Kim Thanh		
14	Chín	44	Kim Liên		
15	Bảy	48	Đại Nguyên		
17	Phụng	49	Thúy		
18	Nương	51	Ngọc Mỹ		
20	Ngọc Thúy	52	Thúy Trang		
21	Thu Hương	56	Hiền		
23	Bảy	57	Lào		

(a) Processing Room 1



Ngày sản xuất:					Sơ chế nhóm xưởng 2		
						MÃ SỐ	TÊN
						2	Loan
						3	Hai
						4	Ngọc Liên
						5	Thu
1		**4**	**7**		**10**	6	Ngọc Nữ
9	1	142	34	2	42	8	Mỹ Duyên
2		**5**	**8**		**11**	9	Lan
69		68	4		19	10	Hiền
3		**6**	**9**		**12**	14	Thu Liên
10		61	8		36	16	Rớt
						17	Hoa Liễm
13		**15**	**17**		**19**	19	Bích Loan
14	3	30	60	4	23	20	Phương Thảo
14		**16**	**18**		**20**	22	Thu Thảo
51		6	70		43	23	Bích Hồng
						24	Kim Anh
						27	Bích Hoa
						28	Kim Nga
21		**24**	**27**		**30**	29	Thu Huệ
50	5	29	22	6	53	30	Huỳnh Kiều
22		**25**	**28**		**31**	34	Cẩm Hiền
17		140	24		28	36	Thu Vân
23		**26**	**29**		**32**	42	Lý
16		2	27		62	43	Ngọc Trinh
						46	Thanh Hoa
33		**35**	**37**		**39**	47	Thanh
5	7	3	46	8	20	50	Tuyết
34		**36**	**38**		**40**	51	Hoa
65		56	47		116	53	Mùi
						56	Ngọc Trinh
						60	Hòa
						61	Tiếu
						62	Kim Chi
						65	Lâu
						68	Hiền Diệu
						69	Ngọc Hiệp
						70	Kim Thanh
						116	Kim Hoa
						140	Thu Hà
						142	Trang

(b) Processing Room 2



Ngày sản xuất(date):					Sơ chế nhóm xưởng 3		
						MÃ SỐ	TÊN
						73	Bảo Trân
						74	Sen
						75	Nga
						76	Mỹ Hảo
1		**4**	**7**		**9**	77	Thúy Hồng
107	1	80	116	2	120	79	Kim Trang
2		**5**	**8**		**10**	80	Đài
111		75	77		82	81	Hồng Loan
3		**6**				82	Kiều Phương
79		76				88	Hiền
						89	Minh Sang
11		**13**	**15**		**17**	93	Hiền
113	3	93	109	4	95	95	Phượng
12		**14**	**16**		**18**	102	Không
102		119	89		108	105	Như Thuận
						107	Lành
						108	Bích Thúy
						109	Kim Hằng
19		**21**	**23**		**25**	111	Kim Xuân
117	5	88	81	6	118	112	Phương Thảo
20		**22**	**24**		**26**	113	Hồng
73		112	74		105	116	Thanh Thuận
						117	Như Ngọc
						118	Thu Sương
						119	Yến Nhi
						120	Thanh Vân

(c) Processing Room 3

Note: The number of tables and worker positions are different across rooms due to differences in room sizes. Pseudonyms are used to generate these samples and not that of the actual workers.