2013

Firing Threats and Tenure: Incentive Effects and Impression Management

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Abstract

We study the effect of firing threats and tenure in a virtual workplace that reproduces features of existing organizations. We show that organizations in which bosses can fire up to one third of their workforce produce twice more than organizations for which firing is not possible. Firing threats sharply decrease on-the-job leisure activities. Nevertheless, organizations endowed with firing threats significantly underperformed those using individual incentives. Our analysis also indicates that, in the presence of firing threats, employees engage in impression management activities in order to be seen as hard-working individuals. These results are consistent with the predictions of our theoretical model in which workers aim at signaling a high level of intrinsic motivation to increase their chance of obtaining tenure. Finally, we show that production levels dropped substantially under tenure while on-the-job leisure surged.

KEYWORDS**:** Firing threats, tenure, incentives, impression management

JEL CODES: C92, D23, D82.

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1. INTRODUCTION

In settings in which employers are unable to provide individual incentives to workers, the threat of being fired becomes an essential feature of an employment contract (Becker and Stigler, (1974), Klein and Leffler, (1981), Shapiro and Stiglitz, (1984), MacLeod and Malcomson, (1989)). At the empirical level, researchers have assessed the effectiveness of firing threats by studying employment protection legislation. For example, Ichino and Riphahn (2005) study absenteeism levels of the workers of an Italian bank before and after a probationary period. The authors find evidence of an increase in the level of absenteeism after the probationary period suggesting a negative incentive effect of employment protection. Similar results were reported by Riphahn (2004) regarding the negative effect of employment protection on absenteeism of German workers.

In this paper, we propose a different approach by assessing the impact of firing threats and tenure in a laboratory environment in which we control for possible confounding factors such as firm size, industry structure, job characteristics, demand shocks, or organizational design. To that end, we build on a platform that reproduces several features of real-world work environments such as real-effort tasks and real-leisure alternative activities (Internet browsing). We study organizations in which bosses are endowed with a real-time monitoring technology so as to assess the work of their nine employees in each of the five periods of the experiment. At the same time, we gave organizational members access to an electronic chat room to exchange messages during the experiment.

We consider three types of incentive structures. In all cases subjects received the same fixed wage at the beginning of each period regardless of pending work productivity. Under the fixed wage only treatment employees received no further incentives, while under firing threats they could be fired for poor productivity. Under individual incentives employees could not be fired but each of them was also rewarded the entire income generated by his or her individual production on the work task.

In the fixed wage and firing threats treatments the boss kept all income generated by the output produced by all the members of the organization. Under firing threats, the boss was also given the option to dismiss one employee at the end of each of periods 2, 3, and 4.[1] Bosses saved on

[1] Workers could not be re-hired by the boss in the rest of the experiment.

labor costs after firing employees as they would not have to continue to pay their fixed wages. Any subject who made it to the start of the last period without being fired found him/herself with de facto tenure for that final production period.

Our analysis relates to the seminal work of Brown, Falk and Fehr (2004) which studies a repeated principal-agent model à la Fehr, Kirchsteiger and Riedl (1993) in which there is an excess supply of agents. In this setting, principals and agents can sign one-period contracts which specify a fixed payment from the principal to the agent and a desired but non-enforceable level of transfer from the agent to the principal. A crucial difference with the original setting of Fehr et al. (1993) is that the authors allow for reputational concerns and long-term contracts by keeping subjects' identification numbers constant across periods. The authors find that principals and agents were willing to develop long-term relationships which in turn resulted in high levels of transfers. The findings in Brown et al. (2004) are in line with the disciplining version of the efficiency wage hypothesis according to which a combination of high wages and threat of dismissal leads to high levels of effort.

In a recent experimental study, Falk, Huffman and MacLeod (2011) extend the work of Brown et al. (2004) by introducing barriers to dismissals. The authors show that dismissal barriers tend to deter principals from building long-term relationships with agents. This is the case because agents' transfers are significantly reduced when the threat of being dismissed by the principal is eliminated. Note that in Brown et al. (2004) and in Falk et al. (2011) dismissals occur either because the principal signs a one-period contract with another agent or because the agent quits. Even though this contractual design constitutes a privileged setting for studying relational contracts and dismissal barriers, it cannot isolate the effect of firing threats from the effect of quitting. In the present study, we abstract away from career concerns and labor markets and focus on the impact of firing threats and tenure on organizational behavior. To that end, we study firing threats and tenure within a virtual workplace that reproduces features of existing organizations such as real effort tasks, real-time monitoring, on-the-job leisure (Internet browsing) and chatting (Corgnet, Hernan-Gonzalez and Rassenti, 2013).[2]

We found that organizations in which bosses were allowed to fire their employees produced more than twice as much as organizations which only relied on the payment of fixed wages. This

[2] This experimental platform was built in line with previous research introducing real-effort experiments in the study of labor issues (e.g. Dickinson, 1999, Van Dijk, Sonnemans, and van Winden (2001)).

was the case even though by the end of the experiment organizations which fired employees were about 30% smaller than those that couldn't. Firing threats also decreased Internet usage and chatting activities by 71.6%. Remarkably, firing threats reduced leisure activities and increased production levels for both low- and high- ability workers. This finding stresses that firing threats stimulated all workers in the organization despite the fact that bosses could only fire up to one third of their workforce. In our theoretical framework, we account for this possibility by introducing intrinsic motivation in the analysis of firing threats. We demonstrate that managers have incentives to fire high-ability subjects that show no intrinsic motivation in completing the task. This is the case because workers who are not intrinsically motivated will reduce their production levels once they are granted tenure. By contrast, intrinsically motivated workers, regardless of ability levels, will maintain their level of effort in the tenure period despite the lack of monetary incentives.

Nevertheless, the incentive effects of firing threats were not as compelling as those of individual incentives. More specifically, we showed that organizations endowed with individual incentives outperformed those endowed with firing threats by 32.6%. Interestingly, leisure activities were as low in the presence of firing threats as they were under individual incentives. Workers spent 7.5% of their time browsing the Internet in organizations endowed with firing threats compared with 8.7% in organizations relying on individual incentives. As a result, the difference in workers' production levels between the two treatments was due to a discrepancy in productivity levels rather than to a difference in working time. Indeed, productivity levels in the presence of firing threats were 26.5% lower than under individual incentives.

These findings suggest that in the presence of firing threats, employees were willing to signal themselves as hard-working individuals who spend long hours at their workstation without browsing the Internet. Social psychologists refer to this process by which people attempt to influence others' perceptions of themselves as *impression management*.[3] We account for *impression management* in our theoretical framework by showing that non-intrinsically motivated workers with high levels of ability may be willing to signal themselves as low-ability intrinsically motivated workers. In that case, high-ability workers who are inherently more productive than low-ability workers would have spare time available for non-productive

[3] According to Newman (2009, p. 184), *impression management* is an "act presenting a favorable public image of oneself so that others will form positive judgments".

activities. During this time, the high-ability workers will avoid browsing the Internet. Instead, they will stay at their workstation without producing to mimic the work behavior of intrinsically motivated low-ability workers.

In line with concerns for *impression management*, we report that employees were reluctant to include their boss in their communications to other employees. Under firing threats a majority of employees deliberately excluded their boss from the list of recipients of their messages (54.8%) while only a very small proportion of employees did so in the absence of firing threats (6.9%).[4]

When firing threats disappear during the last production period of the firing threats treatment, workers' production collapsed to levels which were similar to those of organizations which solely relied on the payment of fixed wages. In this last period, average production was twice larger under individual incentives than in the treatment with firing threats. Consistently, Internet usage surged in the last period of the treatment with firing threats while it did not increase in the last period of the other two treatments.

2. EXPERIMENTAL DESIGN

2.1. *Virtual Organizations*

We develop a framework in which subjects can undertake a real-effort organizational task while having access to Internet browsing and chatting activities at any point in time during the experiment. We consider organizations with ten subjects, nine of which were referred to as *B* subjects while the remaining subject was referred to as the *C* subject. *C* subjects could monitor *B* subjects' activities in real time. A session consisted of 5 periods of 20 minutes each.[5] The experimental environment is described in detail below.[6]

[4] Most of these messages were classified as general chat, not related with any strategic behavior of the participants.
[5] Due to a technical issue with the software, one of the sessions in Treatment W lasted only for 4 periods. This problem was solved for the other sessions. We control for this effect in the analysis of the results.
[6] See instructions at http://sites.google.com/site/vofiring/instructions. A video presentation of the software is available at http://sites.google.com/site/virtualorganization/videos.

2.1.1. *Tasks*

The Work Task

We introduced a particularly long and laborious task so as to ensure that completing the *work task* required a significant level of effort. Subjects were asked to sum up matrices of 36 numbers for 1 hour and 40 minutes.[7] As a result, we expected to identify signs of fatigue and boredom during the experiment. In the *work task*, participants were not allowed to use a pen, scratch paper or calculator. This rule amplified the level of effort subjects had to exert in order to complete tables correctly. Each table had 6 rows and 6 columns. The numbers in each table were generated randomly. An example is shown in Figure 1.

	Column1	Column2	Column3	Column4	Column5	Column6	Sum Row:
	3.00	6.00	3.00	0.00	6.00	0.00	
	10.00	5.00	1.00	5.00	2.00	3.00	
	8.00	3.00	5.00	4.00	8.00	7.00	
	1.00	6.00	0.00	9.00	8.00	0.00	
	3.00	7.00	0.00	8.00	10.00	4.00	
	3.00	10.00	10.00	6.00	10.00	0.00	
Sum Column:							

FIGURE 1.—Example of table summation for the *work task*.

Before providing the final sum of all numbers in the table, participants had to fill in the 12 cells that could be used to sum each row and each column separately. Filling in these cells did not directly generate earnings but could help subjects compute the final sum: only the final answer was rewarded. Each table completed correctly generated a 40-cent profit while a penalty of 20 cents was subtracted from individual production for each incorrect answer.[8] After each subject completed a table, the accumulated individual production was updated so that subjects knew whether their answer was correct or not. At the end of each period, and only then, the total amount of money generated by all *10* participants during the period was displayed in the history panel located at the bottom of the subjects' screens.

[7] Different variations of this task have been used by Bartling, Fehr, Maréchal and Schunk (2009), Dohmen and Falk (2010), and Abeler, Falk, Goette and Huffman (2011). A counting task that consisted of summing up the number of zeros in a table randomly filled with ones and zeros was also used in Falk and Huffman (2007). A long typing task was used in Dickinson's (1999) experiment for which subjects had to come during four days for a two-hour experiment. Falk and Ichino (2006) used a four-hour mailing task in their field experiment on peer effects. In another field experiment by Gneezy and List (2006), subjects were asked to enter data into a computer database for six hours.

[8] Penalties did not apply when individual production was equal to zero so that individual production could not be negative.

At any point during the experiment, all participants could switch from the *work task* to Internet browsing or chatting. Each activity was undertaken separately, in a different window and the experimenter had a precise measurement of the aggregate time spent undertaking each activity.

The Low Effort Clicking Task

In addition to the previously mentioned activities, each subject could click on a box moving slowly from left to right at the bottom of their screen. This clicking task aimed at representing the pay that workers obtain just for being present at their workstation regardless of their commitment to the *work task*. The introduction of the clicking task allowed subjects to collect a constant flow of earnings with low effort but without actually working dilligently at the high effort *work task*. Each time subjects clicked on a box they earned *5 cents*. The box appeared at the bottom of a subject's screen every 25 seconds whether the subject was currently *working on the work task, chatting,* or *browsing the Internet*. Given that the experiment consisted of 5 periods of 20 minutes each, subjects could earn a total of $12.00 just by clicking on all the 240 boxes that appeared on the screen during the experiment.

2.1.2. *Internet Browsing*

Internet browsing and the *work task* were undertaken on different windows so that subjects could not complete tables while browsing the Internet. Switching back and forth between the Internet browser and other activities was quick and easy. Subjects who returned to the Internet screen after being involved in another activity were automatically directed to the last web page they visited. Subjects were free to consult their email or visit any web page.[9] The Internet browser was embedded in the software (see Figure 2) so that the experimenter could keep a record of the switching times between activities as well as the exact amount of time subjects spent on each activity. Participants were informed that their usage of the Internet was strictly confidential.

[9] Subjects were expected to follow the norms set by the university regarding the use of Internet on campus.

FIGURE 2.—Embedded Internet screen.

The introduction of Internet is motivated by the widespread use of Internet at the workplace. According to a 2005 study by *American Online* and *Salary.com*, employees spend about 26% of their time on activities unrelated to their work (Malachowski (2005)). Almost half of this time actually corresponds to Internet usage. In addition, a study by *Nielsen/Net Ratings* report that people spend more than twice as much time online at the office as they do at home (Farrell (2000)). Gordon (2000) argues that Internet usage in the workplace may damage employees' productivity (see also Young (2005, 2006)).

An appealing feature of Internet as an alternative to the *work task* is the wide range of activities that can be completed online. Indeed, a large number of people are likely to derive utility from Internet access as they will be able to browse Web pages that best fit their personal interests. Two related studies (Charness, Masclet and Villeval (2010), Eriksson, Poulsen and Villeval (2009)) have also introduced on-the-job leisure activities in experimental environments by giving subjects access to magazines.

2.1.3. *Chatting Activities*

Subjects also had access to a chat room through which they could communicate with the other subjects during the experiment. A subject could send a message to all subjects at once or to any subset of them. One could access the chat room by simply clicking on the *Chat* option in the activity drop-down menu at the bottom-right of their screens. If a subject received a message while not currently in the chat room, a pop-up window displaying the content of the message as well as the experiment *ID* of the sender would automatically appear on his or her screen. As a result, incoming chat could potentially distract subjects completing the *work task*.

2.1.4. *Monitoring Activities*

In all treatments, the *C* subject (boss) could monitor the nine *B* subjects' (employees') activities at any time during the experiment by selecting the *Watch* option in the drop-down menu. Monitoring activities had to be undertaken in a separate window so that the boss could not complete his or her own *work task*, chat or browse the Internet while monitoring his or her employees. In the monitoring screen, a *C* subject could decide whether to monitor only a subset or all the *B* subjects at the same time. The information was displayed in a table, where each column showed information regarding the activities completed by a given subject (see Figure 3).

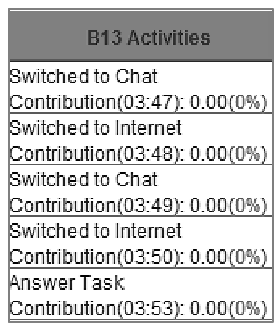

FIGURE 3.—Monitoring screen with a zoom on subject B13.

The header of each column indicated the subject's experiment *ID*. Each cell of a given column displayed information in real time about the activities undertaken by the selected subject. These activities were labeled as follows: *Watch* (monitoring *B* subjects' activities), *Internet* (browsing the web), *Task* (completing the *work task*), or *Chat* (chatting with other participants). Monitors were also informed whenever a subject entered the sum of a column or a row before providing a final answer for the *work task*. This was described as *Sum Column* in the monitoring table. Finally, the current total production of monitored subjects, as well as their contribution to the *work task* (in % terms), were shown in the monitoring screen.

B subjects were notified with a message stating "*The C subject is watching you*" jointly with an eye picture whenever they were being watched. At the end of each period, the *C* subject had access to a monitoring summary, including information regarding *B* subjects' production levels and contributions to total production.

2.2. *Treatments*

We conducted three different treatments (see Table 1). In Treatments W (only fixed wage) and F (firing threats), *B* subjects were rewarded a fixed payment of 200¢ each period while not receiving incentives based on their performance on the *work task*. The *C* subject received the output produced by all subjects (including him/herself) on the *work task* while not being paid any fixed wage. In the firing threats treatment, the *C* subject could fire one *B* subject at the end of each of the periods 2, 3 and 4. The *C* subject did not need to pay the fixed wage to dismissed *B* subjects in the subsequent periods.

TABLE 1. Summary of the treatments.

Treatment	Description	Number of sessions (subjects)
Fixed wage only (W)	*B* subjects were paid a fixed wage of 200¢ per period. The *C* subject kept the value of all output produced by all *B* subjects in the organization. In addition the *C* subject was paid the value of his/her own production. The *C* subject could monitor *B* subjects' activities but had no possible recourse.	5 (50)[10]
Firing threats (F)	*Payment exactly as in (W).* The *C* subject could monitor *B* subjects' activities, and could fire a *B* subject at the end of periods 2, 3 and 4.	6 (60)
Individual incentives (I)	*B* subjects were paid a fixed wage of 200¢ per period and were also rewarded the full value of all output they produced. The *C* subject was paid only the value of his/her own production. The *C* subject could monitor *B* subjects' activities but had no possible recourse.	6 (60)

Dismissed *B* subjects could only browse the Internet, and they were rewarded solely for their earnings on the clicking task which were reduced to 1¢ per box instead of 5¢ per box for the

[10] One session was cancelled because of insufficient subjects.

active B and *C* subjects.[11] They were not able to chat with active *B* and *C* subjects, and they could not be rehired.

In the individual incentives treatment, *B* subjects received a fixed payment of 200¢ per period as in the previous treatments, in addition to being rewarded on the *work task* according to their individual production.

In all treatments, subjects received their individual earnings on the clicking task.

2.3. *Procedures*

Our subject pool consisted of students from a major US University. The experiments took place in May 2011. In total, 170 subjects participated in the experiment, divided into 17 sessions. We conducted five sessions for Treatment W, and six sessions for each of Treatments F and I. Ten students participated in each session. All of the interaction was anonymous.

The instructions were displayed on subjects' computer screens. Subjects had exactly 20 minutes to read the instructions. A 20-minute timer was shown on the laboratory screen. Three minutes before the end of the instructions period, a monitor announced the time remaining and handed out a printed copy of the summary of the instructions. None of the participants asked for extra time to read the instructions. At the end of the 20-minute instruction round, the instructions file was closed, and subjects typed their names to start the experiment. The interaction between the experimenter and the participants was negligible.

At the end of the experiment, subjects were paid their earnings in cash, rounded up to the nearest quarter. Individual earnings at the end of the experiment were computed as the sum of all earnings in the *5* periods. Participants playing the role of a *B* (*C*) subject in Treatments W, F, and I, earned on average $28.00 ($55.25), $27.74 ($85.20), and $38.95 ($37.91), respectively. This includes a $7.00 show-up fee. Experimental sessions lasted on average two hours and thirty minutes.

[11] As a result, the maximum period earnings of dismissed subjects on the clicking task were equal to 48¢ instead of 240¢ for *B* and *C* subjects.

3. CONCEPTUAL FRAMEWORK:
FIRING THREATS AND IMPRESSION MANAGEMENT

In order to establish predictions regarding production levels and Internet usage across treatments, we rely on standard incentive theory (see Laffont and Martimort (2002) for a review). We build on a two-period model of an organization composed of *n* workers and a supervisor.[12]

Workers

In each period, worker $i \in N = \{1, \ldots, n\}$ dedicates his or her time to attend either work ($e_i \geq 0$) or leisure activities ($l_i \geq 0$) where $e_i + l_i = \varphi$ and $\varphi > 0$ is the total amount of time available to workers. We allow for workers who are present at their workstation to dedicate their time either to productive ($e_i^P \geq 0$) or nonproductive activities ($e_i^{\sim P} \geq 0$) where $e_i = e_i^P + e_i^{\sim P}$. Only productive effort generates production on the *work task* (q_i). However, workers may still decide to attend their workstation without generating production ($e_i^{\sim P} > 0$) so as to give their supervisor the impression that they prefer the *work task* to Internet browsing. In that case, the worker may either decide to complete the task with minimal effort (e.g. providing random answers) or choose not to complete the task at all. We refer to this behavior as *impression management*.

Definition. Worker *i* is involved in *impression management* whenever $e_i^{\sim P} > 0$.

We assume that each worker *i* possesses a level of ability on the *work task* denoted by $\alpha_i \in \{\alpha_L, \alpha_H\}$, with $\alpha_L < \alpha_H$, which determines the marginal product of the productive effort as $q_i = \alpha_i e_i^P$. We assume that ability levels are workers' private information. We denote by $N_j \subset N$ the set of workers endowed with ability α_j, with $j \in \{L, H\}$. We denote by $n_j > 0$ the number of workers endowed with ability α_j so that the total number of workers is defined as $n = n_L + n_H$.

We consider that the cost of productive effort $C(e_i^P)$ for worker *i* is such that $C'(\cdot) > 0$ and $C''(\cdot) > 0$. We assume that the nonproductive effort entails no costs save the opportunity costs of not producing for cash or enjoying the leisure activity. Also, we denote by $v(l_i)$ the utility that worker *i* derived from the leisure activity, where $v'(\cdot) > 0$ and $v''(\cdot) < 0$. In order to keep the focus of our analysis on workers' heterogeneity in abilities, we consider that workers have the

[12] This model does not include multiple probationary periods as is the case in our experimental design. The essence of our results would not be affected by considering such case.

same cost of effort and the same utility of leisure. We denote by ω the fixed wage received by each worker at the beginning of a period.

Importantly, we consider that regardless of their ability level workers can either be intrinsically motivated to complete the *work task* or not.[13] We assume that a worker's intrinsic motivation is private information. We denote by $n_{j,R}$ ($n_{j,\sim R}$) the number of (not) intrinsically motivated workers of ability α_j, with $j \in \{L, H\}$. Intrinsically motivated workers derive direct utility from working (Deci (1971), Deci (1975) and Deci, Koestner and Ryan (1999)). We denote such utility as $\vartheta(e_i^P)$, with $\vartheta(e_i^P) \coloneqq 0$ for non-intrinsically motivated workers, and with $\vartheta(e_i^P) > 0$ for $e_i^P > 0$ ($\vartheta(0) = 0$) and $\vartheta'(\cdot) > 0$ and $\vartheta''(\cdot) < 0$ for intrinsically motivated workers.

Supervisor

Each organization is monitored by a supervisor $s \notin N$. The supervisor can monitor workers and obtain information regarding their production levels (q_i) and their dedication to the *work task* (e_i). However, the supervisor cannot distinguish between productive and nonproductive work activities. In addition to monitoring, supervisors can dedicate their time either to work or leisure activities so that: $m_s + e_s + l_s = \varphi$ where m_s is the time dedicated to monitoring activities. For simplicity, we consider two levels of monitoring intensity ($m_s \in \{0, \bar{m}\}$).[14] For $m_s = \bar{m}$, the supervisor can observe individual production and effort levels while in the absence of monitoring ($m_s = 0$), the supervisor can only observe the total production of the organization, that is $\sum_{i=1}^{n} q_i + q_s$, where q_s is the supervisor's production. The cost of monitoring activities is specified as follows: $C_m(0) = 0$ and $C_m(\bar{m}) = \bar{c}$ where $\bar{c} > 0$. In all treatments, the supervisor's own effort is rewarded at its marginal product.

Now we describe subjects' utility functions for each treatment:

Individual Incentives Treatment (Treatment I)

In the individual incentives treatment, workers' utility function is described as follows:

$$U_i \coloneqq \sum_{t=1}^{2} \left[\omega + \alpha_i e_i^{P(t)} + v\left(l_i^{(t)}\right) - C\left(e_i^{P(t)}\right) + \vartheta\left(e_i^{P(t)}\right) \right]$$

[13] Note that instead of intrinsic motivation we could have invoked altruism (Rotemberg, 1994) and other social preferences (Fehr and Schmidt, 1999) to justify that workers may exert effort in the absence of monetary incentives.
[14] We could consider an intermediate level of monitoring for which the supervisor only observes individual production. The nature of our results would not be affected by considering such extension.

and supervisor's utility function is as follows:

$$U_s \coloneqq \sum_{t=1}^{2}\left[\alpha_s e_s^{P(t)} + v\left(l_s^{(t)}\right) - C\left(e_s^{P(t)}\right) + \vartheta\left(e_s^{P(t)}\right) - C_m\left(m_s^{(t)}\right) - n\omega\right]$$

Fixed Wage Treatment (Treatment W)

Similarly, in the fixed wage treatment, workers' utility function is described as follows:

$$U_i \coloneqq \sum_{t=1}^{2}\left[\omega + v\left(l_i^{(t)}\right) - C\left(e_i^{P(t)}\right) + \vartheta\left(e_i^{P(t)}\right)\right]$$

and supervisor's utility function is as follows:

$$U_s \coloneqq \sum_{t=1}^{2}\left[\alpha_s e_s^{P(t)} + v\left(l_s^{(t)}\right) - C\left(e_s^{P(t)}\right) + \vartheta\left(e_s^{P(t)}\right) - C_m\left(m_s^{(t)}\right) + \sum_{i\epsilon N} q_i^{(t)} - n\omega\right]$$

Firing Treatment (Treatment F)

In the firing treatment, the first period corresponds to a probationary period at the end of which, and after having paid workers' wages, the supervisor can fire n_f workers where $n_f \epsilon \{0,1,\dots,\bar{n}_f\}$ and $\bar{n}_f \leq n$. We denote N_F the set of fired workers. In the second period, which can be seen as a tenure period, the workers who were not fired at the end of the first period will receive the same fixed wage $\omega > 0$ as in the first period. Fired workers will not receive any fixed wage and will not be able to produce anymore. Workers will not have the opportunity to work in another organization in the second period. This cost of being fired can be seen as temporary unemployment.

In that setting, the utility function for worker *i* can be described as follows:

$$U_i \coloneqq \omega + v\left(l_i^{(1)}\right) - C\left(e_i^{P(1)}\right) + \vartheta\left(e_i^{P(1)}\right)$$
$$+(1-\pi_i)\left\{\omega + v\left(l_i^{(2)}\right) - C\left(e_i^{P(2)}\right) + \vartheta\left(e_i^{P(2)}\right)\right\} + \pi_i v\left(l_i^{(2)}\right)$$

where π_i is the probability for worker *i* to be fired at the end of the first period. Supervisor's utility function is as follows:

$$U_s \coloneqq \sum_{t=1}^{2}\left[\alpha_s e_s^{P(t)} + v\left(l_s^{(t)}\right) - C\left(e_s^{P(t)}\right) + \vartheta\left(e_s^{P(t)}\right) - C_m\left(m_s^{(t)}\right)\right]$$

$$+\sum_{j\epsilon N} q_j^{(1)} - n\omega + \sum_{j\epsilon N\setminus N_F} q_j^{(2)} - (n - n_f)\omega$$

We derive our conjectures using the following specification of the model: $C(e_i^P) = \frac{(e_i^P)^2}{2}$, $v(l_i) = \beta l_i$ and for intrinsically motivated subjects we assume that $\vartheta(e_i^P) = \gamma e_i^P$, where $\beta > 0$ and $\gamma > 0$. We provide details of our derivations in the online Appendix 1.

Hypotheses

We start by stating our hypotheses regarding the probationary period in which subjects could be fired by their supervisor. This corresponds to periods one to four in our experimental design.

Our first conjecture relates to production levels and Internet usage. We expect that intrinsically motivated workers will be the only ones to dedicate time to productive effort in the fixed wage treatment (Treatment W). Indeed, for non-intrinsically motivated workers, the marginal cost of effort is always greater than the marginal product of effort (which is equal to zero) for any positive level of effort. In the individual incentives treatment (Treatment I), all workers are expected to provide productive effort as their marginal cost of effort is rewarded at their marginal product. As a result, we expect all workers, whether they are intrinsically motivated or not, to produce more and use Internet less in Treatment I than in Treatment W. In addition, under firing threats (Treatment F) we expect workers to produce more and browse the Internet less than in Treatment W. This is the case because non-intrinsically motivated workers will be willing to exert productive effort in order to signal themselves as intrinsically motivated workers to their supervisor in the probationary period. Indeed, workers who are not intrinsically motivated anticipate that the supervisor will be willing to fire non-intrinsically motivated workers since they will exert no effort in the tenure period. As a result, non-intrinsically motivated workers may be willing to mimic the behavior of intrinsically motivated workers so as to reduce the probability of being fired at the end of the probationary period. This will be a best response to the supervisor's strategy whenever the cost of being fired (which is measured by the lost fixed wage) is high and the cost of providing effort to achieve the production levels of intrinsically motivated workers is low (see online Appendix 1).[15] The comparison of Treatments I and F is more complex since non-intrinsically motivated workers may be interested in providing a level

[15] In particular see Case A,*i* and Cases B,*i* to B,*iv*.

of effort in the probationary period of the firing treatment which is higher than the efficient level of effort provided under individual incentives (see Table O.2 in online Appendix 1). This occurs when intrinsic motivation (γ) is particularly strong in which case intrinsically motivated workers without individual incentives would exert a higher level of effort than non-intrinsically motivated workers with individual incentives. In that case, non-intrinsically motivated workers, by mimicking the work effort of intrinsically motivated workers, would produce more in the firing treatment than in the treatment with individual incentives.

We summarize these conjectures in the following hypothesis.

Hypothesis 1 (Production levels and Internet usage)

i) We expect workers' production levels to be greater in the treatments with either individual incentives (I) or firing threats (F) than in the fixed wage treatment without firing (W). Also, we expect workers' Internet usage to be lower in Treatments I and F than in Treatment W.

ii) Workers' production levels as well as Internet usage can either be greater or lower in the individual incentives treatment than in the treatment with firing threats.

A necessary condition for the treatment with firing threats to lead to greater production levels and lower Internet usage than individual incentives is for intrinsic motivation (γ) *to be sufficiently large. The treatment with individual incentives is expected to lead to greater production levels and lower Internet usage than the treatment with firing threats for moderate levels of intrinsic motivation.*

By distinguishing between productive (e_i^P) and non-productive effort ($e_i^{\sim P}$), our theoretical framework allows for *impression management* to arise in equilibrium. For example, consider the case of high-ability non-intrinsically motivated workers who decide to mimic the work behavior of low-ability intrinsically motivated workers in order to reduce their likelihood of being fired (see equilibria of types *i* and *iii* in Table O.1 in online Appendix 1). High-ability workers will be able to achieve the output of low-ability workers (q_L) in a fraction ($\frac{\alpha_L}{\alpha_H} < 1$) of the time necessary for low-ability workers to do so. In the remaining time, high-ability workers will stay at their workstation exerting non-productive effort ($e_i^{\sim P} > 0$) in order to mimic the work behavior of low-ability workers. A consequence of *impression management* is that individual productivity measured as individual production per unit of working time ($\frac{q_i}{e_i}$) is expected to be lower in the firing treatment compared with Treatments W and I. We state our conjectures as follows.

Hypothesis 2 (Impression management)

We expect to observe impression management in the treatment with firing threats. As a result, we expect productivity levels to be lower with firing threats than in the other two treatments.

Regarding firing decisions, our theoretical framework predicts that supervisors will dismiss workers with the lowest levels of performance since they signal low ability levels as well as a lack of intrinsic motivation of the workers.

Hypothesis 3 (Firing decisions)

We expect supervisors to fire the workers with the lowest levels of performance in the group.

Following our theoretical framework, we also expect supervisors to shy away from monitoring activities in the treatments without firing threats (Treatments W and I) preferring either to work for cash or to browse the Internet. By contrast, in the firing treatment (F), monitoring workers' production and effort levels is valuable to supervisors as it increases the probability of granting tenure to intrinsically motivated workers. We summarize this conjecture as follows.

Hypothesis 4 (Monitoring)

We expect the time spent by the supervisor monitoring workers to be greater in the treatment with firing threats than in the other two treatments.

An important implication of our theoretical framework is that the effect of firing threats is expected to be observed for both low- and high- ability workers. Indeed, the incentives to signal oneself as an intrinsically motivated worker deserving tenure are present across ability levels. In particular, high-ability workers who are able to generate a level of output which exceeds their fixed wage may still be willing to produce beyond their fixed wage in the probationary period so as to signal their intrinsic motivation to the supervisor (see online Appendix 1, Case A,*i* and Cases B,*i* to B,*iv*). This is the case because the supervisor is willing to grant tenure to intrinsically motivated workers who will be producing a positive output in the tenure period. Low-ability workers may also respond positively to firing threats even though they are not able to produce as much as their fixed wage. This is the case because the supervisor would rather grant tenure to an intrinsically motivated low-ability worker than to a high-ability worker without intrinsic motivation who would produce nothing in the tenure period. Our summarized conjectures follow.

Hypothesis 5 (Firing threats and subjects' ability)

We expect the positive effect of firing threats on workers' production levels and its negative effect on Internet usage to be observed across ability levels.

In the last period of Treatment F which is referred to as the tenure period, firing threats are removed so that workers' levels of production and Internet usage are expected to converge to the levels which are observed in Treatment W (see Table O.2 in online Appendix 1). Also, in the last period we expect supervisors to dedicate as little time to monitoring activities in Treatment F as in the other two treatments. This is the case because in the tenure period there is no firing decision to be made so that collecting information about workers' performance becomes unnecessary. These conjectures are summarized in the following hypothesis.

Hypothesis 6 (Tenure)

i) *In the last period of the experiment, we expect the production levels of workers not to be significantly different between the fixed wage treatment with firing threats (F) and the fixed wage treatment without firing (W). However, we expect the production levels of workers to be greater in the treatment with individual incentives (I) than in the other two treatments.*

ii) In the last period of the experiment, we expect Internet usage not to be significantly different between the fixed wage treatment with firing threats (F) and the fixed wage treatment without firing (W). However, we expect Internet usage of workers to be lower in the treatment with individual incentives (I) than in the other two treatments.

iii) In the last period of the experiment, we expect the time spent by the supervisor monitoring workers to be the same across all treatments.

4. RESULTS

In Sections 4.1 to 4.4, we analyze the first four periods of our experiment which correspond to probationary periods in Treatment F. We start the results section by comparing production and Internet usage across treatments. In Section 4.2, we study chat activities. Firing decisions are studied in subsequent sections. We analyze the last period of the experiment which corresponds to tenure in Treatment F in Section 4.5.

4.1. *Production and Internet Usage*

We define total production on the *work task* as the total monetary amount generated by a subject's answers on the task divided by the reward for each correct answer (40¢). Thus production is the total number of correct tables completed by a given subject minus 1/2 the number of incorrect tables.

Production levels for *B* subjects were significantly higher under individual incentives (24.4) than under the treatments with firing threats (19.8) or fixed wages only (8.2) (see Table A.1 in the appendix for a detailed statistical analysis). It is interesting to note that in the fixed wage treatment without firing, not only average individual production was strictly greater than zero but the great majority of subjects (82.0%) produced at least one correct table per period. This is consistent with the fact that workers may be intrinsically motivated to complete the task in the absence of incentives as we account for in our theoretical framework. In an independent survey, we report evidence of the importance of intrinsic motivation in the performance of subjects in our experimental environment.[16]

In addition, *B* subjects were browsing the Internet significantly more in the fixed wage treatment (31.1% of their time) compared with the firing treatment (7.5%) or the individual incentives treatment (8.7%) (see Table A.2 in the appendix).[17] We identify no significant differences in Internet usage between Treatments I and F. These findings support *Hypothesis 1* according to which firing threats tend to raise production levels and reduce Internet usage compared with the fixed wage treatment without firing.

In Figure 4, we represent average production (left panel) and Internet usage (right panel) for the first four periods of our three treatments. We observe that average production under individual incentives surpassed production in the other two treatments in each of the four periods. Also, average production in the firing treatment was systematically higher than in the fixed wage treatment without firing threats.

[16] In particular, we show that the answer to the question "How much do you like mathematics?" was significantly correlated with subjects' performance on the *work task* even after controlling for subjects' ability levels (see online Appendix 2 for more details).

[17] Circumstantially, the proportion of their time subjects dedicated to Internet usage under fixed wages (31.1%) was similar to the figures published in the 2005 study by *American Online* and *Salary.com* according to which employees spend about 26.1% of their time on activities unrelated to their work (Malachowski (2005)). Our results show that, even in a laboratory environment usually prone to generating demand effects, subjects were ready to undertake leisure activities for which they were not paid by the experimenter.

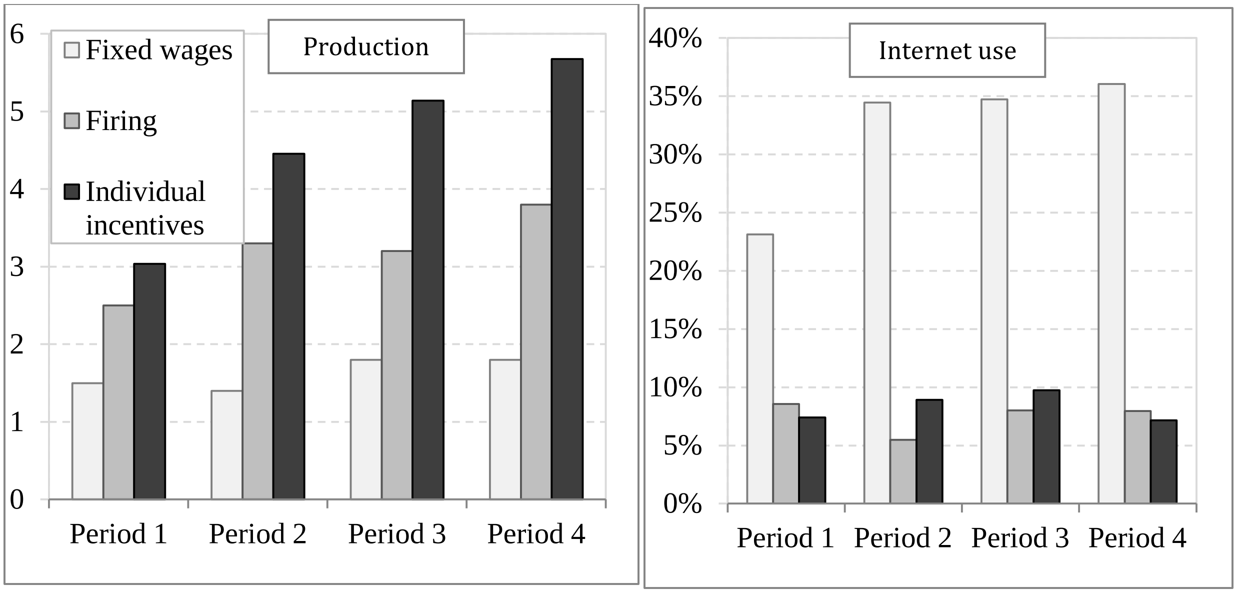

FIGURE 4.— Period-evolution of *B* subjects' average production (left panel) and Internet usage (right panel) across treatments[18]

Despite significant differences in production levels between the firing and the individual incentives treatments, Internet usage was remarkably similar in the two treatments (see Table A.2 in the appendix). In the first four periods of the experiment, when the threat of being fired was present in Treatment F, subjects browsed the Internet for 7.5% of their time in the firing treatment compared with 8.3% in the treatment with individual incentives. As a result, in the first four periods subjects spent as much time on the *work task* screen in the firing treatment (89.1%) as subjects did in the individual incentives treatment (90.7%) while producing significantly less (see Figure 4). In the fixed wage treatment without firing threats, *B* subjects spent only 50.8% of their time on average on the *work task* screen (see Table A.3 for a detailed statistical analysis of working time differences across treatments and periods).

In other words, not only did subjects produce less in the firing treatment compared with the individual incentives treatment, but they also exhibited lower productivity levels. We assess productivity by computing average individual production for ten minutes of working time. Subjects of type *B* produced on average 1.8, 1.9 and 2.6 tables for ten minutes of working time in the fixed wage, firing and individual incentives treatments, respectively. It is important to note that working time in Treatment W was about half the working time in Treatments F and I

[18] We do not include subjects who had been fired before the current period. Our statistical analysis is robust to including or not including fired subjects (see Table A.1).

implying that productivity in Treatment W was not directly comparable with the productivity levels achieved in the other two treatments. This is the case because learning effects on the *work task* are significant as is illustrated by the positive trend in production in both Treatments F and I (see Figure 4).[19] Thus, in order to test *Hypothesis 2* we use a regression analysis in which we compare productivity levels across treatments while controlling for working time. In line with *Hypothesis 2*, we find that productivity levels in Treatment F were significantly lower than in the other two treatments (see Table A.4 in the appendix).

RESULT 1 (Production and Internet usage)

i) In line with Hypothesis 1i, production levels of B subjects were significantly greater in the treatment with firing threats and in the treatment with individual incentives than in the fixed wage treatment. Internet usage was significantly lower in the treatment with firing threats and in the treatment with individual incentives than in the fixed wage treatment.

ii) Production levels of B subjects were significantly greater in the treatment with individual incentives than in the treatment with firing threats. No significant differences in Internet usage were identified between the treatment with firing threats and the treatment with individual incentives.

iii) In line with Hypothesis 2, productivity levels of B subjects were significantly lower in the treatment with firing threats than in the treatment with individual incentives. Productivity levels of B subjects were also significantly lower in the treatment with firing threats than in the fixed wage treatment after controlling for working time differences across treatments.

In addition to the *work task* and *Internet browsing*, subjects could obtain earnings from the clicking task. As we should expect, no significant differences were observed across treatments in this low-effort task. Subjects successfully clicked on the box in 94%, 96% and 95% of its appearances in Treatments W, F and I, resepectively (see online Appendix 3).

4.2. *Chat Activities*

In addition to Internet browsing, chatting activities could divert subjects' attention from the *work task*. Chatting had no strategic function in this experiment except for the firing treatment in

[19] Using a Tobit regression with random effects with individual production as dependent variable and a constant and a trend as regressors, we find that the p-value associated with the trend coefficient was lower than 0.0001 for Treatments F and Treatment I. See also a related study by Corgnet et al. (2013) for evidence of learning effects on a similar task.

which case *C* subjects could use the chat room to define their firing policy and threaten *B* subjects. The categorization of chat messages support the fact that the chat room was largely used as a distraction device. Each chat message was assigned to one of twenty-nine categories by two graduate students coding messages independently (see Table O.6 in online Appendix 4). Then, we computed the Cohen's Kappa coefficient for each category to assess inter-rater agreement (see Table O.7 in online Appendix 4).[20] We dropped category 29 from the analysis because it was empty and another four categories (categories 20, 21, 22, and 27) because the corresponding Cohen Kappa test was not significant at a 5% significance level. These categories represented only 7.9% of the messages (see Figure O.1 in online Appendix 4). The most represented category (35.3%) corresponds to distracting messages (e.g. jokes and stories). General and nonstrategic messages constituted the great majority (73.1%) of chat messages. We consider as general and nonstrategic messages the ones that were assigned to categories related to either presentation (category 1), distraction (categories 2, 3, 4 and 5) or general observations about the experiment (categories 24, 25 and 26). Most of the strategic messages consisted in subjects stating their own performance (category 15, 7.0% of all messages) and attempting to help other subjects complete the task (category 9, 6.2% of all messages).

In summary, chatting activities were mostly leisurely activities. Indeed, similarly to Internet browsing, the average amount of time *B* subjects dedicated to chatting was significantly greater in the fixed wage treatment without firing (20.1%) than in Treatment F (1.2%) and Treatment I (0.5%) (see Table A.5 in the appendix for a statistical analysis). In the first four periods, chat usage of *B* subjects was significantly lower in firing and individual incentives treatments than in the fixed wage treatment without firing.

Furthermore, we categorize messages according to the type of subjects (*B* or *C*) who sent and received the message. Interestingly, we observe that, in the treatment with firing threats, *B* subjects excluded the *C* subject from their messages in the majority of cases (54.8%). By contrast, this happened in only a small proportion of the cases in Treatments W (6.9%) and I (9.3%).[21] In the firing treatment, *B* subjects may have excluded the *C* subject from their chat

[20] According to Landis and Koch (1977), Cohen Kappa coefficients between 0.4 and 0.6 correspond to a moderate agreement level and coefficients greater than 0.6 correspond to full agreement.

[21] We confirm the significance of these findings with a proportion test comparing Treatment F with Treatments W and I (p-value < 0.001). The p-value that corresponds to the comparison between Treatments W and I is equal to 0.150.

discussions so as to avoid being caught by the *C* subject chatting instead of working.[22] This suggests that firing threats led subjects to feel concerned not only about their production levels but also about their dedication to the *work task*. Employees were then inclined to influence positively the perception of their boss regarding their dedication to the *work task*. This behavior can be classified as *impression management* (see Newman (2009)).

We summarize our findings regarding the chat analysis in Result 2.

RESULT 2 (Chat activities)

i) A large majority of messages had general and non-strategic content.

ii) C subjects were largely excluded from B subjects' chat discussions in the firing treatment while this was not the case in the other two treatments.

iii) Chat was used significantly less in the firing treatment than in the fixed wage treatment. Also, chat usage was not significantly different between the firing treatment and the individual incentives treatment.

4.3. *Firing Decisions and Monitoring*

We turn now to the analysis of firing decisions of the *C* subjects in Treatment F. In Table 2 below we summarize the firing decisions of the *C* subjects across the six sessions of the firing treatment.

TABLE 2. Summary of firing decisions per period.

	Period 2	Period 3	Period 4	Total
Total [maximum possible] number of fired subjects	5 [6]	5 [6]	4 [6]	14 [18]
Average production of subjects before being fired[23]	0.10	0.87	1.50	6.00
Average production of other *B* subjects	3.19	3.29	3.53	19.80

[22] The messages excluding the *C* subjects were mostly general and non-strategic messages (66.5%, 70.0% and 76.5% of messages in Treatments W, F and I).

[23] By multiplying these numbers by 40¢ one obtains the average monetary contribution of those subjects. It is evident that the average monetary contribution is well below the fixed wage of 200¢ received by *B* subjects at the beginning of each period.

P-value[24]	0.1972 **[0.031]**	**0.000** **[0.000]**	**0.000** **[0.000]**	**0.000** **[0.000]**

We observe that the *B* subjects who were fired in a given period were producing on average significantly less than the other *B* subjects in the organization. In line with *Hypothesis 3*, all the subjects who were fired in periods 2, 3 or 4 were the lowest producers in their respective sessions. In the cases in which several subjects produced the lowest amount on the *work task* (this occurred in four occasions), the subject who was finally fired was the one who was caught browsing the Internet more often during the period.

Also, there is anecdotal evidence that chat conversations may have affected the *C* subject's firing decisions. This was apparent in the first firing decision in Session 1 in which case two subjects produced the same low amount on the task and were both caught on the Internet. Subject B19 was fired after expressing the following opinions publicly in the chat room: "*if C keeps being a rude passive aggressive boss; we can go on strike. If C fires all of us; C makes no income either*".

The fact that *C* subjects fired *B* subjects according to their relative performance levels suggests that *C* subjects were monitoring *B* subjects to gather information about their production and dedication on the task. Indeed, following *Hypothesis 4* we expect *C* subjects to monitor *B* subjects more intensively in the treatment with firing threats than in Treatments W and F (see Table 3). We confirm this conjecture in a Tobit regression with a treatment dummy for firing threats (p-value = 0.031, See Table A.6 in the appendix).[25]

[24] This p-value refers to the clustered t-test [Wilcoxon rank-sum test] that assesses whether average production is the same for subjects who were fired and for subjects who were not fired.

[25] When compared separately using Tobit regressions with treatment dummies, the average time spent by *C* subjects monitoring was significantly greater in the firing treatment than in the individual incentives treatment (p-value=0.040). However, we did not find significant differences between the fixed wage treatment and the treatment with individual incentives (p-value=0.233) or between the fixed wage treatment and the firing treatment (p-value=0.201).

TABLE 3. Period evolution of monitoring activities.

Treatment	Average time spent by *C* subjects monitoring (% of total time)	Period 1	Period 2	Period 3	Period 4
Fixed wage only (W)	5.3%	7.6%	7.0%	2.6%	4.1%
Firing threats (F)	12.2%	12.1%	18.2%	8.7%	9.8%
Individual incentives (I)	2.5%	0.8%	3.4%	4.3%	1.7%

We summarize our findings as follows.

RESULT 3 (Firing and monitoring decisions)

i) In line with Hypothesis 3, C subjects decided to fire the B subject with the lowest level of production in the period.

ii) In line with Hypothesis 4, C subjects monitored B subjects significantly more in the treatment with firing threats than in both treatments without firing threats.

4.4. *The Effect of Firing Threats across Ability Levels*

We now investigate *Hypothesis 5* by analyzing the effect of firing threats on subjects' production across ability levels in the first four periods of the experiment. To do so, we classify *B* subjects as either high- or low- ability subjects depending on whether they completed their first table correctly (we obtain similar results by categorizing subjects according to their performance rank in the first period of the experiment). We rely on previous research showing the positive relationship between first table performance and subsequent production (see Corgnet et al., 2013 and online Appendix 2). In particular, in an independent sample of 133 subjects involved in an experiment similar to the individual incentives treatment (I), Corgnet et al. (2013) show that production levels of subjects who answered the first table correctly (25.5) were 55% higher than the production levels of those who answered the first table incorrectly (16.5). Similar results hold for the current study in which production levels of subjects who answered the first table correctly (26.1) were 45% higher than the production levels of those who answered the first table incorrectly (18.0).[26] From a theoretical standpoint, we know that differences in production levels across subjects should attest differences in ability levels in the case of individual incentives. As a result, the fact that a subject's success in completing the first table is highly correlated to his or her final production level indicates that such a measure captures ability differences.[27] The proportion of *B* subjects characterized as high-ability subjects is equal to 65% for the whole sample and equal to 58%, 59% and 73% for Treatments W, F and I, respectively. We recognize that this measure can be affected by treatment effects. However, using proportion tests we do not find significant differences in the proportion of high-ability *B* subjects across treatments (the p-values for comparing treatments W and F, W and I, and F and I, were equal to 0.7604, 0.3912, and 0.189, respectively).

Both low- and high- ability *B* subjects produced more in the treatment with firing threats than in the fixed wage treatment as is illustrated in Figure 5 (see Table A.7 in the appendix for statistical analysis). In particular, Treatment F led to production levels which were on average three times (twice) larger than in Treatment W for low-ability (high-ability) subjects. In addition, Internet usage was reduced by 58.1% and 67.0% in Treatment F with respect to Treatment W for low- and high- ability subjects, respectively. In sum, in line with *Hypothesis 5*, the positive effect of firing threats on individual production and its negative impact on Internet usage held across ability levels.

[26] This difference was significant using either a clustered t-test or clustered Wilcoxon rank-sum test (p-value<0.0001). Note that all subjects completed at least one table.

[27] Interestingly, we also show using data from previous studies (Corgnet et al. 2013) that our measure of ability does not correlate with different measures of intrinsic motivation while correlating significantly with production levels (see Table O.4 in online Appendix 2).

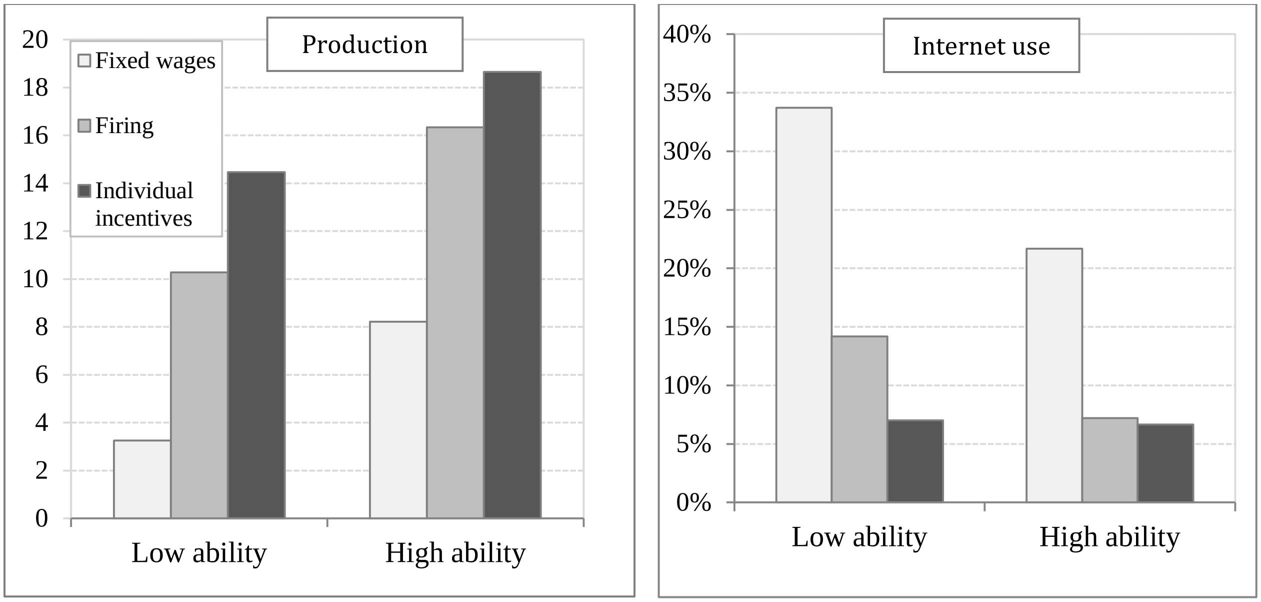

FIGURE 5.— *B* subjects' average production (left panel) and Internet usage (right panel) across ability levels and treatments[28]

We summarize our results as follows.

RESULT 4 (Firing effects across ability levels)

In line with Hypothesis 5, the positive effect of firing threats on production and its negative effect on Internet usage holds across ability levels.

4.5. *Tenure*

In the treatment with firing threats, average production decreased from 3.8 in the fourth period to 2.6 in the last (tenure) period reaching a level similar to the fixed wage treatment without firing (2.1). Average production in the last period was more than twice larger under individual incentives (6.1) than in the treatment with firing threats. We report no significant differences in last-period average production between the fixed wage treatment and the treatment with firing threats (see Table A.1 in the appendix). As a result, removing firing threats in Treatment F led to a collapse in *B* subjects' production levels. This result is in line with *Hypothesis 6i* as well as with the experimental results reported by Falk, Huffman and MacLeod (2011).

[28] In Treatment F, we include all *B* subjects who were not fired before the end of the fourth period. That is, 45 out of 54 *B* subjects. Note that our statistical analysis gives similar results whether we include or exclude fired subjects from the sample (see Table A.7 in the appendix). Production levels are computed excluding the performance on the first table which is used to classify subjects into ability levels.

In addition, Internet usage increased sharply from an average of 7.5% in the first four periods to 17.0% of total available time in the last period in the firing treatment (p-value = 0.002).[29] Internet usage did not increase significantly in the other two treatments. Similarly, chat usage increased from an average of 3.7% in the first four periods to 17.8% of total available time in the last period in the firing treatment (p-value < 0.001). In the last period, both Internet and chat usage were greater in the firing treatment than in the individual incentives treatment (see Tables A.2 and A.5 in the appendix). As a result, on-the-job leisure measured as the sum of chatting and Internet browsing soared in the last period to 34.8% of the time in the firing treatment (see Figure 6). Leisure activities were significantly more pronounced in the firing treatment (34.8%) and in the fixed wage treatment without firing (58.3%) than in the treatment with individual incentives (11.5%) (See Table A.3 in the appendix). This result is consistent with *Hypothesis 6ii*.

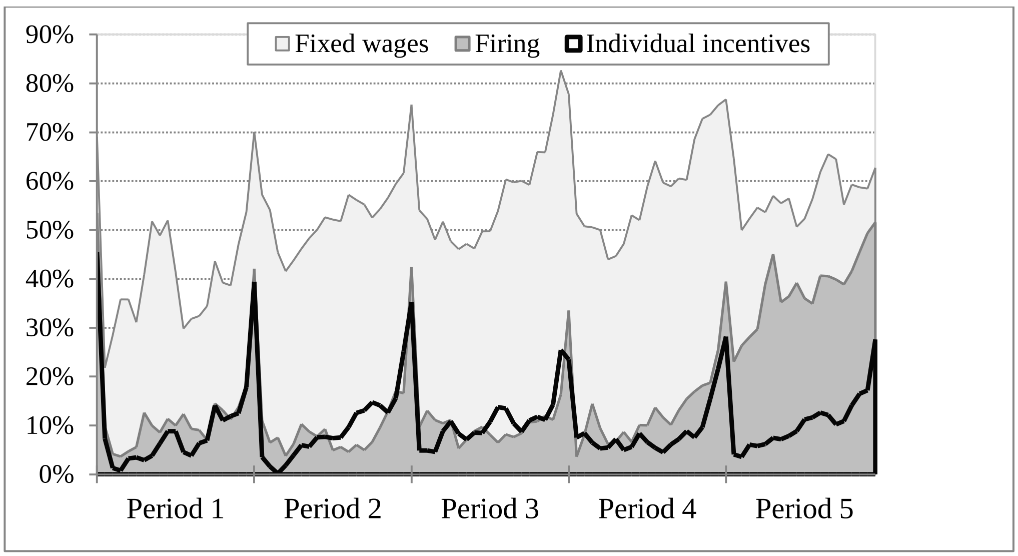

FIGURE 6.— Evolution of the average time (in %) that *B* subjects who had not (yet) been fired spent either browsing or chatting.

Finally, monitoring time decreased sharply in the firing treatment from an average of 12.2% in the first four periods to 5.2% in the last period. In line with *Hypothesis 6iii*, we find that there are no significant differences in monitoring time between the treatment with firing threats and the

[29] The reported p-value corresponds to the dummy regressor that takes value one for the last period and value zero for the previous periods in a Tobit regression with random effects. The dependent variable is the time spent on Internet by a given subject in a given period and the independent variables are the constant term and the last period dummy. Only the *B* subjects who had not been fired were included in the regression. For Treatments W and I, the p-values of the last period dummy were equal to 0.900 and 0.144, respectively. A similar conclusion can be obtained by using dummies for each period (see Table A.8 in the appendix).

other two treatments in Period 5 (see Table A.6 in the appendix). We summarize our findings regarding the tenure period as follows.

RESULT 5 (Tenure)

i) In line with Hypothesis 6i, in the last period, individual production was not significantly different between the fixed wage treatment and the treatment with firing threats. Individual production was significantly lower in the firing treatment than in the treatment with individual incentives.

ii) In line with Hypothesis 6ii, in the last period, Internet usage (as well as chatting) was significantly greater in the treatment with firing threats than in the treatment with individual incentives. No significant differences in Internet usage (as well as chatting) were identified between the firing treatment and the fixed wage treatment.

iii) In line with Hypothesis 6iii, monitoring time was not significantly different between the treatment with firing threats and the other two treatments.

5. CONCLUSIONS

In this paper, we investigated the impact of firing threats and tenure in a virtual organization characterized by real-effort tasks, access to leisure activities and real-time supervision. We showed that the introduction of firing threats significantly affected organizational behavior. In particular, production was more than twice higher in the presence of firing threats than in their absence while Internet usage, as well as chatting activities, were almost eradicated. Also, firing threats positively affected production levels of both low- and high- ability workers. These results show that even though firing threats were limited to a maximum of one-third of the labor force (three out of nine workers), they positively affected the work effort of all employees.

Nevertheless, organizations endowed with firing threats produced significantly less than organizations in which individual incentives were used. Interestingly, organizations endowed with firing threats did not differ from those using individual incentives in terms of leisure activities (Internet browsing and chatting). These results suggest that employees facing firing threats were willing to appear to their bosses as hard-working individuals spending a considerable amount of time (89.1%) on the *work task* screen. According to our theoretical framework, a consequence of such signaling behaviors is the reduced productivity of workers in the firing treatment with respect to fixed wages and individual incentives. We were able to confirm this conjecture. In particular, the time spent on the *work task* screen was the same under firing threats and individual incentives while production levels were about 25% lower in the former case. These findings suggest that under firing threats, employees were willing to signal themselves as hard-working individuals who spend long hours at their workstation without browsing the Internet.

Consistent with this interpretation, we stressed in our analysis of chatting activities that workers facing firing threats were very reluctant to include their boss in their communications to other employees. This seems to indicate that employees feared the negative consequences of being caught by their boss either chatting or browsing instead of working.

Finally, we report a collapse in production levels as well as a surge in Internet browsing and chatting in the final (tenure) period of the treatment with firing threats. This result is consistent with our theoretical framework according to which non-intrinsically motivated workers who successfully signal themselves as intrinsically motivated workers in the probationary periods will reduce their work effort in the tenure period.

Our results provide clear evidence of the incentive effects of firing threats which are commonly used in real work environments. At the same time, we emphasize that firing threats may backfire by inducing employees to engage in *impression management* activities. As a result, employers may inadvertently grant tenure to unmotivated workers leading to a collapse in firm performance.

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7. APPENDIX

In order to assess any statistical differences in individual production or Internet usage across treatments, we use a series of statistical tests that account for the specific nature of our data. More specifically, we use modifications of standard t-tests and Wilcoxon rank-sum tests to the case of clustered data. The clustered version of the Wilcoxon rank-sum test was performed using Datta and Satten test (2005).[30]

TABLE A.1 P-values for clustered t-tests (clustered Wilcoxon rank-sum tests) assessing differences in period production across treatments.

	Tests	Total	Period 1	Period 2	Period 3	Period 4	Period 5
B subjects only	W vs. F	**0.005** **(0.041)**	**0.033** **(0.066)**	**0.000** **(0.013)**	**0.038** **(0.044)**	**0.004** **(0.032)**	0.587 (0.744)
	Excluding fired subjects[31]	**0.007** **0.0280**	**-**	**-**	**0.017** **(0.027)**	**0.000** **(0.009)**	0.135 (0.165)
	W vs. I	**0.000** **(0.007)**	**0.012** **(0.042)**	**0.000** **(0.007)**	**0.000** **(0.007)**	**0.000** **(0.006)**	**0.000** **(0.009)**
	F vs. I	**0.009** **(0.020)**	0.335 (0.360)	0.118 (0.133)	**0.018** **(0.054)**	**0.040** **(0.032)**	**0.000** **(0.004)**
	Excluding fired subjects	**0.014** **(0.030)**	-	-	**0.015** **(0.058)**	**0.106** **(0.077)**	**0.000** **(0.012)**
C subjects only	W vs. F	0.748 (0.855)	0.928 (0.999)	0.986 (0.782)	0.536 (0.926)	0.418 (0.464)	0.155 (0.133)
	W vs. I	0.543 (0.792)	0.400 (0.645)	0.470 (0.647)	0.427 (0.782)	0.884 (0.999)	0.634 (0.713)
	F vs. I	0.398 (0.688)	0.411 (0.809)	0.488 (0.518)	0.703 (0.999)	0.409 (0.520)	0.226 (0.518)

[30] Datta and Satten (2005) as well as Galbraith, Daniel and Vissel (2010) provided us with R codes for the test. The codes for the clustered t-test in R were provided by Frank Harrell who implemented the procedure used in Donner, Birkett and Buck (1981).
[31] The p-values corresponding to the case "Excluding fired subjects" is such that all *B* subjects who had been fired before the end of the fourth period were removed from the sample.

TABLE A.2 P-values for clustered t-tests (clustered Wilcoxon rank-sum tests) assessing differences in internet usage across treatments.

	Tests	Total	Period 1	Period 2	Period 3	Period 4	Period 5
B subjects only	W vs. F	**0.000 (0.009)**	**0.005 (0.029)**	**0.000 (0.013)**	**0.006 (0.029)**	(0.191) **(0.062)**	**0.370 (0.624)**
	Excluding fired subjects	**0.000 (0.009)**	-	-	**0.000 (0.016)**	**0.000 (0.018)**	**0.229 (0.156)**
	W vs. I	**0.000 (0.005)**	**0.012 (0.042)**	**0.000 (0.007)**	**0.000 (0.007)**	**0.000 (0.006)**	**0.000 (0.0141)**
	F vs. I	0.267 (0.411)	0.753 (0.695)	0.322 (0.773)	0.189 (0.337)	**0.001 (0.040)**	**0.000 (0.011)**
	Excluding fired subjects	0.775 (0.646)	-	-	0.690 (0.661)	0.672 (0.156)	0.188 (0.178)
C subjects only	W vs. F	0.229 (0.429)	**0.095 (0.082)**	0.408 (0.931)	0.930 (0.931)	0.172 (0.329)	0.430 (0.609)
	W vs. I	0.345 (0.429)	**0.009 (0.034)**	0.585 (0.931)	0.690 (0.999)	0.428 (0.662)	0.624 (0.690)
	F vs. I	0.745 (0.937)	**0.067** (0.132)	0.559 (0.818)	0.637 (0.937)	0.485 (0.690)	0.548 (0.999)

TABLE A.3 P-values for clustered t-tests (clustered Wilcoxon rank-sum tests) assessing differences in working time (or leisure time) across treatments.

	Tests	Total	Period 1	Period 2	Period 3	Period 4	Period 5
B subjects only	W vs. F	**0.000 (0.009)**	**0.005 (0.029)**	**0.000 (0.013)**	**0.006 (0.029)**	(0.191) **(0.062)**	**0.370 (0.624)**
	Excluding fired subjects	**0.000 (0.009)**	-	-	**0.000 (0.016)**	**0.000 (0.018)**	**0.229 (0.156)**
	W vs. I	**0.000 (0.005)**	**0.012 (0.042)**	**0.000 (0.007)**	**0.000 (0.007)**	**0.000 (0.006)**	**0.000 (0.0141)**
	F vs. I	0.267 (0.411)	0.753 (0.695)	0.322 (0.773)	0.189 (0.337)	**0.001 (0.040)**	**0.000 (0.011)**
	Excluding fired subjects	0.775 (0.646)	-	-	0.690 0.661	0.672 (0.156)	0.188 (0.178)
C subjects only	W vs. F	0.229 (0.429)	**0.095 (0.082*)**	0.408 (0.931)	0.930 (0.931)	0.172 (0.329)	0.430 (0.609)
	W vs. I	0.345 (0.429)	**0.009 (0.034)**	0.585 (0.931)	0.690 (0.999)	0.428 (0.662)	0.624 (0.690)
	F vs. I	0.745 (0.937)	**0.067** (0.132)	0.559 (0.818)	0.637 (0.937)	0.485 (0.690)	0.548 (0.999)

TABLE A.4 Tobit regression with random effects for individual productivity (periods 1 to 4) across treatments.[32]

	Treatment F vs. I	Treatment F vs. W
Intercept	-0.016	-0.081**
Treatment F	-0.067***	-0.050**
Working time (in minutes)	0.014***	0.017***
Number of observations and Log likelihood (L)	*n* = 480 (63 left censored) L = -24.777, [Prob > χ^2] < 0.001	*n* = 440 (76 left censored) L = -25.176, [Prob > χ^2] < 0.001

Treatment F is a dummy variable that takes value 1 for Treatment F and 0 otherwise
*p -value<.10, ** p-value<.05, and *** p-value<.01.

[32] These results are robust to alternative specifications including non-linear specifications of working time.

TABLE A.5 P-values for clustered t-tests (clustered Wilcoxon rank-sum tests) assessing differences in chat usage across treatments.

	Tests	Total	Period 1	Period 2	Period 3	Period 4	Period 5
B subjects only	W vs. F	**0.000 (0.006)**	**0.000 (0.006)**	**0.000 (0.003)**	**0.000 (0.004)**	**0.000 (0.010)**	0.745 (0.740)
	Excluding fired subjects	**0.000 (0.004)**	-	-	**0.000 (0.004)**	**0.000 (0.006)**	0.161 (0.205)
	W vs. I	**0.000 (0.002)**	**0.000 (0.003)**	**0.000 (0.004)**	**0.000 (0.003)**	**0.000 (0.004)**	**0.000 (0.017)**
	F vs. I	**0.001 (0.020)**	0.492 (0.156)	0.924 (0.201)	0.135 (0.248)	**0.000 (0.061)**	**0.000 (0.010)**
	Excluding fired subjects	0.240 (0.220)	-	-	0.971 (0.574)	0.491 (0.278)	**0.007** (0.138)
C subjects only	W vs. F	0.553 (0.931)	0.707 (0.662)	0.763 (0.931)	0.505 (0.999)	0.931 (0.631)	0.798 (0.762)
	W vs. I	0.133 **(0.082)**	0.124 **(0.004)**	0.130 (0.125)	0.223 (0.125)	0.142 (0.125)	0.832 (0.762)
	F vs. I	**0.065 (0.067)**	**0.064 (0.065)**	**0.083 (0.093)**	0.203 (0.240)	0.129 **(0.093)**	0.965 (0.699)

TABLE A.6 Tobit regression with random effects for monitoring time (in seconds).

	Probationary periods[33] Periods 1-4	Tenure Period 5
Intercept	11.553	-10.867
Treatment F	115.707**	64.667
Number of observations and Log likelihood (L)	n = 68 (18 left censored) L = -668.2 [Prob > χ^2] = 0.046	n = 16 (6 left censored) L = -132.0 [Prob > χ^2] = 0.175

Treatment F is a dummy variable that takes value 1 for Treatment F and 0 otherwise
*p -value<.10, ** p-value<.05, and *** p-value<.01.

[33] These results are robust to introducing period dummies.

TABLE A.7 P-values for clustered t-tests (clustered Wilcoxon rank-sum tests) assessing differences in individual production and internet usage across treatments and ability levels.

	Individual production per period		Internet usage per period	
	Low-ability	High-ability	Low-ability	High-ability
W vs. F	**0.067** (0.548)	**0.007** **(0.035)**	**0.016** **(0.054)**	**0.010** **(0.041)**
Excluding fired subjects	**0.019** (0.165)	**0.003** **(0.028)**	**0.009** **(0.056)**	**0.012** **(0.034)**
W vs. I	**0.005** **(0.043)**	**0.001** **(0.043)**	**0.000** **(0.022)**	**0.007** **(0.068)**
F vs. I	0.188 **(0.075)**	0.259 (0.209)	**0.063** (0.136)	0.895 (0.489)
Excluding fired subjects	0.432 0.245	0.939 0.375	0.208 0.472	0.437 0.464

TABLE A.8 Tobit regression with random effects for internet usage per period for *B* subjects only.

	Fixed Wages (W)	*Firing (F)*	*Individual incentives (I)*
Intercept	280.475***	102.570***	88.823***
Period 2	136.353**	-36.681	18.136
Period 3	136.119**	-6.200	27.966
Period 4	156.51***	15.515	-2.899
Period 5	148.247***	117.186***	33.660
Number of observations and Log likelihood (L)	n = 216 (5 right censored) L = -9913.297 [Prob > χ^2] < 0.001	n = 238 (0 right censored) L = -3206.362 [Prob > χ^2] < 0.001	n = 270 (0 right censored) L = -3624.998 [Prob > χ^2] = 0.498

*p -value<.10, ** p-value<.05, and *** p-value<.01.

8. APPENDIX ONLINE (ONLINE APPENDIX)

ONLINE.1. THEORETICAL FRAMEWORK (PROOFS)

We consider the following specification of the model: $C(e_i^P) = \frac{(e_i^P)^2}{2}$, $v(l_i) = \beta l_i$ and for intrinsically motivated subjects we take $\vartheta(e_i^P) = \gamma e_i^P$, where $\beta > 0$ and $\gamma > 0$. Also, we consider that $\alpha_L \geq \beta$, $\gamma \geq \beta$, and $\alpha_H + \gamma - \beta \leq \varphi$.

We denote by $N_{j,R}$ ($N_{j,\sim R}$) the set of (not) intrinsically motivated workers of ability $j\epsilon\{L,H\}$, and $n_{j,R}$ ($n_{j,\sim R}$) stands for the number of (not) intrinsically motivated workers of ability $j\epsilon\{L,H\}$. Also, we use the notation $\langle j|R\rangle$ ($\langle j|\sim R\rangle$) to refer to an (not) intrinsically motivated worker of ability $j\epsilon\{L,H\}$. We also refer to a (not) intrinsically motivated supervisor as s_R ($s_{\sim R}$).

In the absence of firing threats, we derive the following equilibrium values for workers' and supervisors' activities by solving the corresponding first order conditions for any $t\epsilon\{1,2\}$.

Fixed wage treatment (Treatment W)

For any $t\epsilon\{1,2\}$ and any for any worker $l_R\epsilon N_{L,R}$, $h_R\epsilon N_{H,R}$, $l_{\sim R}\epsilon N_{L,\sim R}$ and $h_{\sim R}\epsilon N_{L,\sim R}$ the equilibrium decisions are as follows:

$$\left\langle \begin{matrix} e_{h_{\sim R},W}^{P*(t)} = 0 & e_{l_{\sim R},W}^{P*(t)} = 0 \\ e_{h_R,W}^{P*(t)} = \gamma - \beta & e_{l_R,W}^{P*(t)} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e_{h_{\sim R},W}^{\sim P*(t)} = 0 & e_{l_{\sim R},W}^{\sim P*(t)} = 0 \\ e_{h_R,W}^{\sim P*(t)} = 0 & e_{l_R,W}^{\sim P*(t)} = 0 \end{matrix} \right\rangle$$

$$\left\langle \begin{matrix} e_{s_{\sim R},W}^{P^*(t)} = \alpha_s - \beta \\ e_{s_R,W}^{P^*(t)} = \alpha_s + \gamma - \beta \\ m_{s_R,W}^{*(t)} = 0 \end{matrix} \middle| \begin{matrix} e_{s_{\sim R},W}^{\sim P^*(t)} = 0 \\ e_{s_R,W}^{\sim P^*(t)} = 0 \\ m_{s_{\sim R},W}^{*(t)} = 0 \end{matrix} \right\rangle$$

Individual incentives treatment (Treatment I)

For any $t\epsilon\{1,2\}$ and for any worker $l_R\epsilon N_{L,R}$, $h_R\epsilon N_{H,R}$, $l_{\sim R}\epsilon N_{L,\sim R}$ and $h_{\sim R}\epsilon N_{L,\sim R}$, and for any $s\epsilon\{L,H\}$ the equilibrium decisions are as follows:

$$\left\langle \begin{matrix} e_{h_{\sim R},I}^{P*(t)} = \alpha_H - \beta & e_{l_{\sim R},I}^{P*(t)} = \alpha_L - \beta \\ e_{h_R,I}^{P*(t)} = \alpha_H + \gamma - \beta & e_{l_R,I}^{P*(t)} = \alpha_L + \gamma - \beta \end{matrix} \middle| \begin{matrix} e_{h_{\sim R},I}^{\sim P*(t)} = 0 & e_{l_{\sim R},I}^{\sim P*(t)} = 0 \\ e_{h_R,I}^{\sim P*(t)} = 0 & e_{l_R,I}^{\sim P*(t)} = 0 \end{matrix} \right\rangle$$

$$\left\langle \begin{matrix} e_{s_{\sim R},I}^{P^*(t)} = \alpha_s - \beta \\ e_{s_R,I}^{P^*(t)} = \alpha_s + \gamma - \beta \\ m_{s_R,I}^{*(t)} = 0 \end{matrix} \middle| \begin{matrix} e_{s_{\sim R},I}^{\sim P^*(t)} = 0 \\ e_{s_R,I}^{\sim P^*(t)} = 0 \\ m_{s_{\sim R},I}^{*(t)} = 0 \end{matrix} \right\rangle$$

Firing treatment (Treatment F)

We make the following simplifying assumption. We assume that $\bar{m} < \varphi - (\alpha_H + \gamma - \beta)$ so that supervisors can monitor workers while exerting their optimal level of effort. Therefore, similarly to the other two treatments, the optimal level of effort for the supervisor is always as follows:

$$\left\langle \begin{array}{c|c} e_{s_{\sim R},F}^{P^*(t)} = \alpha_s - \beta & e_{s_{\sim R},F}^{\sim P^*(t)} = 0 \\ e_{s_R,F}^{P^*(t)} = \alpha_s + \gamma - \beta & e_{s_R,F}^{\sim P^*(t)} = 0 \end{array} \right\rangle$$

Note that the supervisors' level of effort is always rewarded at its marginal product. The opportunity cost of monitoring workers is then going to be captured by the loss in utility incurred from supervising in lieu of browsing the Internet ($\bar{m}\beta$).

In order to disregard the case in which intrinsically motivated workers engage in signaling behaviors, we consider that the maximum level of production that can be achieved by a low-ability [high-ability] worker is equal to $(\gamma - \beta)\alpha_L$ $[(\gamma - \beta)\alpha_H]$.[34] Also, we consider that $(\gamma - \beta)\alpha_L < \omega \leq (\gamma - \beta)\alpha_H$, so the supervisor is (not) interested in firing low (high) ability workers if they can be identified. Note that we also assume that fixed wages (ω) cannot be lower than the expected value of production in period 2 of a worker selected at random. That is: $\omega > (\gamma - \beta)\bar{\alpha}$, where $\bar{\alpha} = \frac{n_{L,R}\alpha_L + n_{H,R}\alpha_H}{n}$. As a result, even if supervisors do not monitor workers they will be willing to fire subjects at random. Note that relaxing this assumption would not affect the qualitative nature of our predictions.

We denote $\bar{n}_f$ the maximum number of workers who can be fired. We detail our derivations below.[35]

○ **<u>Case A</u>**. We consider $\bar{n}_f \geq n - n_{H,R}$

□ *i*) *Signaling equilibrium.* In that case, non-intrinsically motivated workers may actually decide to provide productive effort in the first period. In particular, high-ability workers may want to signal themselves to supervisors as intrinsically motivated high-ability workers so as to avoid being fired for sure at the end of the first period. Non-intrinsically motivated low-ability workers

[34] This corresponds to the level of output produced by an intrinsically motivated worker of low [high] ability in the absence of signaling concerns. In our experimental setting, this could be seen as the maximum number of tables that a subject is allowed to complete. Similar results can be obtained by imposing the following restriction on the total amount of time available to workers: $\varphi \leq \gamma - \beta$.

[35] Note that we only consider pure-strategy equilibria.

will not be willing to engage in signaling since $\bar{n}_f \geq n - n_{H,R}$ (and $(\gamma-\beta)\alpha_L < \omega$) implies that mimicking intrinsically motivated low-ability workers will not prevent low-ability workers to be fired. Non-intrinsically motivated high-ability workers will be willing to signal themselves as intrinsically motivated high-ability workers as long as the following condition is satisfied:

$$\omega \geq \frac{(\gamma-\beta)(\gamma+\beta)}{2(1-\pi^*{}_{(i_H)})} \quad (1_A)$$

where $\pi^*{}_{(i_H)} = \frac{n_f^* - n_L}{n_H}$ is the probability that a high-ability worker will be fired in an equilibrium of type (i). Note that in equilibrium,

$$n_f^* = n_L \quad if \quad \omega \leq \frac{n_{H,R}}{n_H}(\gamma-\beta)\alpha_H$$

and

$$n_f^* = \bar{n}_f \quad otherwise$$

Also for this equilibrium to hold it has to be the case that expected value of production of a high-ability worker (either intrinsically or non-intrinsically motivated) is larger than the production of an intrinsically motivated low-ability worker. This condition is stated as follows:

$$\frac{n_{H,R}}{n_H}\alpha_H > \alpha_L \quad (2_A)$$

If this condition does not hold then a high-ability worker would automatically deviate and mimic an intrinsically motivated low-ability worker.

The signaling strategy follows by non-intrinsically motivated high-ability workers will be profitable as long as the supervisor engages in monitoring in the first period. This will hold if the following condition comparing the expected payoffs between monitoring and not monitoring (in period 1) is satisfied:

$$\bar{c} \leq -\bar{m}\beta + n_{H,R}(\gamma-\beta)\alpha_H + \left(1-\pi^*{}_{(i_H)}\right)n_{H,R}(\gamma-\beta)\alpha_H - \left(n-\bar{n}_f\right)(\gamma-\beta)\bar{\alpha} - \left(\bar{n}_f - n_f^*\right)\omega \quad (3_A)$$

If condition (3_A) does not hold equilibrium effort decisions are the same as in Treatment W. In that case, the supervisor would fire $\bar{n}_f$ workers at random.

As a result, when conditions $(1_A), (2_A)$ and (3_A) hold, a signaling equilibrium in Case A exists and is characterized as follows, for any worker $l_R \epsilon N_{L,R}$, $h_R \epsilon N_{H,R}$, $l_{\sim R} \epsilon N_{L,\sim R}$ and $h_{NR} \epsilon N_{L,NR}$:

$$\left\langle \begin{matrix} e^{P*(1)}_{h_{\sim R},F} = \gamma - \beta & e^{P*(1)}_{l_{\sim R},F} = 0 \\ e^{P*(1)}_{h_R,F} = \gamma - \beta & e^{P*(1)}_{l_R,F} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e^{\sim P*(1)}_{h_{\sim R},F} = 0 & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{NP*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{matrix} \right\rangle$$

$$\left\langle \begin{matrix} e^{P*(2)}_{h_{\sim R},F} = 0 & e^{P*(2)}_{l_{\sim R},F} = 0 \\ e^{P*(2)}_{h_R,F} = \gamma - \beta & e^{P*(2)}_{l_R,F} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e^{\sim P*(2)}_{h_{\sim R},F} = 0 & e^{\sim P*(2)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(2)}_{h_R,F} = 0 & e^{\sim P*(2)}_{l_R,F} = 0 \end{matrix} \right\rangle$$

$$\left\langle m^{*(1)}_{s_{\sim R},F} = m^{*(1)}_{s_R,F} = \bar{m} \middle| m^{*(2)}_{s_{\sim R},F} = m^{*(2)}_{s_R,F} = 0 \right\rangle$$

In equilibrium, all low-ability workers are fired. In case that $\omega > \frac{n_{H,R}}{n_H}(\gamma - \beta)\alpha_H$, the supervisor will fire $(\bar{n}_f - n_L)$ high-ability workers at random. If this condition does not hold then the supervisor will only fire low-ability workers in which case $n_f^* = n_L$.

□ *ii) No-signaling equilibrium*. In the absence of a signaling equilibrium, if the following condition holds:

$$\bar{c} \leq -\bar{m}\beta + n_{H,R}(\gamma - \beta)\alpha_H - \left(n - \bar{n}_f\right)(\gamma - \beta)\bar{\alpha} + \left(n - \bar{n}_f - n_{H,R}\right)\omega \quad (4_A)$$

there exists an equilibrium characterized as follows, for any $t\epsilon\{1,2\}$ and for any worker $l_R\epsilon N_{L,R}$, $h_R\epsilon N_{H,R}$, $l_{\sim R}\epsilon N_{L,\sim R}$ and $h_{\sim R}\epsilon N_{L,\sim R}$:

$$\left\langle \begin{matrix} e^{P*(t)}_{h_{\sim R},F} = 0 & e^{P*(t)}_{l_{\sim R},F} = 0 \\ e^{P*(t)}_{h_R,F} = \gamma - \beta & e^{P*(t)}_{l_R,F} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e^{\sim P*(t)}_{h_{\sim R},F} = 0 & e^{\sim P*(t)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(t)}_{h_R,F} = 0 & e^{\sim P*(t)}_{l_R,F} = 0 \end{matrix} \right\rangle$$

$$\left\langle m^{*(1)}_{s_{NR},F} = m^{*(1)}_{s_R,F} = \bar{m} \middle| m^{*(2)}_{s_{NR},F} = m^{*(2)}_{s_R,F} = 0 \right\rangle$$

and $n_f^* = n - n_{H,R}$ so that all workers but the high-ability intrinsically motivated workers are fired in equilibrium.

This equilibrium holds whenever condition (4_A) below holds:

If condition (4_A) does not hold then the supervisor will not monitor workers. In that case, equilibrium effort decisions would be the same as in Treatment W and the supervisor would fire $\bar{n}_f$ workers at random.

○ **<u>Case B</u>**. We consider $n - n_{L,R} - n_{H,R} \leq \bar{n}_f < n - n_{H,R}$. In this case, non-intrinsically motivated low-ability workers may also engage in signaling activities along with non-intrinsically motivated high-ability workers. In turn, high-ability workers without intrinsic motivation will be interested in either mimicking low- or high- ability workers with intrinsic motivation.

There exist four types of pure-strategy signaling equilibria:[36]

i. Both low- and high- ability workers without intrinsic motivation mimic low-ability workers with intrinsic motivation.

ii. High-ability workers without intrinsic motivation mimic high-ability workers with intrinsic motivation while low-ability workers without intrinsic motivation mimic low-ability workers with intrinsic motivation.

iii. High-ability workers without intrinsic motivation mimic low-ability workers with intrinsic motivation.

iv. High-ability workers without intrinsic motivation mimic high-ability workers with intrinsic motivation.

In addition, there exists an equilibrium without signaling (**v**) in which case non-intrinsically motivated workers do not mimic the behavior of intrinsically motivated workers.

□ An equilibrium of type (*i*) occurs if the following conditions are met:

First, workers of type $\langle L|{\sim}R\rangle$ are willing to mimic workers of type $\langle L|R\rangle$:

$$\omega \geq \frac{(\gamma-\beta)(\gamma+\beta)}{2\left(1-\pi^*{}_{(i_{L,R})}\right)} \quad (i_1)$$

where $\pi^*{}_{(i_{L,R})}$ is the probability that a low-ability worker with intrinsic motivation will be fired in an equilibrium of type (*i*), that is $\pi^*{}_{(i_{L,R})} = \frac{n_f^*}{n-n_{H,R}}$. Note that in equilibrium, $n_f^* = \bar{n}_f$.

Second, workers of type $\langle H|{\sim}R\rangle$ are willing to mimic workers of type $\langle L|R\rangle$ while not mimicking type $\langle H|R\rangle$:

$$\frac{2(\gamma-\beta)\beta+\left(\frac{\alpha_L}{\alpha_H}(\gamma-\beta)\right)^2}{2\left(1-\pi_{(i_{L,R})}\right)} \leq \omega < \frac{(\gamma-\beta)(\gamma+\beta)}{2} \quad (i_2)$$

This will hold as long as $\pi_{(i_{L,R})}$ is low enough. This will require a low proportion of high-ability workers who are intrinsically motivated to ensure that $n-n_{H,R}$ is high.

[36] The type of equilibrium in which only low-ability workers mimic intrinsically motivated workers does not exist since it is less costly for high-ability workers to mimic intrinsically motivated workers for the same gains in terms of reduced probability of being fired.

The signaling equilibrium will hold if the following condition comparing the expected payoffs between monitoring and not monitoring (in period 1) is satisfied so that monitoring occurs in equilibrium:

$$\bar{c} \leq -\bar{m}\beta + \left(n_{H,\sim R} + n_{L,\sim R}\right)(\gamma-\beta)\alpha_L + n_{H,R}(\gamma-\beta)\alpha_H + \left(1-\pi_{(i_{L,R})}\right)n_{L,R}(\gamma-\beta)\alpha_L - \left(n-\bar{n}_f\right)(\gamma-\beta)\bar{\alpha} \quad (i_3)$$

If condition (i_3) does not hold then the supervisor will not monitor workers. In that case, equilibrium effort decisions would be the same as in Treatment W and the supervisor would fire $\bar{n}_f$ workers at random.

When conditions (i_1), (i_2) and (i_3) hold, a signaling equilibrium of type (i) exists and is characterized as follows, for any worker $l_R \epsilon N_{L,R}$, $h_R \epsilon N_{H,R}$, $l_{\sim R} \epsilon N_{L,\sim R}$ and $h_{\sim R} \epsilon N_{L,\sim R}$:

$$\left\langle \begin{array}{cc|cc} e^{P*(1)}_{h_{\sim R},F} = \dfrac{\alpha_L}{\alpha_H}(\gamma-\beta) & e^{P*(1)}_{l_{\sim R},F} = \gamma-\beta & e^{\sim P*(1)}_{h_{\sim R},F} = \left(1-\dfrac{\alpha_L}{\alpha_H}\right)(\gamma-\beta) & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{P*(1)}_{h_R,F} = \gamma-\beta & e^{P*(1)}_{l_R,F} = \gamma-\beta & e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{array} \right\rangle$$

$$\left\langle \begin{array}{cc|cc} e^{P*(2)}_{h_{\sim R},F} = 0 & e^{P*(2)}_{l_{\sim R},F} = 0 & e^{\sim P*(2)}_{h_{\sim R},F} = 0 & e^{\sim P*(2)}_{l_{\sim R},F} = 0 \\ e^{P*(2)}_{h_R,F} = \gamma-\beta & e^{P*(2)}_{l_R,F} = \gamma-\beta & e^{\sim P*(2)}_{h_R,F} = 0 & e^{\sim P*(2)}_{l_R,F} = 0 \end{array} \right\rangle$$

$$\left\langle m^{*(1)}_{s_{NR},F} = m^{*(1)}_{s_R,F} = \bar{m} \,\middle|\, m^{*(2)}_{s_{NR},F} = m^{*(2)}_{s_R,F} = 0 \right\rangle$$

and $n_f^* = \bar{n}_f$ such that $\bar{n}_f$ workers are fired at random among those who are not high-ability intrinsically motivated workers.

□ An equilibrium of type (ii) occurs if the following conditions are met:

First, workers of type $\langle L|NR\rangle$ are willing to mimic workers of type $\langle L|R\rangle$:

$$\omega \geq \frac{(\gamma-\beta)(\gamma+\beta)}{2(1-\pi^*_{(ii_{L,R})})} \quad (ii_1)$$

where $\pi^*_{(ii_{L,R})}$ is the probability that a worker identified as a low-ability worker with intrinsic motivation will be fired by the supervisor in an equilibrium of type (ii), that is $\pi^*_{(ii_{L,R})} = min\{\frac{n_f^*}{n_L}; 1\}$.

Second, workers of type $\langle H|{\sim}R\rangle$ mimic workers of type $\langle H|R\rangle$ while not mimicking type $\langle L|R\rangle$:

$$\frac{(\gamma-\beta)(\gamma+\beta)}{2(1-\pi^*{}_{(ii_{H,R})})} \leq \omega < \frac{2(\gamma-\beta)\beta+\left(\frac{\alpha_L}{\alpha_H}(\gamma-\beta)\right)^2}{2\left(1-\min\{\frac{n_f^*+1}{n_L+1};\frac{\bar{n}_f}{n_L+1};1\}\right)} \quad (ii_2)$$

where $\pi^*{}_{(ii_{H,R})}$ is the probability that a high-ability worker with intrinsic motivation will be fired in an equilibrium of type (*ii*). Note that in equilibrium,

$$n_f^* = \min\{\bar{n}_f; n_L\} \quad if \quad \omega \leq \frac{n_{H,R}}{n_H}(\gamma-\beta)\alpha_H$$

in which case $\pi^*{}_{(ii_{H,R})} = 0$, and

$$n_f^* = \bar{n}_f \quad otherwise$$

in which case $\pi^*{}_{(ii_{H,R})} = \max\left\{\frac{n_f^*-n_L}{n_H};0\right\}$.

The signaling equilibrium will hold if the following condition comparing the expected payoffs between monitoring and not monitoring in period 1 is satisfied so that monitoring occurs in equilibrium:

$$\bar{c} \leq -\bar{m}\beta + n_{H,\sim R}(\gamma-\beta)\alpha_H + n_{L,\sim R}(\gamma-\beta)\alpha_L + \left(1-\pi^*{}_{(ii_{H,R})}\right)n_{H,R}(\gamma-\beta)\alpha_H +$$
$$\left(1-\pi^*{}_{(ii_{L,R})}\right)n_{L,R}(\gamma-\beta)\alpha_L - \left(n-\bar{n}_f\right)(\gamma-\beta)\bar{\alpha} - \left(\bar{n}_f-n_f^*\right)\omega \quad (ii_3)$$

If condition (ii_3) does not hold then the supervisor will not monitor workers. In that case, equilibrium effort decisions would be the same as in Treatment W and the supervisor would fire $\bar{n}_f$ workers at random.

As a result, when conditions (ii_1), (ii_2) and (ii_3) hold, a signaling equilibrium of type (*ii*) exists and is characterized as follows, for any worker $l_R \epsilon N_{L,R}$, $h_R \epsilon N_{H,R}$, $l_{\sim R} \epsilon N_{L,\sim R}$ and $h_{\sim R} \epsilon N_{L,\sim R}$:

$$\left\langle \begin{array}{cc|cc} e^{P*(1)}_{h_{\sim R},F} = \gamma-\beta & e^{P*(1)}_{l_{\sim R},F} = \gamma-\beta & e^{\sim P*(1)}_{h_{\sim R},F} = 0 & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{P*(1)}_{h_R,F} = \gamma-\beta & e^{P*(1)}_{l_R,F} = \gamma-\beta & e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{array} \right\rangle$$

$$\left\langle \begin{array}{cc|cc} e^{P*(2)}_{h_{\sim R},F} = 0 & e^{P*(2)}_{l_{\sim R},F} = 0 & e^{\sim P*(2)}_{h_{\sim R},F} = 0 & e^{\sim P*(2)}_{l_{\sim R},F} = 0 \\ e^{P*(2)}_{h_R,F} = \gamma-\beta & e^{P*(2)}_{l_R,F} = \gamma-\beta & e^{\sim P*(2)}_{h_R,F} = 0 & e^{\sim P*(2)}_{l_R,F} = 0 \end{array} \right\rangle$$

$$\left\langle m^{*(1)}_{s_{\sim R},F} = m^{*(1)}_{s_R,F} = \bar{m} \;\middle|\; m^{*(2)}_{s_{\sim R},F} = m^{*(2)}_{s_R,F} = 0 \right\rangle$$

In equilibrium, low-ability workers are fired first. In case there is less low-ability workers than the maximum number of workers that can be fired ($\bar{n}_f$), the supervisor will fire $(\bar{n}_f - n_L)$ high-ability workers at random as long as $\omega > \frac{n_{H,R}}{n_H}(\gamma-\beta)\alpha_H$. That is, if this condition is satisfied then $n_f^* = \bar{n}_f$. If this condition does not hold ($\omega \leq \frac{n_{H,R}}{n_H}(\gamma-\beta)\alpha_H$) then the supervisor will only fire low-ability workers in which case $n_f^* = \min\{n_L, \bar{n}_f\}$.

□ An equilibrium of type (*iii*) occurs if the following conditions are met:

First, workers of type $\langle L|{\sim}R\rangle$ are not willing to mimic workers of type $\langle L|R\rangle$:

$$\omega < \frac{(\gamma-\beta)(\gamma+\beta)}{2\left(1-\frac{n_f^* - n_{L,\sim R}+1}{n_{L,R}+n_{H,\sim R}+1}\right)} \quad (iii_1)$$

Second, workers of type $\langle H|{\sim}R\rangle$ are willing to mimic workers of type $\langle L|R\rangle$ while not mimicking type $\langle H|R\rangle$:

$$\frac{2(\gamma-\beta)\beta+\left(\frac{\alpha_L}{\alpha_H}(\gamma-\beta)\right)^2}{2\left(1-\pi^*{}_{(iii_{L,R})}\right)} \leq \omega < \frac{(\gamma-\beta)(\gamma+\beta)}{2} \quad (iii_2)$$

where $\pi^*{}_{(iii_{L,R})}$ is the probability that a low-ability worker with intrinsic motivation will be fired in an equilibrium of type (*iii*), that is $\pi^*{}_{(iii_{L,R})} = \frac{n_f^* - n_{L,\sim R}}{n_{L,R}+n_{H,\sim R}}$. Note that in equilibrium, $n_f^* = \bar{n}_f$. This will hold as long as $\pi^*{}_{(iii_{L,R})}$ is low enough. This will require a high proportion of high-ability workers who are not intrinsically motivated so that $n_{L,R}+n_{H,\sim R}$ is high and $\pi^*{}_{(iii_{L,R})}$ is low.

The signaling equilibrium will hold if the following condition comparing the expected payoffs between monitoring and not monitoring in period 1 is satisfied so that monitoring occurs in equilibrium:

$$\bar{c} \leq -\bar{m}\beta + n_{H,\sim R}(\gamma-\beta)\alpha_L + n_{H,R}(\gamma-\beta)\alpha_H + \left(1-\pi^*{}_{(iii_{L,R})}\right)n_{L,R}(\gamma-\beta)\alpha_L - \left(n-\bar{n}_f\right)(\gamma-\beta)\bar{\alpha} \quad (iii_3)$$

If condition (iii_3) does not hold then the supervisor will not monitor workers. In that case, equilibrium effort decisions would be the same as in Treatment W and the supervisor would fire $\bar{n}_f$ workers at random.

As a result, when conditions (iii_1), (iii_2) and (iii_3) hold, a signaling equilibrium of type (*iii*) exists and is characterized as follows, for any worker $l_R \epsilon N_{L,R}$, $h_R \epsilon N_{H,R}$, $l_{NR} \epsilon N_{L,\sim R}$ and $h_{\sim R} \epsilon N_{L,\sim R}$:

$$\left\langle \begin{matrix} e_{h_{\sim R},F}^{P*(1)} = \frac{\alpha_L}{\alpha_H}(\gamma - \beta) & e_{l_{\sim R},F}^{P*(1)} = 0 \\ e_{h_R,F}^{P*(1)} = \gamma - \beta & e_{l_R,F}^{P*(1)} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e_{h_{\sim R},F}^{\sim P*(1)} = \left(1 - \frac{\alpha_L}{\alpha_H}\right)(\gamma - \beta) & e_{l_{\sim R},F}^{\sim P*(1)} = 0 \\ e_{h_R,F}^{\sim P*(1)} = 0 & e_{l_R,F}^{\sim P*(1)} = 0 \end{matrix} \right\rangle$$

$$\left\langle \begin{matrix} e_{h_{\sim R},F}^{P*(2)} = 0 & e_{l_{\sim R},F}^{P*(2)} = 0 \\ e_{h_R,F}^{P*(2)} = \gamma - \beta & e_{l_R,F}^{P*(2)} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e_{h_{\sim R},F}^{\sim P*(2)} = 0 & e_{l_{\sim R},F}^{\sim P*(2)} = 0 \\ e_{h_R,F}^{\sim P*(2)} = 0 & e_{l_R,F}^{\sim P*(2)} = 0 \end{matrix} \right\rangle$$

$$\left\langle m_{s_{\sim R},F}^{*(1)} = m_{s_R,F}^{*(1)} = \bar{m} \middle| m_{s_{\sim R},F}^{*(2)} = m_{s_R,F}^{*(2)} = 0 \right\rangle$$

and $n_f^* = \bar{n}_f$. In equilibrium, low-ability workers who are not intrinsically motivated will be fired first and, at random, $\bar{n}_f - n_{L,\sim R}$ workers will be fired among the remaining workers who are not high-ability intrinsically motivated workers.

□ An equilibrium of type (*iv*) occurs if the following conditions are met:

First, a necessary condition for an equilibrium of type (*iv*) to exist is:

$$\frac{n_{H,R}}{n_H}\alpha_H \geq \alpha_L \qquad (iv_1)$$

since workers of type $\langle H|{\sim}R\rangle$ would not be willing to mimic workers of type $\langle H|R\rangle$ in equilibrium otherwise. Instead, they would rather mimic workers of type $\langle L|R\rangle$.

Second, workers of type $\langle L|{\sim}R\rangle$ are not willing to mimic workers of type $\langle L|R\rangle$:

$$\omega < \frac{(\gamma - \beta)(\gamma + \beta)}{2\left(1 - \min\left\{\frac{n_f^* - n_{L,\sim R} + 1}{n_{L,R} + 1}; 1\right\}\right)} \qquad (iv_2)$$

Third, workers of type $\langle H|{\sim}R\rangle$ mimic workers of type $\langle H|R\rangle$ while not mimicking type $\langle L|R\rangle$:

$$\frac{(\gamma - \beta)(\gamma + \beta)}{2(1 - \pi^*{}_{(iv_{H,R})})} \leq \omega < \frac{2(\gamma - \beta)\beta + \left(\frac{\alpha_L}{\alpha_H}(\gamma - \beta)\right)^2}{2\left(1 - \frac{n_f^* - n_{L,\sim R}}{n_{L,R} + 1}\right)} \qquad (iv_3)$$

where $\pi^*{}_{(iv_{H,R})}$ is the probability that a high-ability worker with intrinsic motivation will be fired in an equilibrium of type (*iv*), that is:

$$\pi^*{}_{(iv_{H,R})} = 0 \quad if \quad \omega \leq \frac{n_{H,R}}{n_H}(\gamma - \beta)\alpha_H$$

and

$$\pi^*{}_{(iv_{H,R})} = \max\{\frac{n_f^* - n_L}{n_H}; 0\} \quad otherwise$$

The signaling equilibrium will hold if the following condition comparing the expected payoffs between monitoring and not monitoring in period 1 is satisfied so that monitoring occurs in equilibrium:

$$\bar{c} \leq -\bar{m}\beta + n_{H,\sim R}(\gamma - \beta)\alpha_H + \left(1 - \pi^*{}_{(iv_{H,R})}\right) n_{H,R}(\gamma - \beta)\alpha_H + \left(1 - \pi^*{}_{(iv_{L,R})}\right) n_{L,R}(\gamma - \beta)\alpha_L - \left(n - \bar{n}_f\right)(\gamma - \beta)\bar{\alpha} - \left(\bar{n}_f - n_f^*\right)\omega \quad (iv_4)$$

If condition (iv_4) does not hold then the supervisor will not monitor workers. In that case, equilibrium effort decisions would be the same as in Treatment W and the supervisor would fire $\bar{n}_f$ workers at random.

As a result, when conditions (iv_1), (iv_2), (iv_3), and (iv_4) hold, a signaling equilibrium of type (iv) exists and is characterized as follows, for any worker $l_R \epsilon N_{L,R}$, $h_R \epsilon N_{H,R}$, $l_{R\sim} \epsilon N_{L,\sim R}$ and $h_{\sim R} \epsilon N_{L,\sim R}$:

$$\left\langle \begin{matrix} e^{P*(1)}_{h_{\sim R},F} = \gamma - \beta & e^{P*(1)}_{l_{\sim R},F} = 0 \\ e^{P*(1)}_{h_R,F} = \gamma - \beta & e^{P*(1)}_{l_R,F} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e^{\sim P*(1)}_{h_{\sim R},F} = 0 & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{matrix} \right\rangle$$

$$\left\langle \begin{matrix} e^{P*(2)}_{h_{\sim R},F} = 0 & e^{P*(2)}_{l_{\sim R},F} = 0 \\ e^{P*(2)}_{h_R,F} = \gamma - \beta & e^{P*(2)}_{l_R,F} = \gamma - \beta \end{matrix} \middle| \begin{matrix} e^{\sim P*(2)}_{h_{\sim R},F} = 0 & e^{\sim P*(2)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(2)}_{h_R,F} = 0 & e^{\sim P*(2)}_{l_R,F} = 0 \end{matrix} \right\rangle$$

$$\left\langle m^{*(1)}_{s_{\sim R},F} = m^{*(1)}_{s_R,F} = \bar{m} \middle| m^{*(2)}_{s_{\sim R},F} = m^{*(2)}_{s_R,F} = 0 \right\rangle$$

In equilibrium, low-ability workers are fired first. In case there is less low-ability workers than the maximum number of workers that can be fired, the supervisor will fire $(\bar{n}_f - n_L)$ high-ability workers at random as long as $\omega > \frac{n_{H,R}}{n_H}(\gamma - \beta)\alpha_H$. That is, if this condition is satisfied then $n_f^* = \bar{n}_f$. If the previous condition does not hold ($\omega \leq \frac{n_{H,R}}{n_H}(\gamma - \beta)\alpha_H$) then the supervisor will only fire low-ability workers in which case $n_f^* = \min\{n_L, \bar{n}_f\}$.

□ No-signaling equilibrium (v). The equilibrium is characterized as follows.

First, workers of type $\langle L|\sim R\rangle$ are not willing to mimic workers of type $\langle L|R\rangle$:

$$\omega < \frac{(\gamma-\beta)(\gamma+\beta)}{2\left(1-\frac{n_f^{*}-n_{L,\sim R}-n_{H,\sim R}+1}{n_{L,R}+1}\right)} \quad (v_1)$$

where $\pi^{*}{}_{(v_{L,R})}$ is the probability that a low-ability worker with intrinsic motivation will be fired in a no-signaling equilibrium, that is $\pi^{*}{}_{(v_{L,R})} = \frac{n_f^{*}-n_{L,\sim R}-n_{H,\sim R}}{n-n_{H,R}}$.

Second, workers of type $\langle H|{\sim}R\rangle$ are not willing to mimic workers of either type $\langle L|R\rangle$ or type $\langle H|R\rangle$:

$$\omega < \min\left\{\frac{(\gamma-\beta)(\gamma+\beta)}{2};\frac{2(\gamma-\beta)\beta+\left(\frac{\alpha_L}{\alpha_H}(\gamma-\beta)\right)^2}{2\left(1-\frac{n_f^{*}-n_{L,\sim R}-n_{H,\sim R}+1}{n_{L,R}+1}\right)}\right\} \quad (v_2)$$

The no-signaling equilibrium with monitoring will hold if the following condition comparing the expected payoffs between monitoring and not monitoring (in period 1) is satisfied so that monitoring occurs in equilibrium:

$$\bar{c} \leq -\bar{m}\beta + n_{H,R}(\gamma-\beta)\alpha_H + \left(1-\pi^{*}{}_{(v_{L,R})}\right)n_{L,R}(\gamma-\beta)\alpha_L - \left(n-\bar{n}_f\right)(\gamma-\beta)\bar{\alpha} \qquad (v_3)$$

where $\pi^{*}{}_{(v_{L,R})}$ is the probability that a low-ability worker with intrinsic motivation will be fired in a no-signaling equilibrium, that is $\pi^{*}{}_{(v_{L,R})} = \frac{n_f^{*}-n_{L,\sim R}-n_{H,\sim R}}{n-n_{H,R}}$.

If condition (v_3) does not hold then the supervisor will not monitor workers. In that case, equilibrium effort decisions would be the same as in Treatment W and the supervisor would fire $\bar{n}_f$ workers at random.

As a result, when conditions (v_1), (v_2), and (v_3) hold, a no-signaling equilibrium of type (v) exists and is characterized as follows, for any $t\epsilon\{1,2\}$ and for any worker $l_R\epsilon N_{L,R}$, $h_R\epsilon N_{H,R}$, $l_{\sim R}\epsilon N_{L,\sim R}$ and $h_{\sim R}\epsilon N_{L,\sim R}$:

$$\left\langle \begin{matrix} e_{h_{\sim R},F}^{P*(t)} = 0 & e_{l_{\sim R},F}^{P*(t)} = 0 \\ e_{h_R,F}^{P*(t)} = \gamma-\beta & e_{l_R,F}^{P*(t)} = \gamma-\beta \end{matrix} \middle| \begin{matrix} e_{h_{\sim R},F}^{\sim P*(t)} = 0 & e_{l_{\sim R},F}^{\sim P*(t)} = 0 \\ e_{h_R,F}^{\sim P*(t)} = 0 & e_{l_R,F}^{\sim P*(t)} = 0 \end{matrix} \right\rangle$$

$$\left\langle m_{s_{NR},F}^{*(1)} = m_{s_R,F}^{*(1)} = \bar{m} \middle| m_{s_{NR},F}^{*(2)} = m_{s_R,F}^{*(2)} = 0 \right\rangle$$

and $n_f^* = \bar{n}_f$. In equilibrium, the supervisor will fire first the non-intrinsically motivated workers $(n_{L,\sim R} + n_{L,\sim R})$ before firing at random $(\bar{n}_f - (n_{L,\sim R} + n_{L,\sim R}))$ low-ability intrinsically motivated workers.

○ **Case C**. We consider $\bar{n}_f < n - n_{L,R} - n_{H,R}$.

This case is similar to Case B. The same types of equilibria (*i* to *v*) exist and derivations are obtained following the same procedure.

We summarize equilibrium decisions for each equilibrium type in Table O.1.

TABLE O.1 Summary of workers' equilibrium decisions in the probationary period (t=1) under different types of equilibrium in which the supervisor monitors workers.

Equilibrium Type	Workers' levels of productive (e^{P}) and nonproductive ($e^{\sim P}$) effort.
i)	$\left\langle \begin{matrix} e^{P*(1)}_{h_{\sim R},F} = \frac{\alpha_L}{\alpha_H}(\gamma-\beta) & e^{P*(1)}_{l_{\sim R},F} = \gamma-\beta \\ e^{P*(1)}_{h_R,F} = \gamma-\beta & e^{P*(1)}_{l_R,F} = \gamma-\beta \end{matrix} \middle\vert \begin{matrix} e^{\sim P*(1)}_{h_{\sim R},F} = \left(1-\frac{\alpha_L}{\alpha_H}\right)(\gamma-\beta) & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{matrix} \right\rangle$
ii)	$\left\langle \begin{matrix} e^{P*(1)}_{h_{\sim R},F} = \gamma-\beta & e^{P*(1)}_{l_{\sim R},F} = \gamma-\beta \\ e^{P*(1)}_{h_R,F} = \gamma-\beta & e^{P*(1)}_{l_R,F} = \gamma-\beta \end{matrix} \middle\vert \begin{matrix} e^{\sim P*(1)}_{h_{\sim R},F} = 0 & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{matrix} \right\rangle$
iii)	$\left\langle \begin{matrix} e^{P*(1)}_{h_{\sim R},F} = \frac{\alpha_L}{\alpha_H}(\gamma-\beta) & e^{P*(1)}_{l_{\sim R},F} = 0 \\ e^{P*(1)}_{h_R,F} = \gamma-\beta & e^{P*(1)}_{l_R,F} = \gamma-\beta \end{matrix} \middle\vert \begin{matrix} e^{\sim P*(1)}_{h_{\sim R},F} = \left(1-\frac{\alpha_L}{\alpha_H}\right)(\gamma-\beta) & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{matrix} \right\rangle$
iv)	$\left\langle \begin{matrix} e^{P*(1)}_{h_{\sim R},F} = \gamma-\beta & e^{P*(1)}_{l_{\sim R},F} = 0 \\ e^{P*(1)}_{h_R,F} = \gamma-\beta & e^{P*(1)}_{l_R,F} = \gamma-\beta \end{matrix} \middle\vert \begin{matrix} e^{\sim P*(1)}_{h_{\sim R},F} = 0 & e^{\sim P*(1)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(1)}_{h_R,F} = 0 & e^{\sim P*(1)}_{l_R,F} = 0 \end{matrix} \right\rangle$
v)	$\left\langle \begin{matrix} e^{P*(t)}_{h_{\sim R},F} = 0 & e^{P*(t)}_{l_{\sim R},F} = 0 \\ e^{P*(t)}_{h_R,F} = \gamma-\beta & e^{P*(t)}_{l_R,F} = \gamma-\beta \end{matrix} \middle\vert \begin{matrix} e^{\sim P*(t)}_{h_{\sim R},F} = 0 & e^{\sim P*(t)}_{l_{\sim R},F} = 0 \\ e^{\sim P*(t)}_{h_R,F} = 0 & e^{\sim P*(t)}_{l_R,F} = 0 \end{matrix} \right\rangle$

In Table O.2, we establish the conditions under which the treatment with firing threats (F) leads to higher production levels than the individual incentives treatment (I) in the probation period, for any $j \epsilon \{L, H\}$.

TABLE O.2

COMPARISON OF INDIVIDUAL PRODUCTION LEVELS AND INTERNET USAGE BETWEEN TREATMENT I AND TREATMENT F

Equilibrium type	Treatment F leads to higher production levels than Treatment I under the following conditions	Treatment F leads to lower Internet usage than Treatment I
i)	$\gamma \geq \frac{n_L {\alpha^2}_L + n_H {\alpha^2}_H - n_{H,\sim R}\beta(\alpha_H - \alpha_L)}{(n_{L,\sim R} + n_{H,\sim R})\alpha_L}$	$\gamma \geq \frac{n_L \alpha_L + n_H \alpha_H}{n_{L,\sim R} + n_{H,\sim R}}$
ii)	$\gamma \geq \frac{n_L {\alpha^2}_L + n_H {\alpha^2}_H}{n_{L,\sim R}\alpha_L + n_{H,\sim R}\alpha_H}$	$\gamma \geq \frac{n_L \alpha_L + n_H \alpha_H}{n_{L,\sim R} + n_{H,\sim R}}$
iii)	$\gamma \geq \frac{n_L {\alpha^2}_L + n_H {\alpha^2}_H - n_{H,\sim R}\beta(\alpha_H - \alpha_L) - n_{L,\sim R}\beta\alpha_L}{n_{H,\sim R}\alpha_L}$	$\gamma \geq \frac{n_L \alpha_L + n_H \alpha_H - n_{L,\sim R}(\varphi - \beta)}{n_{H,\sim R}}$
iv)	$\gamma \geq \frac{n_L {\alpha^2}_L + n_H {\alpha^2}_H - n_{L,\sim R}\beta\alpha_L}{n_{H,\sim R}\alpha_H}$	$\gamma \geq \frac{n_L \alpha_L + n_H \alpha_H - n_{L,\sim R}(\varphi - \beta)}{n_{H,\sim R}}$
v)	Never	Never

ONLINE.2. INTRINSIC MOTIVATION AND ARITHMETIC SKILLS (SURVEY)

In the following regression, we use data from an independent sample of subjects who were invited to participate in a one-hour survey in which subjects had to answer questions related to demographics, personality traits and arithmetic skills.[37] In particular, subjects' summation skills were measured in an incentivized exercise similar to the *work task* in the current experimental design in the spirit of Dohmen and Falk (2011). Subjects were asked to sum five one-digit numbers for a duration of five minutes. The number of correct answers is what we refer to as *Ability* in Table O.3 below. In addition, subjects answered the following question: "How much do you like mathematics?" on a 7-point Likert scale as an attempt to measure intrinsic motivation in the summation task. We define the variable *Intrinsic Motivation* as the answer (between 1 and 7) to the previous question. Note that subjects (in experimental sessions with a chat room) typically refer to the Task as "math". We also collected a measure of unincentivized productivity à la Dohmen and Falk (2011) in which subjects were asked to sum five numbers as fast as possible without being paid for it. Note that we obtain similar results using this variable as a measure of intrinsic motivation.

Given that all 296 subjects recruited for the survey participated in earlier experiments similar to the one described in the current paper, we were able to regress their individual production on the *work task* as well as their use of Internet in the previous experiment with respect to *Ability* and *Intrinsic Motivation*.

TABLE O.3 Tobit regression with random effects for individual production and internet usage with respect to intrinsic motivation and ability.

	Individual Production	Internet usage
Intercept	-2.570	1.039**
Ability	23.349***	-0.018
Intrinsic Motivation	28.486**	-0.138**
Number of observations and Log likelihood (L)	n = 296 (28 left censored) L = -2038.521 [Prob > χ^2] < 0.001	n = 296 (67 left censored) L = -194.554 [Prob > χ^2] = 0.042

[37] Due to the double-blind protocol used in the lab where the experiments for the current paper were conducted, we could not invite back these subjects to participate in the survey.

Using the same survey data as in Table O.3, we conducted a regression to estimate the effect of individual production, intrinsic motivation and ability on the probability of a subject's success in completing the first table (see Table O.4). We find that *Ability* coefficient is positive and highly significant, while the coefficient for *Intrinsic Motivation* is not significant. This result suggests that the variable *First Table Correct* can be used as a proxy for subjects' ability.

TABLE O.4 Probit regression with random effects for our measure of ability (success in completing the first table) with respect to production and intrinsic motivation.

	First Table Correct	*First Table Correct*
Intercept	-0.777***	-0.443*
Individual Production	0.051***	-
Intrinsic Motivation	-0.015	0.016
Ability	-	0.021***
Number of observations and Log likelihood (L)	*n* = 296 L = -160.052 [Prob > χ^2] < 0.001	*n* = 296 L = -181.040 [Prob > χ^2] = 0.028

ONLINE.3. THE CLICKING TASK

In each period, subjects could earn up to $2.40 by clicking on the box that appeared on their screen every 25 seconds. We summarize the earnings on the *clicking task* in Table O.5 by displaying the proportion of times a subject clicked on a box before it disappeared from the screen. We refer to this proportion as the success rate.

TABLE O.5. Clicking task performance across treatments.

Clicking task	Treatment W	Treatment F	Treatment I
Success rate	94%	96%	95%
Pairwise comparison of treatments (Proportion tests (p-values))			
Treatment F	0.295	-	-
Treatment I	0.692	0.655	-

Success rate: Average proportion of the 240 boxes subjects clicked.

We observe that subjects were able to click on almost all the boxes regardless of the treatment and the activity they were undertaking (*work task*, Internet, chatting or monitoring others) and whether they had being fired (in which case the value of each box was only 1cent). The average earnings on the *clicking task* were equal to \$2.26, \$2.30 and 2.28\$ for Treatments W, F and I, respectively.

ONLINE.4. CHAT ANALYSIS

TABLE O.6 Categories for chat messages.

New Category	Category Number	Category
Distraction	1	Greetings (Hello/Goodbye)
	2	Distracting others (jokes, stories)
	3	Personal chat (talking about likes and dislikes)
	4	Others (not readable)
	5	Complaints about Task
Encouragements	6	Encouraging others to produce
	7	Thanking other for their cooperative behavior
	8	*C* give positive feedback about *B* contributions
	9	Help others complete the task
Discouragements	10	Discouraging others to produce
	11	Asking others what is the point of producing anything
	12	*C* give negative feedback about *B* contributions
Performance evaluation and comparison	13	Ask others' performance on the task
	14	*B* asks *C* about his/her own relative performance on the task
	15	State your own performance
Threats	16	*B* threatening *C* not to produce anything
	17	*C* Threatening others to fire them if they do not produce enough
Complaints about firing/supervision strategy	18	Complaints about the supervision of the *C* subject
	19	Complaints about the firing strategy of the *C* subject
Comments on firing/supervision strategy	20	Suggesting/stating Firing strategy
	21	Suggesting/stating Supervising strategy
	22	Comments on effectiveness of firing policy
Envy	23	*B* envying the *C* subject
Non-strategic comments on the experiment	24	Ask others for help and hints to complete the task
	25	General comments about the experiment and its goals
	26	Specific comments on how earnings are calculated
	27	Other specific comments on the experiment
Influence and manipulation	28	Influencing *C* subject
Fairness	29	Comments on fairness of firing policy

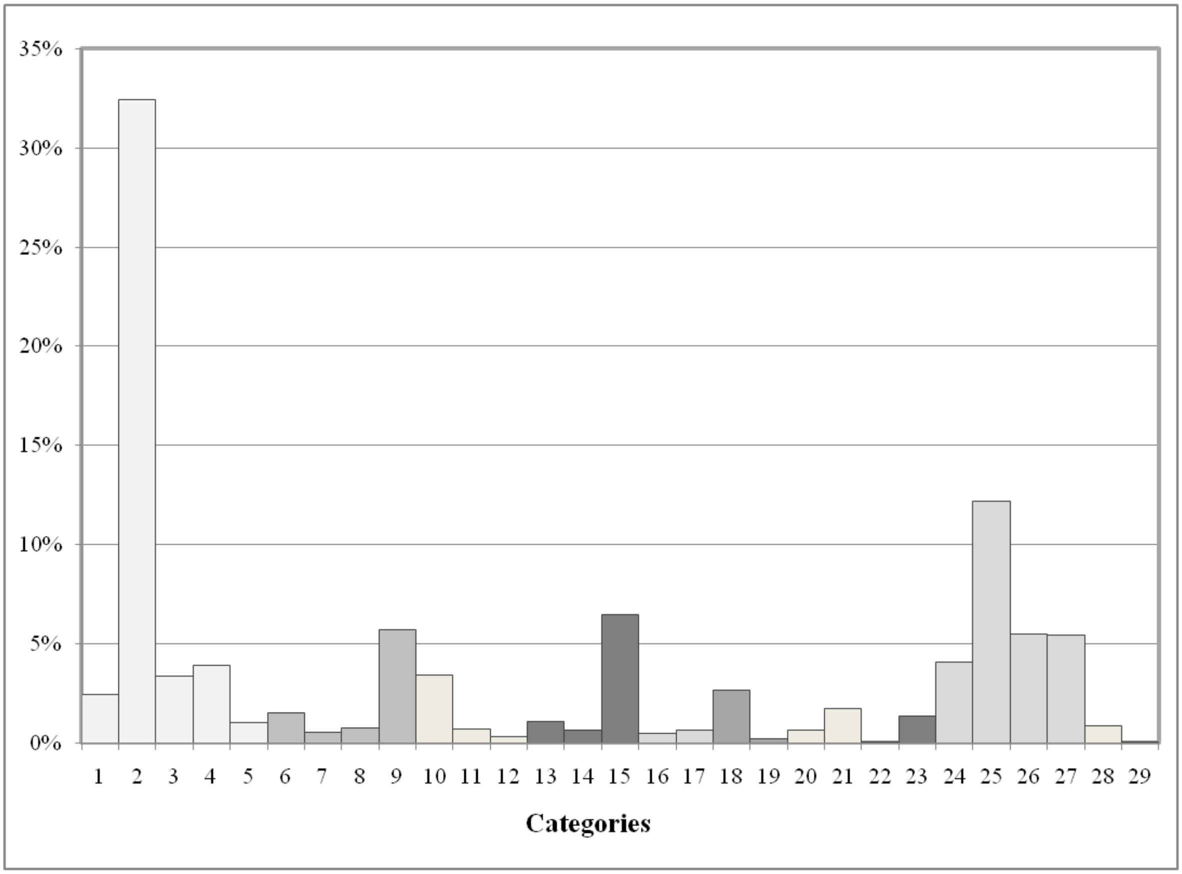

FIGURE O.1.— Histogram of categorization of messages for all treatments[38]

[38] We computed frequencies by taking the average frequency of a given category across the two independent raters.

TABLE O.7 Inter-rater analysis of chat messages categorization.

Category	Agreement	Expected Agreement	Kappa	Standard Error	Z	Prob> Z
1	99%	95%	0.85	0.023	37.38	0
2	78%	55%	0.51	0.021	24.11	0
3	94%	93%	0.06	0.023	2.65	0.004
4	94%	92%	0.27	0.02	13.63	0
5	99%	98%	0.43	0.022	19.84	0
6	98%	97%	0.36	0.021	16.76	0
7	99%	99%	0.25	0.02	12.56	0
8	99%	99%	0.38	0.019	20	0
9	94%	89%	0.44	0.02	21.75	0
10	96%	93%	0.38	0.02	18.8	0
11	99%	99%	0.4	0.022	17.83	0
12	100%	99%	0.5	0.022	22.28	0
13	99%	98%	0.52	0.023	22.83	0
14	100%	99%	0.72	0.023	31.67	0
15	95%	88%	0.55	0.023	24.39	0
16	99%	99%	0.4	0.021	19.12	0
17	99%	99%	0.43	0.021	20.7	0
18	97%	95%	0.48	0.022	21.93	0
19	100%	100%	0.25	0.02	12.67	0
20	99%	99%	0	0	0	0.5
21	97%	97%	0.02	0.016	1.33	0.0922
22	100%	100%	0	0	0	0.5
23	99%	97%	0.46	0.021	21.78	0
24	94%	92%	0.22	0.016	13.72	0
25	78%	77%	0.08	0.013	5.92	0
26	91%	89%	0.18	0.018	9.64	0
27	89%	89%	0.01	0.007	-0.77	0.7791
28	99%	98%	0.31	0.021	14.64	0
29	100%	100%	0	0	0	0.5

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