

Goal Setting and Monetary Incentives: When Large Stakes Are Not Enough

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Abstract

The aim of this paper is to test the effectiveness of wage-irrelevant goal setting policies in a laboratory environment. In our design, managers can assign a goal to their workers by setting a certain level of performance on the work task. We establish our theoretical conjectures by developing a model in which assigned goals act as reference points to workers' intrinsic motivation. Consistent with our model, we find that managers set goals which are challenging but attainable for an average-ability worker. Workers respond to these goals by increasing effort, performance and by decreasing on-the-job leisure activities with respect to the no-goal setting baseline. Finally, we study the interaction between goal setting and monetary rewards and find, in line with our theoretical model, that goal setting is most effective when monetary incentives are strong. These results suggest that goal setting may produce intrinsic motivation and increase workers' performance beyond what is achieved using solely monetary incentives.

KEYWORDS: Intrinsic motivation, incentives, goal-setting, reference dependent preferences.

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1. INTRODUCTION

1.1. Work Motivation and Goal Setting

Motivating workers is a crucial dimension of labor relationships which has been studied at length in fields ranging from Psychology to Economics. In the Economics literature, the principal-agent paradigm has emphasized the importance of monetary incentives (i.e., wages and the threat of being fired) as the most effective way to induce workers to exert effort (see Laffont and Martimort (2002) or Bolton and Dewatripont (2005) for reviews). These theories highlight the role of *extrinsic motivation* by which people engage in an activity for monetary rewards while disregarding the fact that people may engage in an activity for their own sake (*intrinsic motivation*). Psychologists (Deci (1971, 1975)) and behavioral economists (Frey and Jegen (2001)) have pointed out the relevance of intrinsic motivation and its relationship with extrinsic (i.e., monetary) incentives. Intrinsic motivation can be interpreted as an idiosyncratic characteristic of workers that could be undermined by the presence of extrinsic incentives as the latter may conceal the non-monetary motives of a person's work, generating the so-called "motivation crowding-out effect" (see Gneezy et al. (2011) and Kamenica (2012) for reviews). The previous approach leaves a relevant question open: Can we boost workers' intrinsic motivation and by the same token increase their level of performance? Many psychologists give a positive answer to this question by arguing that wage-irrelevant (i.e., nonbinding) performance goals enhance employees' motivation and work performance (Locke and Latham (2002)). In line with this argument, workers respond to goals because their attainment creates a sense of accomplishment that increases satisfaction at work. The effectiveness of goal setting has been reported consistently in the experimental literature in psychology. Locke and Latham (2002) provide an exhaustive literature review of the topic and find that goals increase performance in more than 90% of the studies.

In this paper, we propose to test the effectiveness of goal setting policies and assess their interaction with monetary incentives in an incentivized controlled laboratory setting. Our experimental methodology enables us to control for confounding factors that may have interfered in the empirical evaluation of goal setting policies such as corporate culture, explicit and implicit incentives as well as supervision policies. To that end, we consider a laboratory environment which reproduces several features of field settings while keeping control over the decision environment (Corgnet et al. (2013a)). Our experimental approach to the analysis of goal-setting is novel in many ways. First, we consider a work environment where monetary incentives prevail. The interplay between goal setting and monetary incentives is especially relevant for the economic literature on intrinsic motivation and the crowding out effect of incentives. The idea is that if nonbinding goals enhance workers' intrinsic motivation they could also mediate the relation between the two sources of work motivation: Intrinsic motivation and monetary incentives. Second, in our setting, goals are determined by participants who were assigned the role of managers rather than

selected randomly or assigned arbitrarily by the experimenter (Latham and Locke (1979), Winter and Latham (1996)). This was intended to mimic actual managerial practices. Third, we allow participants to undertake a real leisure activity (Internet browsing) instead of working on the task. Our intention is not only to reproduce a relevant feature of real-world organizations but also to ensure that our results are not driven by a lack of alternative activities in the laboratory. This issue has been described as the *active participation hypothesis* (Lei, Noussair and Plott (2001)). Finally, we consider a multi-period setting which allows us to evaluate the effectiveness of goal setting over time.

To establish our conjectures we develop a principal-agent (manager-worker) model where the worker's motivation to exert effort is twofold. First, as in standard models, the worker responds to *extrinsic* incentives which are captured by the magnitude of the monetary reward. Second, workers are *intrinsically motivated* to exert effort in order to attain the goals which are set by their managers. We model workers' intrinsic motivation as a goal-dependent intrinsic utility function in line with prospect theory (Kahneman and Tversky (1979)). Our theoretical framework is an extension of Wu et al. (2008). In this paper the authors examine the agent's response to exogenously given goals under prospect theory preferences and in the absence of monetary incentives. In our model, we extend the previous analysis by considering the case in which the principal is in charge of setting goals. In addition, our model introduces extrinsic incentives with the aim of studying the interaction between monetary incentives and workers' responses to goals. In order to avoid gift-exchange effects (Fehr et al. (1993) and Fehr et al. (1997)) and isolate the effect of goal setting, we consider the case in which monetary incentives are outside of the control of managers.

Our experiment consists of two main treatments which will be referred to as *Baseline* and *Goal Setting*. In the goal setting treatment, managers were able to set wage-irrelevant goals for workers while no such option was available in the *Baseline*. Comparing the two treatments, we find that goal setting increases workers' performance. We also observe that goals increase workers' dedication to the work task, increasing effort and decreasing the time spent browsing the Internet. The effectiveness of goal setting is closely related to the fact that managers set goals that are challenging but yet attainable by an average-ability worker, which is consistent with our theoretical conjectures. Relatedly, the positive effect of goals disappears when restricting our analysis to non-reasonable goals which are too far away from a worker's inherent ability level. Allowing participants to set goals, we are able to analyze goal selection. In line with our model, we find that managers set higher goals when monetary incentives were high.

Importantly, the effectiveness of goal setting is magnified rather than undermined by the use of high monetary incentives as the effect of goal setting on workers' performance is found to be strongest when monetary incentives are high. This is consistent with our theoretical results according to which high monetary incentives promote higher goals which in turn boost workers' motivation and performance. We

report additional complementarities between goals and monetary incentives by showing that the effect of goal setting on performance can only be sustained over time if monetary incentives are sufficiently high.

Finally, we show the robustness of our findings by studying personal and computerized goals. We show that the goals set by managers effectively increase workers' production even in the case in which workers have personal goals. Also, we find the positive effect of goal setting to be robust to the case of computerized goals, which were drawn from the distribution of goals set by managers in the original goal setting treatment. This result suggests that the effect of goal setting does not crucially depend on the interpersonal relationship between workers and managers.

Overall, our findings suggest that the effectiveness of goal setting that has been reported in the psychology literature is robust to the more general case of work environments where monetary incentives prevail.

1.2. Literature Review

The idea that specific, attainable and nonbinding goals affect workers' motivation has received considerable attention in the psychology literature (Locke (1996), Latham (2000) and Locke and Latham (2002) for reviews).¹ The first finding of this literature is that specific and difficult (but perceived as attainable) goals lead to greater performance than vague and easy goals. Second, workers are more motivated or more committed to attain goals when they perceive their goal as being relevant and difficult to attain. Finally, goals are shown to increase workers' persistence to exert effort. These results suggest that goal setting may be an effective tool to boost a worker's intrinsic motivation. Our study complements this previous research by studying an environment in which nonbinding goals and monetary incentives coexist.

In Economics, the concept of intrinsic motivation has been closely linked to the idea of "motivation crowding-out" (Frey and Jegen (2001)). Workers' intrinsic motivation has been introduced into economic models in which monetary rewards were shown to crowd out intrinsic motives to work (e.g., Benabou and Tirole (2003)). Gneezy and Rustichini (2000) provide evidence of "motivation crowding-out" in a controlled laboratory environment. The authors find that, although performance increases with significant monetary compensation, small monetary incentives may actually undermine performance compared to a situation with no compensation at all. Recently, Pokorny (2008) and Ariely et al. (2009) have reported experimental evidence that very high monetary rewards can also decrease performance. This evidence sheds light on the non-monotonic relationship between monetary incentives and performance. This is not only the case that low rewards can do worse than no rewards at all but very high rewards may also have a

¹ The goal setting literature is certainly vast, according to Latham (2000): "...the theory has been shown to predict, influence, and explain the behavior of over 40,000 people in numerous countries (e.g., Australia, Canada, the Caribbean, England, Germany, Israel, Japan, and the United States), in both laboratory and field settings, involving at least 88 different tasks in occupations that included logging, word processing, engineering, and teaching in a university."

detrimental effect on workers' motivation. Interestingly, we confirm this result in our baseline design without goal setting in which we observe that performance levels tend to be lower when monetary incentives are either low or high compared with the case of average incentives. However, this non-monotonic pattern in the effect of monetary incentives disappears in the goal setting treatment in which case large stakes increase workers' performance. We were able to account for these findings by adding reference earnings à la Pokorny (2008) to our basic model. Our results contribute to the economic literature on intrinsic motivation in two different ways. First, they indicate that it is possible to produce intrinsic motivation using monetary irrelevant goals. Second, the complementarity between goals and monetary incentives points out that when large stakes are detrimental to workers' performance, one can use goal setting policies to alleviate the crowding out effect of monetary incentives.

To our knowledge ours is the first work that assesses the joint effect of wage-irrelevant goals and monetary incentives on workers' effort and performance. From a theoretical standpoint, our paper relates to the Economics and Management literature including the work of Wu et al. (2008) who study workers' response to goals in the context in which goals are exogenously given and monetary incentives are absent.² Wu et al. (2008) find that performance increases with goals which are attainable but may decrease otherwise. As we will see, this result will play an important role in our model with monetary incentives in which goals are endogenously selected by managers. Gómez-Miñambres (2012) studies a principal-agent model where agents derive utility from attaining nonbinding goals in which case the principal is willing to use goal setting policies to increase agents' intrinsic motivation to work, which in turn increases performance and reduces the wage bill. Likewise, a number of theoretical papers (e.g., Koch and Nafziger (2011), Hsiaw (2012)) have considered the effects of personal (i.e., self-set) goals in attenuating self-control problems. At the empirical level, in a recent study, Goerg and Kube (2012) study the impact of setting personal goals in a field experiment where participants have to search and relocate books at a large library. The authors consider a standard piece rate compensation treatment as a baseline. They compare this baseline with several other treatments: A purely nonbinding personal goal, a binding personal goal for which the compensation increases with the goal if it is attained while no money is received otherwise, and two standard bonus contracts. The authors show that the highest increase in performance levels is achieved when workers are allowed to set personal goals even if goals do not entail monetary consequences.

The paper proceeds as follows. Section 2, presents the experimental environment while the theoretical framework and the hypotheses are derived in Section 3. Main results are exposed in Section 4 while robustness checks are presented in Section 5. Section 6 concludes.

² The authors consider the utility function which was proposed by Heath et al. (1999) who considered the goal as a reference point. In that respect, goals tend to alter the psychological value of monetary outcomes in a way which is consistent with prospect theory.

2. EXPERIMENTAL DESIGN

2.1. Virtual Workplace with Real Effort and Real Leisure

We develop a framework in which participants can undertake a real-effort task while having access to Internet at any point in time during the experiment. The experiment consisted of 8 periods of 10 minutes each. The experimental environment is described in detail below.

2.1.1 Organizational Roles

We consider organizations with two types of participants referred to as B (worker) and C (manager). At the beginning of each of the eight periods, participants were randomly assigned to one of these two roles. As a result, participants could either be a worker or a manager depending on the period. Then, each worker was randomly matched with a single manager. During a period, and regardless of the treatment, workers could dedicate their time to either completing the *work task* or *browsing the web* while managers could only browse the Internet. At the beginning of each period, managers could set a *goal* for the worker's production level on the work task in the goal setting treatment.

2.1.2 The Work Task

We consider a real-effort task that is particularly long, laborious and effortful compared to previous real-effort experiments that have reported the use of counting tasks (e.g. Dohmen and Falk (2011), Eriksson, Poulsen and Villeval (2009), Niederle and Vesterlund (2007)). In particular, participants were asked to sum up matrices of 36 numbers comprised between 0 and 3 for 1 hour and 20 minutes. Participants were not allowed to use a pen, scratch paper or calculator. This rule amplified the level of effort participants had to exert in order to complete tables correctly. Our work task was designed to reduce as much as possible the intrinsic motivation derived from the task itself. An example of the work task is shown in Figure 1.

	Column1	Column2	Column3	Column4	Column5	Column6	
	3.00	0.00	0.00	2.00	3.00	0.00	
	2.00	3.00	3.00	2.00	1.00	1.00	
	1.00	1.00	2.00	0.00	0.00	1.00	
	3.00	0.00	0.00	1.00	1.00	2.00	
	1.00	3.00	0.00	3.00	2.00	1.00	
	1.00	3.00	1.00	1.00	2.00	3.00	
Sum Column:							

FIGURE 1.- Example of table summation for the work task.

The value of a correct table was selected randomly at the beginning of each period from the following set of values: 10 cents, 80 cents or 150 cents. No pecuniary penalties were enforced for incorrect answers.³ Therefore, monetary incentives varied across periods allowing us to study the interplay between goals and monetary stakes. Total earnings were split equally between the worker and the manager at the end of each period and were displayed in the history panel located at the bottom of participants' screens.

³ This was decided so as to be able to define goals on the basis of the number of tables completed correctly rather than defining goals on the basis of the monetary value of workers' production. This difference is relevant given that workers may face different monetary incentives making it more difficult for managers to set goals. Note that there still exists an opportunity cost for completing a table incorrectly.

Note that managers were not in charge of assigning the incentives to workers so as to avoid a possible gift-exchange game structure (Fehr et al. (1993) and Fehr et al. (1997)) and isolate the effect of goal setting.

2.1.3 Internet Browsing

At any point during the experiment, workers could switch from the work task to the leisure activity that consisted of browsing the Internet. Each activity was undertaken separately, in a different screen so that participants could not complete tables while being on the Internet. Participants were informed that their use of the Internet was strictly confidential. Participants were free to consult their email or visit any web page. The Internet browser was embedded in the software (see Figure 2) so that the experimenter could keep record of the exact amount of time participants spent on each activity.



FIGURE 2.- Embedded Internet screen.

The introduction of Internet in our virtual workplace is motivated by the widespread use of Internet at work. 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. An appealing feature of Internet as an alternative to the work task is the wide range of activities that can be completed online. The consideration of leisure-related issues in the experimental literature was introduced in the analysis of labor supply by Dickinson (1999). Falk and Huffman (2007) also introduced the possibility for participants to quit the experiment when analyzing minimum wages and workfare in the laboratory.⁴

2.1.4 Goal Setting

A crucial feature of our experiment is the introduction of nonbinding goals assigned by managers to their worker. This feature will allow us to assess the effect of goal setting on workers' effort and performance. At the beginning of each period and after learning the value of monetary rewards for completing the work task (either 10 cents, 80 cents or 150 cents), managers could set a goal for their

⁴ 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 participants access to magazines.

workers. The goal stated the number of correct tables to be completed by a worker during the period. Workers knew from the instructions that the goal set by their manager did not entail monetary consequences so that producing more or less tables than the goal neither generates rewards nor induces penalties. Note that the manager could decide not to set a goal in which case the label “*no goal*” would appear on the screen. After managers made their decision regarding the goal, workers were informed about their goal as well as the monetary incentives associated with completing the work task correctly. At any moment during the experiment participants had access to their past performance levels and earnings.

2.2. Treatments and procedures

We conducted two main treatments (see Table 1). In the goal setting treatment, managers could set wage-irrelevant goals for workers at the beginning of each period while no such option was available for the *baseline*.

TABLE 1. Summary of the treatments.

Treatment	Description	Number of sessions (participants) [observations]
Baseline	Worker’s production is split equally between the worker and the manager.	8 (94) [376]
Goal Setting	The manager can set a wage-irrelevant goal for the worker. Worker’s production is split equally between the worker and the manager.	8 (94) [376]

Our participant pool consisted of students from a major U.S University. We recruited people who participated in related studies (Corgnet et al. 2013a, 2013b) so as to ensure that they had previous experience in completing the work task used in this experiment. The objective was to ensure that participants could assess with some level of accuracy the performance that can be achieved by an average worker on the task.

The experiments took place in March/April 2012 and in October 2013. In total, 186 participants completed the experiment, divided in 16 sessions. We conducted eight sessions for the Baseline treatment, and eight sessions for the Goal Setting treatment. Each session consisted of 8 periods (of 10 minutes each) in which participants were randomly matched to either the role of worker or manager. As a result, we collected a total of 752 observations.

The experiment was computerized and all of the interaction was anonymous. The instructions were displayed on participants’ computer screens. Participants 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 the experiment started. The interaction

between the experimenter and the participants was negligible. At the end of the experiment and before payments were made, participants were asked to complete a debriefing questionnaire (see Appendix C).

Participants were paid their earnings in cash. Individual earnings at the end of the experiment were computed as the sum of the earnings in the 8 periods. Participants in the baseline treatments earned on average \$37.92, while participants in the goal setting treatment earned on average \$40.80. This includes a \$7.00 show-up fee. Experimental sessions lasted on average two hours.

3. THEORETICAL FRAMEWORK

In this section, we develop a principal-agent model with goal-dependent preferences so as to derive a set of conjectures for our experiments.

3.1. The Model

We build a model in which wage-irrelevant goals affect the intrinsic value of workers' production in a way that is consistent with prospect theory (Kahneman & Tversky (1979)). We consider a principal-agent model with one risk neutral manager (principal) and one worker (agent). Worker's production (y) is defined as follows: $y = \theta e$, where e is the time that the worker dedicates to productive activities and θ is the worker's ability. There are two types of workers indexed by $i \in \{L, H\}$, where L stands for low-ability worker (θ_L) and H for high-ability worker (θ_H) where $\theta_H > \theta_L > 0$. Managers do not observe workers' ability levels but know the proportion $p \in [0, 1]$ of high-ability workers in the population. The worker is endowed with a total amount of time, normalized to 1, which can be dedicated to either productive ($e_i \geq 0$) or leisure activities ($l_i \geq 0$). Hence $e_i + l_i = 1$ for all $i \in \{L, H\}$. We consider a standard increasing and convex disutility of effort function: $c(e_i) = \frac{e_i^2}{2}$ (see Appendix B.2 for a more general version of the model). We denote by $\Omega_i = A y_i > 0$ the monetary value of the worker's production where A denotes the value of each unit of production generated by the worker, which is assumed to be exogenous. The manager and the worker share total production equally. Therefore, if we define $\alpha = \frac{A}{2}$, then $w_i = \alpha \theta_i e_i$ is the pay of worker i . The worker is assumed to be both extrinsically and intrinsically motivated. The extrinsic utility function of the worker coincides with the worker's pay (w_i):

$$V_E(y_i, \alpha) = w_i.$$

In addition, the worker derives intrinsic utility from achieving the goal set by the manager. We define the worker's intrinsic utility function so that it is consistent with the properties of the value function in prospect theory (Kahneman & Tversky (1979)). More specifically, the reference point is assumed to be

the goal (g) which is set by the manager.⁵ The intrinsic utility function is defined as follows and illustrated in Figure 3:

$$V_I(y_i, g, \lambda) = \begin{cases} (y_i - g)^{\frac{1}{2}} & \text{if } y_i > g, \\ -\lambda(-y_i - g)^{\frac{1}{2}} & \text{if } y_i \leq g. \end{cases}$$

Thus, the goal (g) acts as a reference point that alters the intrinsic utility of the worker dividing the space of outcomes into gains, when the goal is attained, and losses, when the goal is not attained. Note that the function $V_I(\cdot)$ satisfies the standard prospect theory properties of loss aversion and diminishing sensitivity, where $\lambda > 1$ is the coefficient of loss aversion.

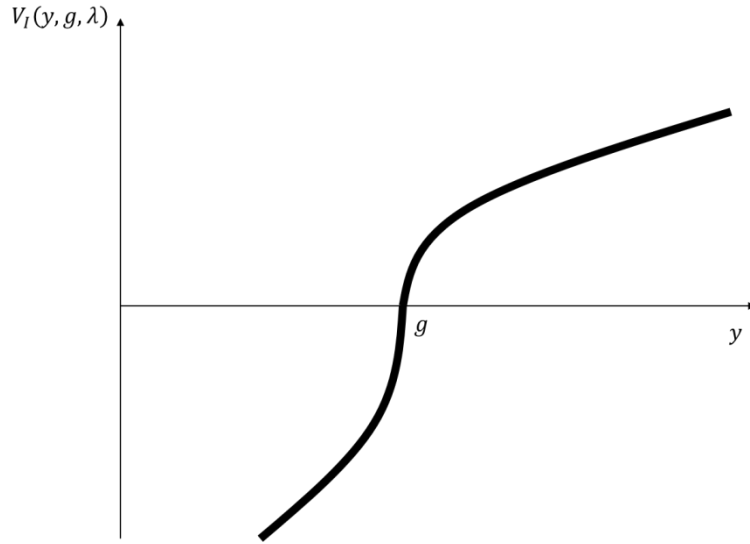


FIGURE 3.- The goal-dependent intrinsic utility: $V_I(y_i, g, \lambda)$.

We denote by $u(y_i, g, \lambda, \alpha)$ the sum of extrinsic and intrinsic motivation:

$$u(y_i, g, \lambda, \alpha) = V_E(y_i, \alpha) + V_I(y_i, g, \lambda) = \begin{cases} w_i + (y_i - g)^{\frac{1}{2}} & \text{if } y_i > g, \\ w_i - \lambda(-y_i - g)^{\frac{1}{2}} & \text{if } y_i \leq g. \end{cases}$$

and assume that the overall utility of the worker takes the general separable form:

$$U(y_i, g, \lambda, \alpha) = u(y_i, g, \lambda, \alpha) - c(e_i).$$

Although managers are not in charge of setting monetary incentives they can assign goals that affect workers' intrinsic motivation. The manager's utility only depends on worker's production and the exogenously given monetary incentives:

$$\Pi(y_i, \alpha) = \alpha y_i.$$

⁵ See Heath et al. (1999) for a formal discussion of such a value function. An alternative goal-dependent intrinsic utility function is considered by Gómez-Miñambres (2012). Most of the qualitative results of our model are robust to both specifications.

Therefore, in our framework, the manager's unique objective is to set the goal that maximizes the worker's production.⁶ In particular, given a goal (g) the worker's optimal effort is characterized by the following first order conditions:

$$\alpha\theta_i + \frac{\theta_i}{2}(\theta_i e_i - g)^{-\frac{1}{2}} = e_i \quad \text{if } \theta_i e_i > g, \quad (1)$$

$$\alpha\theta_i + \lambda \frac{\theta_i}{2}(g - \theta_i e_i)^{-\frac{1}{2}} = e_i \quad \text{if } \theta_i e_i \leq g. \quad (2)$$

The left-hand side of equations (1) and (2) is the marginal utility of effort ($\frac{du}{de}$) while the right-hand side represents the marginal cost of effort ($\frac{dc}{de}$). We assume that $\alpha\theta_H < 1$ so that in the standard model without intrinsic motivation ($V_I(y_i, g, \lambda) = 0$) it is never optimal to exert the maximum possible effort.^{7,8} Our first result describes several properties of the optimal level of effort for a given goal, which will be useful in our subsequent analysis. The details of the proofs are available in Appendix B.1.

Lemma 1. Using equations (1) and (2) we obtain the following properties:

- (i) Given a goal (g), effort increases with monetary incentives (α).
- (ii) $\frac{d^2U}{de_i dg} > 0$ (< 0) if and only if $y_i > g$ ($< g$). Thus, $\frac{de_i}{dg} \geq 0$ (≤ 0) if and only if $y_i > g$ ($< g$).

Property (i) is a standard result which follows from the fact that effort and incentives are complements in terms of extrinsic utility, i.e. $\frac{d^2V_E}{de_i d\alpha} = \theta_i > 0$. Wu et al. (2008) provide a formal proof of Property (ii) using a general specification of a prospect theory value function and a convex disutility of effort (see Proposition 1 in Wu et al. (2008)). An important implication of Property (ii) is that performance increases with the difficulty of the goal if the goal is attainable so that goal and effort are complements. However, workers' performance decreases with goal difficulty if the goal is not attainable so that goal and effort are substitutes in that case. Therefore, Property (ii) ensures that the worker's performance is higher when the assigned goal is difficult but yet attainable than in the absence of goals. It also implies that a challenging but attainable goal works better than either too easy or too difficult goals. These properties will help us to interpret our equilibrium results; in particular note that property (ii) implies that a goal may have very

⁶ Note that if the managers were in charge of setting monetary incentives, they would also want to maximize the workers' intrinsic utility in order to pay lower wages (see Gómez-Miñambres (2012)).

⁷ For $\alpha\theta_H > 1$ the maximum level of effort ($e=1$) will be automatically achieved, at least for the high type which renders our theoretical framework less appealing. This assumption is made for the sake of exposition and does not affect our qualitative results.

⁸ Note that the convexity of the intrinsic utility function for losses implies that solutions are not unique in general. Following Wu et al. (2008), we assume that among the multiple possible equilibria that may arise when the individual is unable to attain the goal, the individual picks the one with the lowest level of production (which entails the lowest level of effort). This is a technical assumption that greatly simplifies our analysis but does not affect our qualitative results. Moreover, this assumption implies that at the optimal level of effort, which is characterized by equations (1) and (2), the following second order conditions are automatically satisfied: $\frac{d^2U}{d^2e_i} < 0$.

different effects depending on workers' ability levels. A goal that is seen as challenging by a low-ability worker may not motivate a high-ability worker.

In Lemma 1 we have described important properties of the optimal level of worker's effort for a given goal. In the subsequent analysis, we determine the optimal value of the goal which is the one that maximizes workers' production levels. We start by describing the solution for the case of perfect information in which managers know the worker's level of ability with certainty, so that they can design individualized goals (g_i) to motivate workers with different ability levels.

Proposition 1. (*Perfect information*) If the manager knows the worker's level of ability, the optimal goals are determined as follows:

$$g_i^{PI} = \alpha\theta_i^2 + 3\left(\frac{\lambda\theta_i^2}{4}\right)^{2/3},$$

where PI stands for Perfect Information and $i \in \{L, H\}$.

In equilibrium both types of workers attain the goal so that $y_i^{PI} > g_i^{PI}$, where y_i^{PI} is given by the solution to the following equation:⁹

$$\alpha\theta_i + \frac{\theta_i}{2}(y_i^{PI} - g_i^{PI})^{-1/2} = \frac{y_i^{PI}}{\theta_i}.$$

We illustrate the equilibrium for the case of perfect information in Figure 4. We plot marginal benefits and marginal costs of effort as a function of worker's performance (y_i) for a given goal g . The solid curve represents the marginal utility of effort ($\frac{du}{de}$) which includes *extrinsic* and *intrinsic utility* while the dash line represents the marginal cost of effort ($\frac{dc}{de}$).

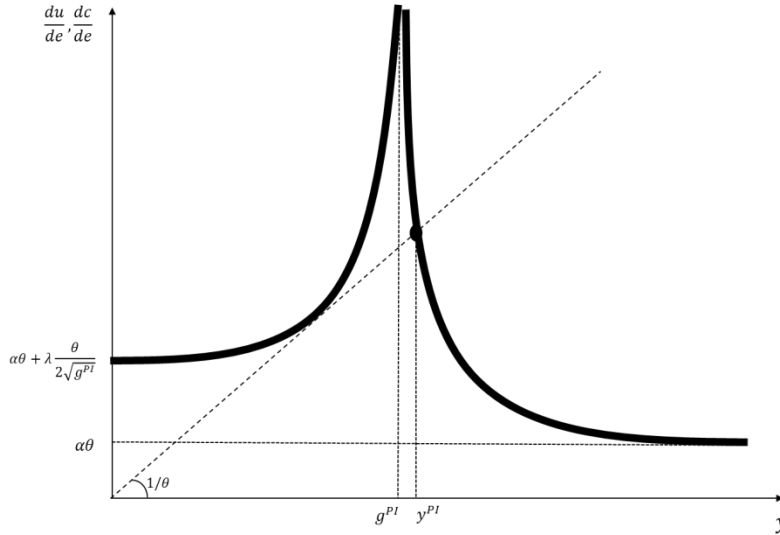


FIGURE 4.- Values for goals and production levels in the perfect information equilibrium.

⁹ Note that under our assumptions, $\alpha\theta_i < 1$, and hence first order conditions (1) and (2) cannot be satisfied if $y_i = g$.

When the level of ability of the worker is known, the optimal strategy for managers is to assign a goal which is equal to the maximum level of production that can be attained by a worker given his or her ability level. These challenging goals are such that they maximize the level of effort of workers. Graphically, the equilibrium goal under perfect information will be the maximum goal that leads to an intersection of the marginal cost line for which $y_i^{PI} > g_i^{PI}$ so that the worker derives intrinsic utility from working ($V_I(y_i, g, \lambda) > 0$).

As we can see in Figure 5, deviating from g_i^{PI} is not profitable to the manager. On the one hand, setting a goal higher than g_i^{PI} (g_i^H) would imply that the worker does not attain the goal so that production would decrease ($y_i|g_i^H < y_i^{PI}$) (left panel of Figure 5). On the other hand, if the manager sets a goal that is easier than g_i^{PI} (g_i^L) we know from Lemma 1 (ii) that the worker's level of performance would also be lower ($y_i|g_i^L < y_i^{PI}$), as goals and effort are complements when the goal is attainable (right panel of Figure 5).

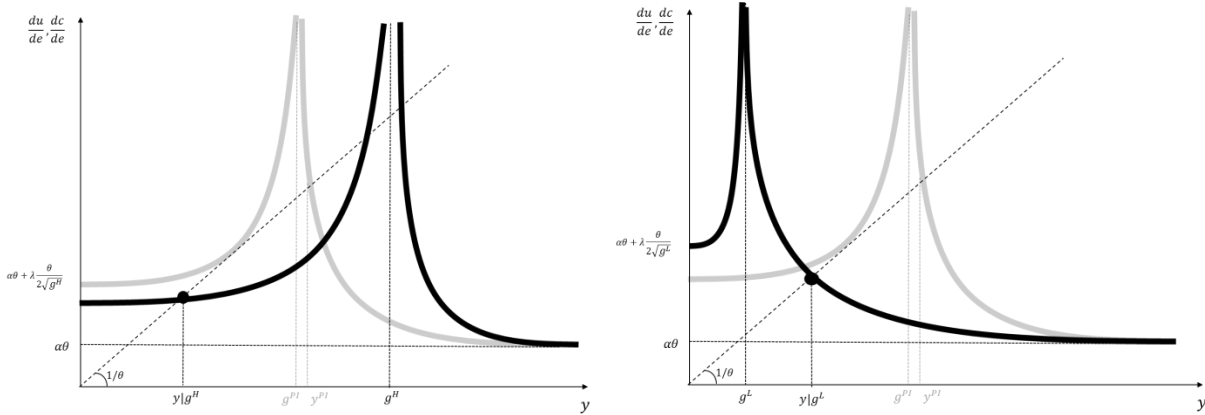


FIGURE 5.- Values for goals and production levels for the case in which the manager sets a goal which is more difficult than the equilibrium goal, $g^H > g^{PI}$, (left panel) and for the case in which the manager sets a goal which is easier than the equilibrium goal, $g^L < g^{PI}$, (right panel).

Note that $\frac{dg_i^{PI}}{d\alpha} > 0$ which implies that the maximum goal that a worker can attain in equilibrium increases with extrinsic incentives. As a result, under perfect information, goals are expected to rise with the magnitude of monetary incentives. This follows from the fact that monetary incentives affect workers' intrinsic motivation indirectly by promoting more challenging but yet attainable goals. Since attainable goals and worker's effort are complements (see Lemma 1 (ii)), an interesting implication of this result is that goal setting is more effective in increasing performance when monetary rewards are high. As we shall see in Corollary 1, this result is robust to the case of imperfect information.

Now we proceed to describe the case in which managers do not know workers' ability levels. In that case, managers will set a single goal (g^*) for both types of workers. Note that managers will not set a goal which is lower than the goal they would set for a low-ability worker under perfect information (g_L^{PI}) or which is higher than the goal they would set for a high-ability worker (g_H^{PI}) under perfect information. Applying Lemma 1 (ii), we know that both types of workers will produce more with goal g_L^{PI} , which is

attained by both types of workers, than with any lower goal. As a result, in equilibrium, performance is expected to be higher with goal setting than in the absence of goals because $g^* > 0$ as long as $g_L^{PI} > 0$.

In the next proposition we summarize the main result of our model with imperfect information.

Proposition 2 (*Imperfect information: Goal setting*). Given parameters $\{\alpha, \lambda, p, \theta_H\}$ there exists a threshold $\hat{\theta}$ such that:

$$\begin{cases} g^* = g_L^{PI} & \text{if and only if } \theta_L \geq \hat{\theta}, \\ g^* \in (g_L^{PI}, g_H^{PI}] & \text{if and only if } \theta_L < \hat{\theta}. \end{cases}$$

Proposition 2 captures the tradeoff faced by the manager between raising the goal to increase the high-ability worker's performance and keeping the goal low enough to maximize the low-ability worker's performance. If ability levels are not too different, the manager will be better off selecting a goal which is attainable by both low- and high- ability workers. By contrast, if the difference in ability levels is high enough, the manager will set a goal which can only be attained by high-ability workers.

Finally, we point out the relationship between goal setting and monetary incentives in Corollary 1. We show, as in the case of imperfect information, that equilibrium goals and monetary incentives are complements.

Corollary 1 (*Imperfect Information: Goal setting and monetary incentives*). In equilibrium, the goal increases with monetary incentives, i.e., $\frac{dg^*}{d\alpha} \geq 0$.

The intuition for Corollary 1 is described as follows. Given the level of monetary incentives (α), a marginal increment in the equilibrium goal (g^*) would decrease the performance of the low-ability worker (y_L^*) while increasing the performance of the high-ability worker (y_H^*) (see Lemma 1 (ii)). If monetary incentives increase, the performance of both types of workers will also increase (Lemma 1 (i)). Then, the manager could take advantage of this situation by raising the goal above g^* to such a level that the performance of the low-ability workers is the same as before the increase in monetary incentives (y_L^*). This increase in the goal will lead to an increase in the performance of the high-ability worker and make the manager better off. As a result, the equilibrium goal increases with monetary incentives.

In sum, goal setting magnifies the effect of high monetary incentives, which can foster workers' motivation and performance in two ways. On the one hand, it has a direct positive effect on performance as it increases extrinsic motivation to work. On the other hand, it allows the manager's to set higher goals, which further increases performance through its effect on workers' intrinsic motivation.

3.2. Theoretical conjectures

Based on the previous analysis, we state the following conjectures regarding the impact of wage-irrelevant goals on production levels and effort which will be measured, in our experiment, as the amount of time workers dedicate to the work task. First, we expect production and effort levels to be higher in the

goal-setting treatment than in the baseline. Following our model, we know that whenever workers are intrinsically motivated to attain goals, managers will use goal setting policies to increase the workers' level of effort which will translate in an increase in production levels.

Hypothesis 1 (Production Levels and Work Effort)

We expect work production levels and work effort to be greater in the goal setting treatment than in the baseline.

We also conjecture that the manager will set goals which are moderately difficult, that is, which are challenging for an average-ability worker (see Proposition 2).¹⁰ In addition, we expect higher monetary incentives to lead to higher goals and performance levels (see Corollary 1).

Hypothesis 2 (Goal Setting and Incentives)

- (i) *We expect managers to set goals which are challenging for an average-ability worker.*
- (ii) *We expect goals to be larger when monetary incentives are high.*
- (iii) *We expect monetary incentives and goals to be complements so that the positive effect of goals on workers' performance will be most pronounced when incentives are high.*

4. MAIN RESULTS

We start the results section by comparing workers' production levels across treatments (Section 4.1). In Section 4.2 we analyze the effect of goals on work effort and work accuracy. We study the interaction between goal setting and monetary incentives in Section 4.3. The selection of goals by managers is analyzed in Section 4.4. The effect of goal accuracy and reaction to goals is studied in Section 4.5.

4.1. Goal setting and workers' performance

We define production as the total number of correct tables completed by workers. In Table 2, we present descriptive statistics regarding workers' production levels on the work task in both the baseline and the goal setting treatment. For the goal setting treatment, we present separately the descriptive statistics for those participants who were assigned a goal (left column) and for those who were not assigned a goal (right column).

TABLE 2. Workers' production on the work task.

	Baseline (n=376)	Goal setting	
		Goals (n=354)	No goals (n=22)
Mean	9.66	10.76	7.41
Standard Deviation	4.55	4.31	5.70

¹⁰ As a result, if managers had access to information about workers' ability levels (for instance by having access to past performances) they could set individualized goals which would be more effective than generic goals. In that sense, our experimental design can be seen as a conservative test for the effect of nonbinding goals on workers' performance.

Production levels were on average 15.2% higher under the goal setting treatment than under the baseline when restricting our analysis to those workers who were assigned a goal in the goal setting treatment. Workers' performance in the goal setting treatment was very different whether a participant had or had not been assigned a goal. In particular, the average production of workers who did not receive a goal was 37.1% lower than the average production of workers who received a goal. This result is in line with our theoretical model in which zero goals (i.e., no goals) undermine production compared to a situation with positive but attainable goals. Interestingly, we also find that the average production of the workers who did not receive a goal was 27.6% lower than the average production in the baseline, where setting goals was not available. This additional result, which is not accounted for by our theoretical framework, stresses that failing to provide goals to workers in an environment in which they are expected to do so may undermine motivation as it may be perceived as a lack of interest in a worker's task. Managers recognize the negative effect of not setting goals and choose this option in only 5.8% of the cases. In the management literature, caring about workers' tasks has been recognized as a fundamental dimension of leadership (e.g. Goffee and Jones, 2000).

We study the statistical significance of our results by conducting a regression analysis assessing the effect of goal setting on workers' production. To that end, we use a panel data Poisson regression with random effects. In the regressions, we control for workers' ability levels by using three different measures of ability. First, we construct a dummy variable which takes value 1 if a participant has completed the first table correctly and value 0 otherwise. We rely on previous research showing the positive relationship between first table performance and subsequent production (Corgnet et al., 2013a). We also introduce a continuous measure of ability by computing the amount of time (in minutes) participants needed to complete their first table correctly. Finally, we assessed participants' summation skills in the spirit of Dohmen and Falk (2011) in half of the experimental sessions.¹¹ Upon arrival at the lab and before receiving instructions for the corresponding treatment, participants were asked to sum as many five one-digit numbers as they could during two minutes. Each correct answer was rewarded 10 cents. The number of correct answers is what we refer to as "summation skills". In the table below, we provide the average scores on these ability measures for each treatment.

¹¹ We collected this measure of ability in the 16 sessions (out of 32) which were added to the original version of the paper following a referee's suggestion.

TABLE 3. Ability measures across treatments.

Average (Number of participants)	Baseline	Goal setting
First table correct	0.729 (n=94)	0.795 (n=94)
Time to get first table correct (in minutes)	0.937 (n=94)	0.851 (n=94)
Summation skills	15.48 (n=48)	15.67 (n=48)

All three measures of ability significantly correlate with production levels (see Table A.1 in the appendix). We do not find significant differences in ability levels across treatments (see Table A.2 in the appendix).

TABLE 4. Poisson regression with random effects for production.¹²

	Coefficients	Coefficients	Coefficients
Intercept	1.987***	2.249***	1.521***
Goal Setting Dummy	0.092*	0.108**	0.085**
No Goal Dummy	-0.338**	-0.353**	0.036
<u>Ability measures</u>			
First table correct	0.255***	-	-
Time to get first table correct	-	-0.085*	-
Summation skills	-	-	0.042***
<u>Incentive dummies</u>			
Average incentives	0.150***	0.148***	0.114**
High incentives	0.139***	0.147***	0.143***
Number of observations (sessions)	n = 752 (16)	n = 752 (16)	n = 384 (8)
Wald test	50.23	41.89	127.96
Prob > χ^2	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.

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

In our regression analysis (see Table 4), we measure the effect of the goal setting treatment by introducing a “Goal Setting Dummy” which takes value 1 for goal setting and value 0 for the baseline. We also include as an independent variable a “No Goal” Dummy variable which takes value 1 if a manager decided not to set any goal to the worker in the goal setting treatment. Finally, we control for incentives by constructing an “Average (High) Incentives Dummy” which takes value one if monetary incentives for producing a table correctly were equal to 80 (150) cents. In line with Hypothesis 1, we show that goal setting affects workers’ performance positively. First, workers performed better in the goal

¹² The performance on the first table is excluded from the current and subsequent analyses.

setting treatment than in the baseline, regardless of the measure we used to control for ability levels. Second, workers who were not assigned a goal by their manager in the goal setting treatment performed significantly worse than those who were assigned a goal.¹³

These findings are consistent with the results of the debriefing questionnaire in the goal setting treatment in which we asked participants whether goal setting had a negative, neutral or positive effect on their level of production and motivation using a seven-point scale (see Appendix C). A large proportion of participants reported that goal setting had a significantly positive effect for both motivation and production levels (61.0% and 72.9% of the participants, respectively) while only 2.1% and 6.0% of the participants reported negative effects of goal setting on production and motivation levels. In the debriefing questionnaire, we also asked participants to report how they felt had they produced more or less than the goal set by their manager. In line with previous results, a large proportion of participants (77.1%) reported that attaining goals made them feel good while most of the participants (64.0%) reported feeling bad when not attaining the goal set by the manager. These results support the idea that workers value nonbinding goals, and that the goal acts as a reference point, consistently with our theoretical model.

In order to shed light on the magnitude of goal setting effects on workers' performance we study the time dynamics of workers' production levels for both the baseline and the goal setting treatment. In Table 5, we provide descriptive statistics for production levels analyzing the first (periods 1 to 4) and the second part (periods 5 to 8) of the experiment separately.

TABLE 5. Dynamics of workers' production.

	First half of the experiment (n=188)		Second half of the experiment (n=188)	
	Baseline	Goal setting	Baseline	Goal setting
Mean	9.04	10.66	10.28	10.85
Standard Deviation	4.26	4.07	4.75	4.53

We observe that in the first half of the experiment, production levels in the goal setting treatment were on average 17.9% higher than in the baseline treatment while goal setting outperforms the baseline by only 5.5% in the second half of the experiment. We show in the statistical analysis in Table 6 that the positive effect of goal setting is significant in the first part of the experiment while being negligible in the second part. We shed light on the apparent weakening of goal setting effects over time in Section 4.3. when studying in detail the interaction between goal setting and monetary incentives and in Section 4.5 and when studying goal accuracy and reaction to goals.

¹³ We do not report any negative effect of not assigning a goal when controlling for "summation skills" in our regression. However, in this case we restrict our analysis to half the number of sessions in which case managers did not set a goal to the worker in only 9 cases.

TABLE 6. Poisson regression with random effects for production.

	First half of the experiment			Second half of the experiment		
Intercept	1.900***	2.189***	1.499***	1.998***	2.424***	1.549***
Goal Setting Dummy	0.132**	0.151***	0.086*	0.039	0.049	0.065
No Goal Dummy	-0.430**	-0.463**	- ¹⁴	-0.153	-0.116	- ¹⁵
<u>Ability measures</u>						
First table correct	0.263***	-	-	0.299***	-	-
Time to get first table correct	-	-0.106*	-	-	-0.263***	-
Summation skills	-	-	0.041***	-	-	0.043***
<u>Incentive dummies</u>						
Average incentives	0.208***	0.195***	0.112**	0.169***	0.181***	0.137**
High incentives	0.138**	0.149***	0.158**	0.214***	0.237***	0.171***
Number of observations	n = 376	n = 376	n = 192	n = 376	n = 376	n = 192
Wald test	35.59	30.29	95.90	41.81	47.63	105.68
Prob > χ^2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.

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

We summarize our results regarding the effect of goal setting on workers' performance as follows.

RESULT 1 (Production)

- i) Workers' production levels were significantly greater in the goal setting treatment than in the baseline treatment. This effect was significant in the first half of the experiment while being negligible in the second half.
- ii) Setting no goal in the goal setting treatment had a significantly negative effect on workers' production. This effect was highly significant in the first half of the experiment while being negligible in the second half.

After identifying differences in production levels across treatments, we propose to pinpoint the origin of these differences by investigating workers' effort and accuracy levels.

4.2. Goal setting, work effort and work accuracy

We assess the effect of goal setting on work effort which can be measured by the amount of time workers spent working on the task and by the number of tables they completed. We observe that workers spent a higher proportion of available time on the work task (rather than on the Internet) in the goal setting treatment (95.2%) compared with the baseline (90.6%) consistently with Hypothesis 1. This difference is more pronounced in the first part of the experiment (96.4% vs. 89.4%) than in the second part of the experiment (93.9% vs. 91.8%). Consistently, the number of completed tables was 10.9%

¹⁴ Insufficient number of observations to estimate the No Goal Dummy.

¹⁵ Insufficient number of observations to estimate the No Goal Dummy.

higher in the goal setting treatment than in the baseline. This difference was also greater in the first part of the experiment (17.3%) than in the second part (5.2%). We test for differences across treatments by conducting a regression analysis for the proportion of available time spent on the work task (see Table A.3 in the appendix) and for the number of completed tables (see Table A.4 in the appendix).¹⁶ The coefficient of the dummy variable for the goal setting treatment is positive and significant in the first part of the experiment for both variables. This difference vanishes in the second half of the experiment.

In order to assess differences in the quality of the workers' output, we define an accuracy variable as the ratio of the number of tables which were completed correctly over the total number of completed tables. We find that accuracy levels were not significantly different between the goal setting (84.1%) and the baseline treatments (85.2%) (see Table A.5 in the appendix).

We summarize our results as follows.

RESULT 2 (Work Effort and Accuracy)

- i) The proportion of available time spent on the work task was significantly larger in the goal setting treatment than in the baseline. This effect was highly significant in the first half of the experiment while being negligible in the second half.
- ii) The number of completed tables was significantly greater in the goal setting treatment than in the baseline. This effect was highly significant in the first half of the experiment while being negligible in the second half.
- iii) Setting no goal in the goal setting treatment had a significantly negative effect on work effort. This effect was highly significant in the first half of the experiment while being negligible in the second half.
- iv) Accuracy levels did not differ across treatments.

4.3. Goal setting and monetary incentives

4.3.1. Empirical analysis

In our experimental design, monetary incentives were assigned on a random basis at the beginning of each period. Regardless of the treatment, the monetary reward for completing one table correctly was 10, 80 or 150 cents. In this section, we study the effect of monetary incentives on workers' production and effort levels as well as the interaction between monetary incentives and goal setting. It is worth noting how significant the differences in incentives are. An average performer who only receives low incentives for the duration of the experiment would generate an average earning of \$4 compared to \$60 in the case of high incentives. The value of average incentives (80¢) was selected so that a participant who only

¹⁶ We provide results for the "first table correct" ability measure. Similar results are obtained controlling for workers' ability using either "time to get first table correct" or "summation skills". The p-values when controlling for "summation skills" are typically higher than in the other two cases, however, as we collected this measure for only half of the 16 experimental sessions.

worked under this incentive scheme would earn an average of \$32 which corresponds to the typical average payment for a two-hour experiment at the laboratory in which the study was conducted.

In the baseline treatment without goal setting, production levels were greater under average monetary incentives (10.4) than under low (9.1) and high incentives (9.6). These results are in line with Pokorny (2008) and Ariely et al. (2009) who report a non-monotonic relationship between monetary incentives and production levels, suggesting an adverse effect of high monetary incentives. In the goal setting treatment, however, we observe a monotonic relationship between production levels and incentives. Production levels under high incentives (11.4) were larger than under average incentives (10.9) and low incentives (9.5).

We provide a statistical analysis in Table 7 by displaying the results of Poisson regressions with random effects. We assess incentive effects for both treatments separately, and report the coefficient and p-values for the dummy variables capturing incentive effects after controlling for workers' ability levels using the "first table correct" measure.¹⁷

TABLE 7. Incentives dummies for Poisson regressions with random effects for production.

	Baseline	Goal setting
Average incentives	0.142**	0.121***
High incentives	0.101	0.177***
Test equality of coefficients (p-value)	0.2694	0.584

Estimation output using robust standard errors clustered at the session level.
*p-value<.10, **p-value<.05, and ***p-value<.01

Not surprisingly, average incentives significantly outperformed low incentives in both treatments. However, high incentives did not outperform either low or average incentives in the baseline. In the goal setting treatment, high incentives outperformed low and average incentives.¹⁸ In sum, the adverse effect of high incentives which was found in the baseline treatment disappeared in the presence of goal setting.

These results suggest that the effect of goal setting may have been most pronounced under high incentives. Indeed, average production in the goal setting treatment was 21.0% larger than in the baseline under high incentives whereas the production gap between treatments was only equal to 8.3% and 5.2% in the low and average incentives, respectively. We conduct Poisson regressions with random effects to assess goal setting effects for low, average and high incentives, separately (see Table A.6 in the appendix).¹⁹ We find that workers' production levels were significantly greater in the goal setting

¹⁷ Similar results are obtained using "time to get first table correct" or "summation skills" as ability measures.

¹⁸ Comparing high incentives with both low and average incentives, the corresponding p-values for the "High Incentives Dummy" is equal to 0.005 (0.541) in the goal setting (baseline) treatment.

¹⁹ See Appendix A for the same analysis for the proportion of available time spent on the work task (Table A.7), the number of completed tables (Table A.8) and work accuracy (Table A.9).

treatment than in the baseline treatment for the case of high monetary incentives. This effect was significant in the first half of the experiment while being negligible in the second half. The goal setting effect was negligible in the case of low and average incentives taken separately for both the first and second parts of the experiment. Interestingly, the effect of goal setting was significant for both the first and second parts of the experiment once we removed low incentives from the analysis as is shown in Table 8 below. These findings are consistent with our theoretical conjectures (Hypothesis 2.iii).

TABLE 8. Treatment dummy for Poisson regressions with random effects for production across incentive schemes for the first and second parts of the experiment, separately.²⁰

	Average & High incentives	
	First half of the experiment	Second half of the experiment
Intercept	2.177***	2.241***
Goal Setting Dummy	0.170***	0.118**
No Goal Dummy	-0.249**	-0.123
First table correct	0.163***	0.152**
High incentives	-0.054	0.033
Number of observations	n = 315	n = 310
Wald test	20.14	17.75
Prob > χ^2	<0.001	0.001

Estimation output using robust standard errors clustered at the session level.

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

We summarize our findings regarding the effects of goals and incentives on workers’ production levels as follows.

RESULT 3 (Goals and Incentives)

- i) Incentive effects were observed in both treatments as average incentives outperformed low incentives.
- ii) We found evidence of an adverse effect of high monetary incentives in the baseline treatment but not under goal setting.
- iii) Workers’ production levels were significantly greater in the goal setting treatment than in the baseline treatment under average and high monetary incentives. This effect was significant in both the first half and the second half of the experiment.

While Result 3.i and 3.iii are consistent with our theoretical predictions, our model does not capture the adverse effect of high monetary incentives in the baseline (Result 3.ii). Ariely et al. (2009) account for this effect by the excessive arousal and preoccupation produced by the presence of large stakes (“choking under pressure”) that can lead to a decrement in performance. However, we observe in our baseline treatment that accuracy levels were slightly higher under high incentives (84.6%) than under low

²⁰ Similar results are obtained using the other two measures of ability.

and average incentives (83.9%). This seems to be inconsistent with “choking under pressure” as we would expect, under this assumption, that high incentives engender more mistakes and lower accuracy levels. Alternatively, the adverse effect of high monetary incentives can be accounted for by the presence of reference earnings (see Pokorny (2008)). We follow this alternative and build upon Pokorny’s model to extend our goal setting model and account for the possible adverse effect of high monetary incentives in the following section.

4.3.2. Goal setting model with reference earnings

Building upon the model of Pokorny (2008), we consider the following extrinsic utility function:

$$V_E(y, \alpha, R, s) = \begin{cases} \alpha y & \text{if } \alpha y < R, \\ R + s(\alpha y - R) & \text{if } \alpha y \geq R. \end{cases}$$

This function has two new parameters. The parameter R represents reference earnings upon which workers evaluate their total earnings (αy). Workers are in the “loss” domain if total earnings are lower than reference earnings and in the “win” domain otherwise. The parameter $s < 1$ captures loss aversion and indicates that marginal extrinsic utility is smaller when total earnings are above reference earnings than when they are below. This extension of the model allows us to replicate the non-monotonic relationship between effort and monetary incentives that has been previously established in the literature (Pokorny (2008)) (see Appendix B.3 for the details of the proofs). The following lemma summarizes the optimal effort level in the absence of goals (baseline):

Lemma 2. Given parameters α , R , s and θ the worker’s optimal effort in the absence of goals is given by the following implicit equations:

$$\begin{cases} e_I^B = \alpha\theta + \frac{\theta}{2}(\theta e_I^B)^{-1/2} & \text{if } \alpha < \alpha_L^B, \\ e_{II}^B = \frac{R}{\alpha\theta} & \text{if } \alpha_L^B \leq \alpha \leq \alpha_H^B, \\ e_{III}^B = s\alpha\theta + \frac{\theta}{2}(\theta e_{III}^B)^{-1/2} & \text{if } \alpha > \alpha_H^B. \end{cases}$$

where $\alpha_L^B\theta = \frac{R}{\alpha_L^B} - \frac{\theta}{2}\left(\frac{R}{\alpha_L^B}\right)^{-\frac{1}{2}}$ and $s\alpha_H^B\theta = \frac{R}{\alpha_H^B} - \frac{\theta}{2}\left(\frac{R}{\alpha_H^B}\right)^{-\frac{1}{2}}$.

We observe that when the incentive parameter is below α_L^B , or above α_H^B , higher monetary incentives lead to higher effort as in the standard model without reference earnings. The most interesting case arises when the incentive parameter lies between α_L^B and α_H^B . In that range, workers satisfy themselves with reference earnings (R) which they can achieve with low effort when incentives are high. This generates a negative relationship between effort and incentives.

To study the relationship between optimal effort and monetary incentives with goal setting, we have to consider the following two cases separately: (i) $g < R/\alpha$ and (ii) $g \geq R/\alpha$. We present the logic of case (i)

and relegate case (ii) to the appendix. The same qualitative results are derived in both cases. We also focus on the perfect information case in which the manager knows the level of ability of workers. In case (i), the worker maximizes the following utility function:

$$u(y, g, \lambda, \alpha) = V_E(y, \alpha, R, s) + V_I(y, g, \lambda) = \begin{cases} \alpha y - \lambda(-y - g)^{\frac{1}{2}} & \text{if } y \leq g, \\ \alpha y + (y - g)^{\frac{1}{2}} & \text{if } g < y < \frac{R}{\alpha}, \\ R + s(\alpha y - R) + (y - g)^{\frac{1}{2}} & \text{if } y \geq \frac{R}{\alpha}. \end{cases}$$

We derive the optimal effort level with goal setting in the following lemma:

Lemma 3. Given parameters α , R , s , λ and θ the worker's optimal effort with goal setting is given by the following implicit equations:

$$\begin{cases} e_I^{GS} = \alpha\theta + \frac{\theta}{2}(\theta e_I^{GS} - g^*)^{-1/2} & \text{if } \alpha < \alpha_L^{GS}, \\ e_{II}^{GS} = \frac{R}{\alpha\theta} & \text{if } \alpha_L^{GS} \leq \alpha \leq \alpha_H^{GS}, \\ e_{III}^{GS} = s\alpha\theta + \frac{\theta}{2}(\theta e_{III}^{GS} - g^*)^{-1/2} & \text{if } \alpha > \alpha_H^{GS}. \end{cases}$$

where $\alpha_L^{GS}\theta = \frac{R}{\alpha_L^{GS}\theta} - \frac{\theta}{2}\left(\frac{R}{\alpha_L^{GS}} - g^*\right)^{-\frac{1}{2}}$, $s\alpha_H^{GS}\theta = \frac{R}{\alpha_H^{GS}\theta} - \frac{\theta}{2}\left(\frac{R}{\alpha_H^{GS}} - g^*\right)^{-\frac{1}{2}}$ and $g^* = \alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3}$.

Also, comparing the baseline results (Lemma 2) and the goal setting results (Lemma 3) we obtain the following corollary.

Corollary 2. Comparing Lemma 2 and Lemma 3 we obtain the following results:

- (i) $e^{GS} \geq e^B$ for all α .
- (ii) $\alpha_H^B > \alpha_H^{GS}$.

The first part of Corollary 2 states that goal setting increases effort when we consider reference earning in the extrinsic utility function. Therefore, our main results still apply to this more general model. The second part of Corollary 2 implies that high monetary incentives are more likely to be effective when goals are present than when they are absent. In Figure 6, we illustrate the fact that this more general model of goal setting with reference earnings can account for Result 3.ii according to which there is an adverse effect of high incentives in the baseline that disappears under goal setting. On the left panel, we represent the model predictions for effort levels as a function of the incentive parameter (α) for both the baseline and the goal setting cases. The actual production levels in the experiment are represented on the right panel.

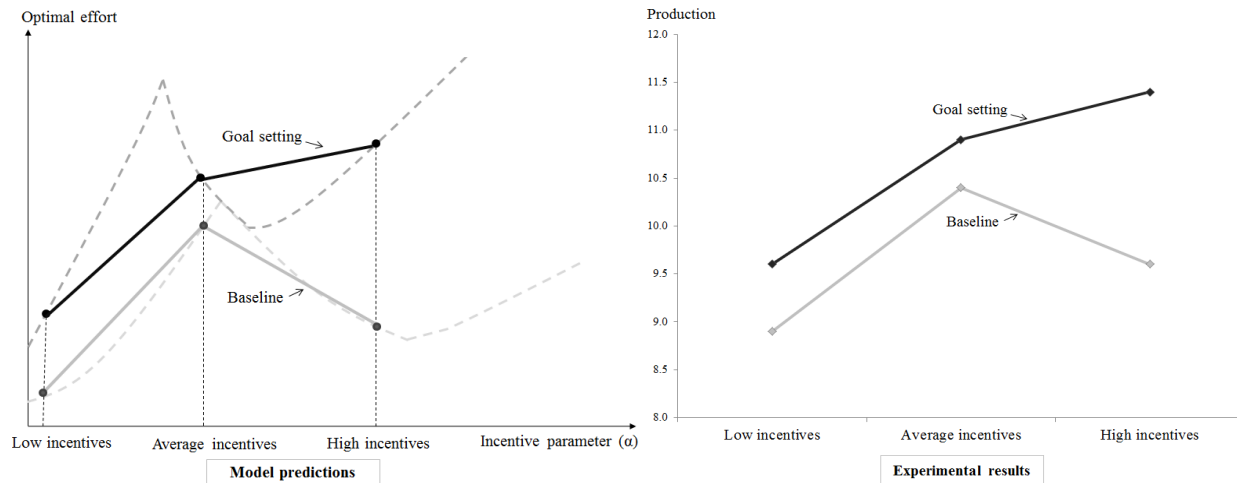


FIGURE 6.- Adverse effect of high incentives with reference earnings: Model effort predictions (left panel) and experiment results (right panel).

4.4. An analysis of goal selection

In the goal setting treatment, the average goal was set at 10.3 tables which was challenging for an average-ability worker given that average production in the baseline treatment was equal to 9.7 tables. Under goal setting, workers produced on average slightly more, 10.8 tables, than their assigned goals so that workers attained their assigned goal in 59.8% of the cases suggesting that goals were chosen to be challenging but yet accessible, in line with our theoretical conjecture (Hypothesis 2.i).

Managers used their own experience on the work task in order to set their goal to workers. The correlation between the average goal set by a manager and his or her average level of performance during the experiment was positive and significant ($p\text{-value} = 0.0476$). We also observed that goals increased significantly over time, the average goal being equal to 8.5 in the first period and 11.2 in the last period. This positive trend in goals follows from the fact that average production also increased over time from 9.0 in the first period to 11.7 in the last period.

In line with the previous results, we find that a significant proportion of participants (41%) reported in the debriefing questionnaire to set goals which they considered challenging but yet attainable for an average-ability worker. Also, 18% of the participants mentioned that they set goals to be equal to their own maximum attainable performance. Similarly, 21% of the participants mentioned that their goal was based on their own past performance.

In a regression analysis (see Table A.10 in the appendix), we show that managers set higher goals when performing well in the previous period as a worker. Consistently, more able managers, as measured with “summation skills”, were also inclined to set higher goals. However, we see no evidence that being assigned the role of worker or manager in the previous period affected managers’ goals. Also, the goals experienced by managers in the previous period as workers did not significantly affect their goal setting

strategy. Finally, we find that goals were significantly greater under high incentives (10.8) than under either average (9.9) or low incentives (10.1). This result, which is consistent with our theoretical conjectures (Hypothesis 2.ii), is crucial to understand why goal setting is most effective when monetary incentives are high: high monetary incentives promote challenging goals which in turn increase workers' motivation.

RESULT 4 (Goal Selection)

- i) Managers set goals which were challenging for an average-ability worker.
- ii) Managers increased the difficulty of the goal over time so as to respond to the increase in workers' production levels.
- iii) Managers used information regarding their own performance on the task to set their goals. Managers with higher ability levels on the task set higher goals.
- iv) Goals were greater for high monetary incentives than for low and average incentives.

4.5. Goal accuracy and reaction to goals

After assessing the aggregate effect of goals in previous sections, we turn to the analysis of the effect of goal accuracy and reaction to goals in the goal setting treatment. Our objective is to deepen our understanding of the effect of goals and connect our findings to our theoretical framework. To fully understand the effect of goals, we need to identify those goals which were reasonably accurate in the sense of being attainable by workers of a given ability level.

We start by using our measure of “summation skills” to predict the number of tables a given participant should be able to complete correctly in the work task. We denote this predictor of performance by *work task ability*. This variable is constructed for each participant *i* as follows:

$$\text{Work task ability}_i = \hat{\alpha}_0 + \hat{\alpha}_1(\text{Summation skills}_i)$$

where the coefficients $\hat{\alpha}_0$ and $\hat{\alpha}_1$ are estimated with the following linear panel regression:

$$\text{Number of correct tables}_{it} = \alpha_0 + \alpha_1(\text{Summation skills}_i) + \epsilon_{it}$$

using the data from the baseline treatment. We obtain $\hat{\alpha}_0 = 3.871$ (p-value<0.0001) and $\hat{\alpha}_1 = 0.381$ (p-value<0.001), for a regression with $R^2 = 0.21$.²¹ Also, production levels in the baseline were less than one (two) [three] tables away from *work task ability* in 28.17% (53.7%) [71.5%] of the cases.

We define reasonably and non-reasonably accurate goals on the basis of *work task ability*. Reasonably (non-reasonably) accurate goals are defined such that the difference -in absolute terms- between the goal set by the manager and the *work task ability* of the worker is less (more) than two tables. Using this criterion, 43.7% of the goals in the goal setting treatment are classified as reasonably accurate. We obtain

²¹ Using the same procedure for the other two measures of ability we obtain $R^2 = 0.03$ and $R^2 = 0.01$ for “first table correct” and “time to get first table correct”.

similar results by using either a wider (+/-3 tables, in which case 58.0% of goals are classified as reasonably accurate) or a narrower range (+/- 1 table, in which case 19.1% of goals are classified as reasonably accurate) for the definition of reasonably accurate goals. The difference between a worker's maximum and minimum levels of production in the baseline treatment was on average equal to 2.5 tables indicating that, on average, a goal which is within +/-2 or +/-3 tables of *work task ability* is likely to correspond to a normal range of values of production for a given participant.

We show that higher goals led to higher production levels when goals were reasonably accurate (see Table 9 below), whereas such a positive effect of goals was absent for the case of non-reasonably accurate goals (see Table 10 below).

TABLE 9. Poisson regression with random effects for the number of correct tables as a function of goals, in the case of reasonably accurate goals.

	All periods	First half of the experiment	Second half of the experiment
Intercept	-4.302*	-1.137	-7.620***
Goal	0.105***	0.111***	0.060**
Summation skills	0.623**	0.258	1.053***
<u>Incentive dummies</u>			
Average incentives	0.055	0.037	0.014
High incentives	0.093	0.165	-0.052
Number of observations	n = 79	n =40	n =39
Wald test	44.99	21.80	73.88
Prob > χ^2	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.
*p-value<.10, **p-value<.05, and ***p-value<.01

TABLE 10. Poisson regression with random effects for the number of correct tables as a function of goals, in the case of non-reasonably accurate goals.

	All periods	First half of the experiment	Second half of the experiment
Intercept	1.133	-5.485	3.339
Goal	-0.001	-0.013*	-0.009
Summation skills	0.124	0.872*	-0.115
<u>Incentive dummies</u>			
Average incentives	0.190***	0.170*	0.294***
High incentives	0.196***	0.199**	0.293***
Number of observations	n = 113	n =56	n =57
Wald test	11.30	26.86	14.22
Prob > χ^2	0.023	<0.001	0.007

Estimation output using robust standard errors clustered at the session level.
*p-value<.10, **p-value<.05, and ***p-value<.01

We find that the positive effect of reasonably accurate goals on production did not vanish in the second half of the experiment. As a result, the lack of aggregate effect of the goal setting treatment in the second half of the experiment does not imply that the effectiveness of goals fades over time. In line with our theoretical setting, the accuracy of the goal is crucial in understanding the effectiveness of goal setting.

Finally, we show that reasonably accurate goals led to significantly higher production levels than inaccurate goals after controlling for ability levels (see Table A.11).

RESULT 5 (Reaction to Reasonably Accurate Goals)

- i) Higher goals led to higher production levels when goals were in a reasonable range of a worker's ability level. Non-reasonable goals did not affect production.
- ii) The positive effect of reasonable goals on production did not vanish over time.

Also consistent with our model, participants reported in the debriefing questionnaire a significant decrease in effort after the goal was achieved (Wilcoxon Signed Rank test, $p\text{-value} < 0.01$).²²

5. ROBUSTNESS CHECKS

5.1. Computerized goals

We designed an additional treatment in which goals were selected randomly instead of being assigned by the manager. We conducted a total of four sessions involving 50 participants. The set of possible values which was used to draw the computerized goals was taken from the goals which were set by the managers in the original goal setting treatment. To allow for a valid comparison of the relative effectiveness of human and computerized goals, the set of possible values used for computerized goals was made contingent on both the period and the value of a correct table. Both dimensions appeared to be crucial for managers to set goals in the original goal setting treatment. The computerized goals treatment allows us to control for possible confounding factors in the effect of goals in the original goal setting treatment. In particular, the assignment of goals by managers introduced an interaction between the manager and the worker which was not present in the baseline and which may have fostered social preferences leading workers to exert higher levels of effort under goal setting. In addition, this treatment allows us to assess the possibility of a “ratchet effect” (e.g. Charness, Kuhn and Villeval (2011)) according to which workers may refrain from exerting high effort so as to avoid managers raising goals in future periods. In the computerized goals treatment this possible “ratchet effect” is eliminated because

²² In four of the eight sessions of the goal setting treatment (48 participants), we asked participants using a seven-point scale what were their level of effort before and after the goal was achieved.

goals are not selected by the managers and cannot be affected by workers' production patterns, as a result.²³

Using computerized goals, we obtain similar results than in the case of human goals showing that the effect of goal setting is highly significant in the first part of the experiment while largely disappearing in the second part of the experiment (see Table 11). We also show that computerized and human goals do not differ significantly in production levels (see Table A.12 in the appendix).

TABLE 11. Poisson regression with random effects for production.
Computerized goals vs. Baseline

	First half of the experiment			Second half of the experiment		
Intercept	1.801***	2.213***	1.409***	2.016***	2.337***	1.524***
Computerized Goal Dummy	0.240***	0.230***	0.097*	0.130*	0.099	0.032
No Goal Dummy	-0.096	-0.066	-0.084	0.317	0.280	0.205
<u>Ability measures</u>						
First table correct	0.320***	-	-	0.207**	-	-
Time to get first table correct	-	-0.216***	-	-	-0.201***	-
Summation skills	-	-	0.043***	-	-	0.039***
<u>Incentive dummies</u>						
Average incentives	0.274***	0.279***	0.193***	0.237***	0.248***	0.305***
High incentives	0.213**	0.244***	0.245**	0.274***	0.285***	0.317***
Number of observations	n = 288	n = 288	n = 196 ²⁴	n = 288	n = 288	n = 196
Wald test	40.57	49.92	111.07	42.54	68.29	76.64
Prob > χ^2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.

"Computerized Goal Dummy" is a dummy variable that takes value 1 for the computerized goal setting treatment and value 0 for the baseline.

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

Similarly to the case of human goals, we find a significant effect of computerized goals in the second part of the experiment when focusing on average and high incentive schemes. The p-value associated to the Computerized Goal Dummy are equal to 0.002, 0.025, and 0.075 when using "first table correct", "time to get first table correct", and "summation skills" to control for ability levels. We summarize our findings below.

RESULT 6 (Computerized Goals)

- i) Production levels did not differ between the computerized goal treatment and the original goal setting treatment with human goals.

²³ Our experimental design also limits the possible existence of "ratchet effects". Roles are randomly selected and partners are randomly matched at the beginning of each period, limiting the dynamic strategic interaction between workers and managers. In addition, participants did not receive any feedback about the production of other workers.

²⁴ We elicited summation skills in all the computerized goals session and in half of the baseline sessions.

- ii) Production levels were significantly greater in the computerized goal treatment than in the baseline treatment. Similarly to the case of human goals, this effect was significant in the first half of the experiment while being negligible in the second half.
- iii) Similarly to the case of human goals, we find a significant effect of computerized goals in the second part of the experiment when focusing on average and high incentive schemes.

5.2. Personal goals

In addition to being assigned goals during the experiment, participants may have set their own personal goals which may have acted as a confounding factor when measuring the effectiveness of goal setting. To control for the effect of personal goals, we asked participants whether they set a goal to themselves. We created a Personal Goal Dummy variable which takes value 1 if a participant set a personal goal and value 0 otherwise. The proportion of participants who set a goal to themselves was similar across treatments (39.1% for the baseline and 37.0% for the goal setting treatment, Proportion test, p-value = 0.836).²⁵ We confirm the robustness of our main result regarding the effect of goals in the first part of the experiment (see Table A.13 in the appendix). Even though participants setting a personal goal produced more than those who did not, the difference was only marginally significant (p-value = 0.068). It is also the case that the effect of goals subsists even if we restrict our sample to the participants who set a personal goal to themselves (see Table 12). The significance of the Goal Setting Dummy is even more pronounced for the subset of workers who did not set a goal for themselves (p-value < 0.01).

TABLE 12. Poisson regression with random effects for production for participants who set a personal goal.

First half of the experiment	Coefficients
Intercept	2.017***
Goal Setting Dummy	0.211**
No Goal Dummy	-0.463***
First table correct	0.187
<u>Incentive dummies</u>	
Average incentives	0.198***
High incentives	0.068
Number of observations	n = 66
Wald test	27.77
Prob > χ^2	<0.001

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

These findings suggest that, even in the presence of personal goals, the goals set by the managers are effective in increasing workers' production levels.

²⁵ We elicited personal goals for a total of eight sessions (92 participants) including 46 participants from the baseline and 46 participants from the goal setting treatments. We did not elicit "summation skills" for these sessions and used first table correct as a measure of ability.

RESULT 7 (Personal Goals)

The effect of the goal setting treatment was found to be robust to controlling for the presence of personal goals.

5.3. Additional analyses

In Appendix D, we report additional analyses controlling for goal setting dynamics as well as participants' social preferences. We find that production remains higher in the goal setting treatment than in the baseline after controlling for participants' roles, monetary incentives and goals in the previous period (see Table D.1 in Appendix D). Also, we find that the effect of the goal setting treatment is robust to controlling for social preferences (see Table D.3 in Appendix D).

6. CONCLUSIONS

The purpose of this paper was to test the effectiveness of wage-irrelevant goal setting policies in the laboratory and its interaction with monetary rewards. Although goals did not entail any monetary consequences, we found that they significantly increased both production levels and effort. These results suggest that the intuitive appeal of goal setting which has been reported at length in the psychology literature is robust to the more general case of work environments in which monetary incentives prevail.

We found that the effectiveness of goal setting was magnified rather than undermined by the use of high monetary incentives. The complementarity between monetary incentives and goals which was highlighted in our theoretical model follows from the fact that high monetary incentives promote higher goals which in turn increase motivation and performance. In line with the complementarity argument, we also reported that the effect of goal setting on performance could only be sustained over time if monetary incentives were sufficiently high. The fact that wage-irrelevant goals were particularly effective when combined with high monetary incentives contributes to the understanding of the literature documenting the crowding-out effect of high incentives on workers' intrinsic motivation (see Gneezy et al. (2011) and Kamenica (2012) for reviews). In particular, we showed that the negative effect of large stakes on performance (Pokorny (2008) and Ariely et al. (2009)) vanished once we introduce goal setting. We were able to account for this finding by extending our original goal setting model to the case of reference earnings à la Pokorny (2008). Our results suggest that management tools which enhance workers' intrinsic motivation like goal setting may help alleviate the crowding-out effect of high monetary incentives.

The current design also allowed us to study the managers' selection of goals. In particular, we observed that managers set goals that were challenging but yet attainable by an average-ability worker. In line with the complementarity argument between goals and incentives, we found that managers set higher goals under high monetary incentives than under average and low incentives.

Our findings suggest that managers not only should care about both intrinsic and extrinsic incentives but should also make sure to design these incentive schemes in tandem. This finding is particularly relevant in light of the Behavioral Economics literature which postulates that economic and psychological phenomena should not be studied in isolation.

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APPENDIX A

Ability measures

TABLE A1. Correlation across production and ability measures.

	Production	First table correct	Time to get first table correct	Summation skills
Production	1			
First table correct	0.2678***	1		
Time to get first table correct	-0.2826***	-0.0394	1	
Summation skills	0.5861***	0.2000***	-0.3985***	1

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

TABLE A.2. Comparison of ability measure across treatments.

	First table correct	Time to get first table correct	Summation skills
Proportion test (p-value)	0.498	-	-
Wilcoxon Rank Sum test (p-value)	-	0.906	0.336

Goal setting effects on work effort and accuracy

Proportion of available time spent on the work task

TABLE A.3. Tobit regressions with random effects
for the proportion of available time spent on the work task.

	All periods	First half of the experiment	Second half of the experiment
Intercept	0.764***	0.728***	0.798***
Goal Setting Dummy	0.039**	0.070**	0.007
No Goal Dummy	-0.255***	-0.353***	-0.060
First table correct	0.094***	0.138***	0.049*
<u>Incentive dummies</u>			
Average incentives	0.111***	0.095***	0.131***
High incentives	0.117***	0.096***	0.148***
Number of observations	<i>n</i> = 752	<i>n</i> = 376	<i>n</i> = 376
Wald test	94.96	71.28	41.60
Prob > χ^2	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.
*p-value<.10, **p-value<.05, and ***p-value<.01

Number of completed tables

TABLE A.4. Poisson regression with random effects for the number of completed tables.

	All periods	First half of the experiment	Second half of the experiment
Intercept	2.200***	2.121***	2.200***
Goal Setting Dummy	0.090**	0.139***	0.034
No Goal Dummy	-0.330**	-0.504**	-0.042
First table correct	0.182***	0.186**	0.223***
<u>Incentive dummies</u>			
Average incentives	0.153***	0.199***	0.172***
High incentives	0.145***	0.140**	0.223***
Number of observations	<i>n</i> = 752	<i>n</i> = 376	<i>n</i> = 376
Wald test	44.35	36.17	39.43
Prob > χ^2	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.
*p-value<.10, **p-value<.05, and ***p-value<.01

Accuracy

TABLE A.5. Linear regression with random effects for accuracy.

	All periods	First half of the experiment	Second half of the experiment
Intercept	0.774***	0.756***	0.796***
Goal Setting Dummy	0.005	0.126	0.001
No Goal Dummy	0.006	0.034	-0.041
First table correct	0.076***	0.088***	0.057**
<u>Incentive dummies</u>			
Average incentives	0.159	0.014	0.015
High incentives	0.138	0.024	0.009
Number of observations	$n = 721$	$n = 355$	$n = 366$
Wald test	19.62	23.35	8.29
Prob > χ^2	0.001	<0.001	0.141

Estimation output using robust standard errors clustered at the session level.

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

Goal setting effects across incentive schemes for production, work effort and accuracy²⁶

Production

TABLE A.6. Poisson regressions with random effects for production across incentive schemes for the first and second parts of the experiment, separately.

	First half of the experiment			Second half of the experiment		
	Low incentives	Average incentives	High incentives	Low incentives	Average incentives	High incentives
Intercept	1.833***	2.153***	1.896***	1.855***	2.194***	2.205***
Goal Setting Dummy	0.187*	0.003	0.153**	0.015	0.062	0.056
No Goal Dummy	-0.323	-0.363	-0.080***	-0.143	-0.319***	-0.181***
First table correct	0.320**	0.274**	0.383***	0.497***	0.202**	0.224***
Number of observations	$n = 127$	$n = 121$	$n = 128$	$n = 73$	$n = 120$	$n = 118$
Wald test	8.53	6.24	77.76	14.22	29.03	86.44
Prob > χ^2	0.036	0.100	<0.001	0.002	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.

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

²⁶ Similar results are obtained using the other two measures of ability.

Proportion of available time spent on the work task

TABLE A.7. Treatment dummy for Tobit regressions with random effects for the proportion of available time spent on the work task across incentive schemes.

	All periods	First half of the experiment	Second half of the experiment
Low incentives	0.041	0.115*	0.020
Average incentives	0.013	0.004	0.022
High incentives	0.030	0.042	0.007

Estimation output using robust standard errors clustered at the session level.

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

Number of completed tables

TABLE A.8. Treatment dummy for Poisson regressions with random effects for the number of completed tables across incentive schemes.

	All periods	First half of the experiment	Second half of the experiment
Low incentives	0.060	0.195**	-0.002
Average incentives	0.063	0.035	0.068
High incentives	0.131**	0.147**	0.071

Estimation output using robust standard errors clustered at the session level.

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

Accuracy

TABLE A.9. Treatment dummy for linear regressions with random effects for accuracy across incentive schemes.

	All periods	First half of the experiment	Second half of the experiment
Low incentives	0.031	0.032	0.033
Average incentives	-0.011	-0.001	-0.023
High incentives	0.014	0.032	0.001

Estimation output using robust standard errors clustered at the session level.

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

Goal selection

TABLE A.10. Linear regression with random effects for managers' goals.

	Coefficients
Intercept	4.065***
Summation skills	0.222***
Period trend	0.309***
<u>Dynamics</u>	
Goal assigned in previous period	0.027
Role in previous period	1.194
Production in previous period	0.253**
Earnings in previous period	-0.004
<u>Incentive dummies</u>	
Average incentives	0.167
High incentives	0.645***
Number of observations	n = 168
R ²	0.205

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

Reasonable vs. non-reasonable goals

TABLE A.11. Poisson regression with random effects comparing production for reasonable and non-reasonable goals

	First half of the experiment	Second half of the experiment
Intercept	1.521***	1.464***
Summation skills	0.042***	0.052***
Reasonable Goal Dummy	0.092**	0.096*
<u>Incentive dummies</u>		
Average incentives	0.077	0.112
High incentives	0.211**	0.107
Number of observations	n = 90	n = 93
Wald test	70.13	76.34
Prob > χ^2	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.

“Reasonable Goal Dummy” is a dummy variable that takes value 1 if the goal set by the manager is characterized as reasonable (see Section 4.5) and value 0 otherwise.

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

Computerized goals

TABLE A.12. Poisson regression with random effects for production.
Computerized vs. human goals

	First half of the experiment			Second half of the experiment		
Intercept	2.152***	2.397***	1.531***	2.153***	2.505***	1.488***
Computerized Goal Dummy	0.103	0.078	0.013	0.081	0.036	-0.024
<u>Ability measures</u>						
First table correct	0.078	-	-	0.096	-	-
Time to get first table correct	-	-0.215**	-	-	-0.360***	-
Summation skills	-	-	0.040***	-	-	0.045***
<u>Incentive dummies</u>						
Average incentives	0.188***	0.193***	0.180***	0.258***	0.278***	0.302***
High incentives	0.211***	0.220***	0.271***	0.252***	0.267***	0.275***
Number of observations	n = 258	n = 258	n = 176	n = 279	n = 279	n = 190
Wald test	15.95	44.31	121.69	17.83	53.45	101.98
Prob > χ^2	0.003	<0.001	<0.001	<0.001	<0.001	<0.001

Estimation output using robust standard errors clustered at the session level.

“Computerized Goal Dummy” is a dummy variable that takes value 1 for the computerized goal setting treatment and value 0 for the baseline.

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

Personal goals

TABLE A.13. Poisson regression with random effects for production
controlling for personal goals.

First half of the experiment	Coefficients
Intercept	1.816***
Goal Setting Dummy	0.231***
No Goal Dummy	-0.893***
Personal Goal Dummy	0.118*
First table correct	0.253***
<u>Incentive dummies</u>	
Average incentives	0.237***
High incentives	0.126**
Number of observations	n = 160
Wald test	31.41
Prob > χ^2	<0.001

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

APPENDIX B (For Online Publication)
B.1. Main model: PROOFS

Proof of Lemma 1

It follows directly from FOC (1) and (2).

Q.E.D.

Proof of Proposition 1

Taking into account that $y_i = \theta_i e_i$, and that the manager assigns goals with perfect information, we can rewrite FOC (1) and (2) as:

$$\alpha\theta_i + \frac{\theta_i}{2}(y_i - g_i)^{-\frac{1}{2}} = \frac{y_i}{\theta_i} \quad \text{if } y_i \geq g_i, \quad (\text{B1})$$

$$\alpha\theta_i + \lambda \frac{\theta_i}{2}(g_i - y_i)^{-\frac{1}{2}} = \frac{y_i}{\theta_i} \quad \text{if } y_i < g_i. \quad (\text{B2})$$

The manager's objective is to get the maximum effort from both types of workers. Applying Lemma 1 (ii) we know that effort increases with the goal if the worker attains it but decreases with the goal otherwise. Therefore, the optimal goals are the maximum goal that each type is able to attain.

Let us define by \hat{g}_i the minimum goal that the worker would fail to attain and by \hat{y}_i the corresponding production (see Figure B.1).

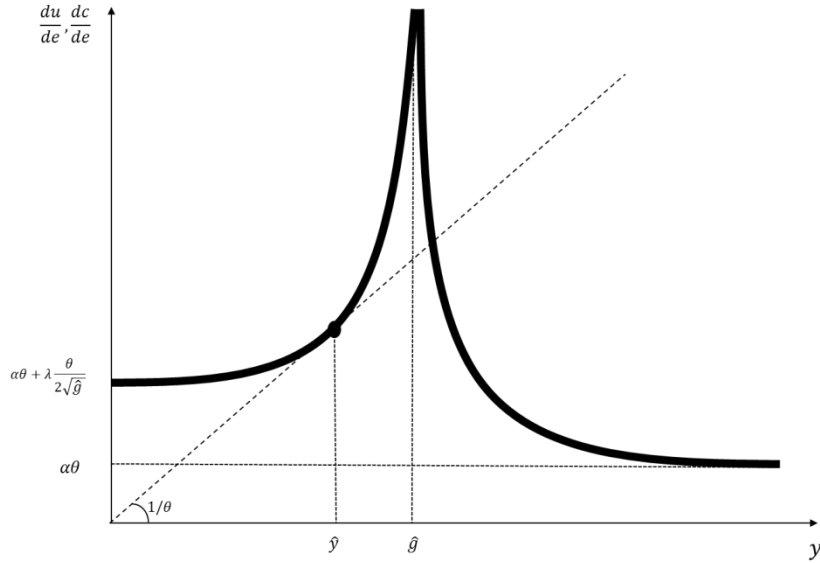


FIGURE B.1- Plot of \hat{g}_i and \hat{y}_i .

Note that $(\hat{g}_i - \hat{y}_i)$ can be obtained by deriving both sides of equation (B2) with respect to y_i :

$$\begin{aligned} \frac{1}{\theta_i} &= \frac{\theta_i}{4} \lambda (\hat{g}_i - \hat{y}_i)^{-3/2}, \\ \hat{g}_i - \hat{y}_i &= \left(\frac{\theta_i^2}{4} \lambda \right)^{2/3}. \end{aligned} \quad (\text{B3})$$

By manipulating FOC (B2) we obtain:

$$g_i - y_i = \left(\frac{\lambda \theta_i^2}{2(y_i - \alpha \theta_i^2)} \right)^2. \quad (\text{B4})$$

Therefore, we can use (B3) and (B4) to get:

$$\hat{y}_i = \left\{ y : \left(\frac{\lambda \theta_i^2}{2(y - \alpha \theta_i^2)} \right)^2 = \left(\frac{\theta_i^2}{4} \lambda \right)^{2/3} \right\}.$$

Hence,

$$\hat{y}_i = \frac{(2\lambda \theta_i^2)^{2/3}}{2} + \alpha \theta_i^2, \quad (\text{B5})$$

and,

$$\hat{g}_i = \alpha \theta_i^2 + 3 \left(\frac{\lambda \theta_i^2}{4} \right)^{2/3}.$$

Note that by definition of \hat{g}_i , for any $\varepsilon > 0$, $g_i = \hat{g}_i - \varepsilon$ implies $y_i > g_i$. Therefore, the goal that maximizes worker i 's performance is obtained by taking $\varepsilon \rightarrow 0$. So, in equilibrium

$$g_i^{\text{PI}} = \alpha \theta_i^2 + 3 \left(\frac{\lambda \theta_i^2}{4} \right)^{2/3}.$$

Finally, y_i^{PI} is obtained by substituting g_i^{PI} in FOC (B1). So the result follows.

Q.E.D.

Proof of Proposition 2 (Sketch)

First we provide a sufficient condition for both types of workers to achieve the goal in equilibrium.

Lemma B1. If $g_L^{\text{PI}} \geq \theta_H - \left(\frac{\theta_H}{2(1-\alpha\theta_H)} \right)^2$ then $g^* = g_L^{\text{PI}}$ and $e_L^* \leq e_H^* = 1$.

Where e_L^* is given by the solution of the following equation:

$$\alpha \theta_L + \frac{\theta_L}{2} (\theta e_L^* - g_L^{\text{PI}})^{-1/2} = e_L^*.$$

Proof of Lemma B1

The high type's production when exerting the maximum effort ($e_H=1$) is $y_H=\theta_H$. Manipulating FOC, we get:

$$y_H - g = \left(\frac{\theta_H^2}{2(y_H - \alpha \theta_H)} \right)^2.$$

Hence if $y_H=\theta_H$ then $g = \theta_H - \left(\frac{\theta_H^2}{2(y_H - \alpha \theta_H)} \right)^2$. Therefore, $e_H^*=1$ for all $g \geq \theta_H - \left(\frac{\theta_H^2}{2(y_H - \alpha \theta_H)} \right)^2$.

If $g^* = g_L^{\text{PI}}$ both types achieve the goal in equilibrium. Note that a slightly more difficult goal implies that the low-ability type does not achieve the goal which lowers his production but high type production would increase as we know from Lemma 1 (ii). However, if $g^* = g_L^{\text{PI}} \geq \theta_H - \left(\frac{\theta_H^2}{2(y_H - \alpha \theta_H)} \right)^2$, we have a

corner solution where the high type exerts the maximum possible effort, so the manager has not incentives to increase the goal beyond g_L^{PI} .

Q.E.D.

Let's assume that $g_L^{PI} < \theta_H - \left(\frac{\theta_H}{2(1-\alpha\theta_H)}\right)^2$. By Lemma B1 we know that in this case $e_H^* < 1$.

Using Lemma 1 (ii) we know that when $\theta_L < \theta_H$ the manager faces the following trade-off: by increasing the goal, $g^* \in (g_L^{PI}, g_H^{PI}]$, he can increase the production of the high type but at the cost of decreasing production of the low type. Clearly, if $\theta_L \rightarrow \theta_H$, $g^* = g_L^{PI} \rightarrow g_H^{PI}$ and both types attains the goal in equilibrium. Similarly, if $\theta_L \rightarrow 0$, $g^* \rightarrow g_H^{PI}$ and only the high type attains the goal in equilibrium. Therefore, there exists a threshold, $\hat{\theta}$, up to which $g^* = g_L^{PI}$. This threshold for θ_L depends on the other parameters of the model $\{\alpha, \lambda, p, \theta_H\}$. In Figure B.2 we plot the equilibrium goal as a function of the low type ability.

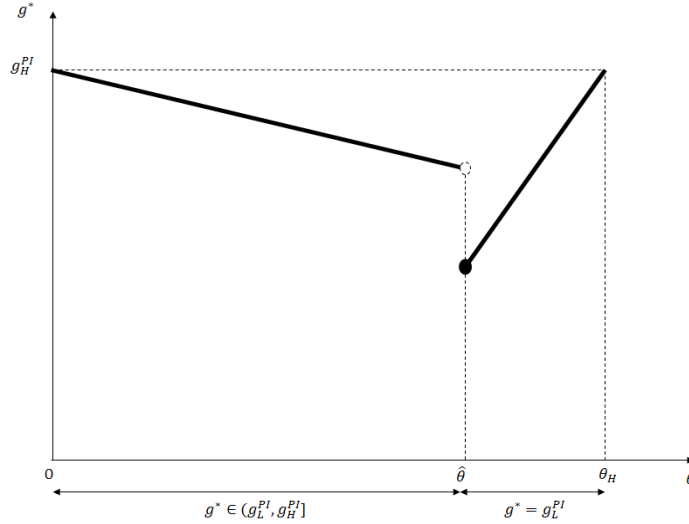


FIGURE B.2- The equilibrium goal g^* .

On the one hand, $\theta_L \in [\hat{\theta}, \theta_H]$ implies $g^* = g_L^{PI}$ and hence the goal increases with θ_L because, as we have shown in Proposition 1, $\frac{dg_L^{PI}}{d\theta_L} > 0$. On the other hand, $\theta_L \in [0, \hat{\theta})$ implies $g^* \in (g_L^{PI}, g_H^{PI}]$ so $y_L^* < g^* < y_H^*$. In the last case, g^* decreases with θ_L because, as θ_L decreases, the low type is less important for the manager and he focuses more on increasing high type's production increasing the goal. The jump in the equilibrium goals that we can observe in Figure B.2, comes from the fact that if $g = g_L^{PI} - \varepsilon$, for an $\varepsilon \rightarrow 0$, then y_H marginally increases while y_L jumps from y_L^{PI} to $\hat{y}_L < y_L^{PI}$, where \hat{y}_L is the production associated with the minimum goal that the individual would fail to attain, and it was defined in the proof of Proposition 1 (see equation B5).

Q.E.D.

Proof of Corollary 1

First note that if $g^* = g_L^{\text{PI}}$ or $g^* = g_H^{\text{PI}}$, the result follows straightforwardly from the definition of g_i^{PI} in Proposition 1.

If $g^* \in (g_L^{\text{PI}}, g_H^{\text{PI}})$, the high-ability worker (θ_H) attains the goal while the low-ability worker (θ_L) fails. Let us consider a level of monetary incentives α_1 that induces the equilibrium goal $g^*|\alpha_1$ and the corresponding level of efforts $e_L|\alpha_1$ and $e_H|\alpha_1$ satisfying first order conditions (1) and (2):

$$\begin{aligned}\alpha_1 \theta_H - e_H|\alpha_1 + \frac{\theta_H}{2} (\theta_H e_H|\alpha_1 - g^*|\alpha_1)^{-\frac{1}{2}} &= 0, \\ \alpha_1 \theta_L - e_L|\alpha_1 + \lambda \frac{\theta_L}{2} (g^*|\alpha_1 - \theta_L e_L|\alpha_1)^{-\frac{1}{2}} &= 0.\end{aligned}$$

Now let us consider a higher level of monetary incentives $\alpha_2 > \alpha_1$. It follows from Lemma 1(i) that, given goal $g^*|\alpha_1$, performance of both worker types will increase with α_2 . Since a goal higher than g^* would increase performance of the high type but decrease performance of the low type (Lemma 1(ii)), we can define the goal $\tilde{g} > g^*|\alpha_1$ such that performance of the low type would be the same as the equilibrium performance with monetary incentives α_1 :

$$\alpha_2 \theta_L - e_L|\alpha_1 + \lambda \frac{\theta_L}{2} (\tilde{g} - \theta_L e_L|\alpha_1)^{-\frac{1}{2}} = 0.$$

Therefore, note that goal \tilde{g} promotes performance of the high type while it does not undermine performance of the low type. Thus, under α_2 , $\tilde{g} > g^*|\alpha_1$ induces higher performance than $g^*|\alpha_1$ so it is preferred by the manager.

Q.E.D.

B.2. Model extension: general intrinsic utility and cost of effort functions

The purpose of our theoretical framework in Section 3 was to introduce a parsimonious model that fits our experimental environment. For the sake of simplicity and clarity of exposition we used reduced form functions to derive our theoretical hypotheses. Our model generalizes Wu et al. (2008) by incorporating the following elements into the analysis: imperfect information on ability levels, an extrinsic (i.e., monetary) utility function, and more importantly, a goal setting environment where the principal is in charge of setting goals. Nevertheless, Wu et al. (2008) uses general intrinsic utility and cost of effort functions instead of the functional forms used in our analysis. In this section we show the robustness of our main theoretical result (Proposition 1) regarding the manager's goal selection to the case of a general reference-dependent intrinsic utility function and a convex cost of effort function.

As in Wu et al. 2008, we consider the case of perfect information in which ability levels are known by the managers. In that case, we can assume without loss of generality that $\theta=1$, thus $y=e$ is the agent's performance on the work task. The following assumptions are based on Wu et al. (2008):

Assumption B.1 (Convex cost of effort). For all y , the cost function, $c(y)$ has the following properties: $c'(y)>0$ and $c''(y)>0$.

Assumption B.2 (Prospect theory intrinsic utility function). The intrinsic utility function, for a particular goal g , is given by $V_I(y-g)$ where $V_I(\cdot)$ is defined as follows:

- (i) $V_I(0) = 0$;
- (ii) $V'_I(y) > 0$;
- (iii) $V_I(y) < -V_I(-y)$ for $y > 0$;
- (iv) $V''_I(y) > 0$ for $y < 0$, and;
- (v) $V''_I(y) < 0$ for $y > 0$.

Thus, assumption B.2 captures the main prospect theory properties: (i) and (ii) imply that when performance is below the goal the worker experiences a “loss” and when performance is above the goal (s)he experiences a “gain” (*reference dependence*); (iii) implies that losses loom larger than gains (*loss aversion*) and (iv) and (v) imply that the intrinsic utility function is concave in the region of gains but convex in the region of losses (*diminishing sensitivity*). Note that the intrinsic utility function that we used in Section 3 satisfies all these properties.

Workers choose the level of performance that maximizes overall utility: $\alpha y + V_I(y-g) - c(y)$.

First, we check that our Lemma 1 still applies to this general framework:

Note that, given a goal g , the worker's optimal performance level is characterized by the following first order condition:

$$c'(y^*(g)) = \alpha + V'_I(y^*(g) - g). \quad (\text{B6})$$

By deriving both sides of (B6) with respect to g we get:

$$c''(y^*(g)) \frac{dy^*(g)}{dg} = V''_I(y^*(g) - g) \left(\frac{dy^*(g)}{dg} - 1 \right).$$

Thus,

$$\frac{dy^*(g)}{dg} = \frac{V_I''(y^*(g) - g)}{V_I''(y^*(g) - g) - c''(y^*(g))} .$$

Since second order conditions must hold for $y^*(g)$ (see the proof of Proposition 1 in Wu et al. (2008) for details) the denominator of this expression is negative ($V_I''(y^*(g) - g) < c''(y^*(g))$). Therefore, $\frac{dy^*(g)}{dg}$ and $V_I''(y^*(g) - g)$ must have opposite signs. Moreover, note that by Assumption B.2. (iv) and (v), $V_I''(y^*(g) - g) > 0$ (< 0) if and only if $y^*(g) < g$ ($y^*(g) > g$). This means that increasing a goal improves performance if the worker exceeds the goal (the goal is attainable) but decreases performance if the worker does not exceed the goal (the goal is not attainable).

We now derive the optimal goals assigned by the manager and the associated level of performance. In other words, we show the robustness of Proposition 1 to more general intrinsic-utility and cost functions. As we did in the proof of Proposition 1 we define by \hat{g} the minimum goal that the worker would fail to attain and by \hat{y} the corresponding performance (see Figure B.3).

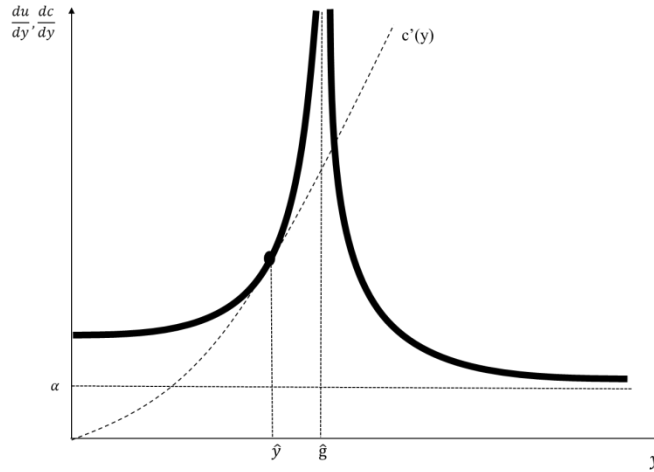


FIGURE B.3- Plot of \hat{g} and \hat{y} .

By deriving both sides of (B6) with respect to y we get:

$$c''(\hat{y}) = V_I''(\hat{y} - \hat{g}) \tag{B7}$$

We can compute \hat{g} and \hat{y} solving the system of equations:

$$c''(\hat{y}) = V_I''(\hat{y} - \hat{g})$$

$$c'(\hat{y}) = \alpha + V_I'(\hat{y} - \hat{g})$$

Finally, given the optimal goal $g^* = \hat{g} - \varepsilon$ with $\varepsilon \rightarrow 0$, we can obtain the optimal performance, $y^*(g^*)$, using the first order condition (B6):

$$c'(y^*(g^*)) = \alpha + V_I'(y^*(g^*) - g^*)$$

We illustrate this result in Figure B.4.

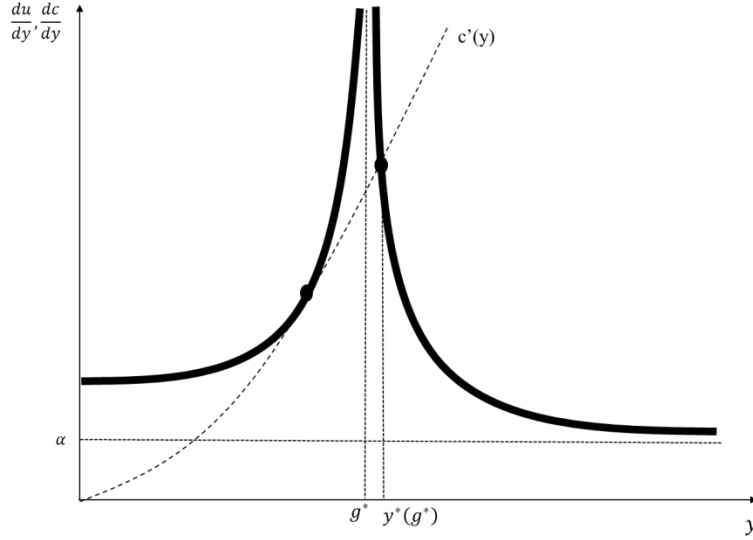


FIGURE B.4- Plot of g^* and $y^*(g^*)$.

B.3. Extension with reference earnings

The sum of extrinsic and intrinsic motivation is given by

$$u(y, g, \lambda, \alpha) = V_E(y, \alpha, R, s) + V_I(y, g, \lambda)$$

where

$$V_I(y_i, g, \lambda) = \begin{cases} (y_i - g)^{\frac{1}{2}} & \text{if } y_i > g, \\ -\lambda(-y_i - g)^{\frac{1}{2}} & \text{if } y_i \leq g. \end{cases}$$

and

$$V_E(y, \alpha, R, s) = \begin{cases} \alpha y & \text{if } \alpha y < R, \\ R + s(\alpha y - R) & \text{if } \alpha y \geq R. \end{cases}$$

Proof of Lemma 2

Note that if $g=0$ then $V_I(y, 0, \lambda) = V_I(y) = y^{1/2}$. Thus,

$$u(y, g, \lambda, \alpha) = V_E(y, \alpha, R, s) + V_I(y) = \begin{cases} \alpha y + y^{\frac{1}{2}} & \text{if } \alpha y < R, \\ R + s(\alpha y - R) + y^{\frac{1}{2}} & \text{if } \alpha y \geq R. \end{cases}$$

Worker's optimal effort is characterized by the following first order conditions:

$$\begin{cases} e_I^B = \alpha\theta + \frac{\theta}{2}(\theta e_I^B)^{-1/2} & \text{if } \alpha\theta e_I^B < R, \\ e_{II}^B = \frac{R}{\alpha\theta} & \text{if } \alpha\theta e_I^B \leq R \leq \alpha\theta e_{III}^B, \\ e_{III}^B = s\alpha\theta + \frac{\theta}{2}(\theta e_{III}^B)^{-1/2} & \text{if } \alpha\theta e_{III}^B > R. \end{cases}$$

We represent the non-monotonic relationship between effort and incentives in Figure B.5, where $\alpha_L^B = \{\alpha: e_I^B = e_{II}^B\}$ and $\alpha_H^B = \{\alpha: e_{II}^B = e_{III}^B\}$ are given by the following implicit equations:

$$\alpha_L^B \theta = \frac{R}{\alpha_L^B \theta} - \frac{\theta}{2} \left(\frac{R}{\alpha_L^B} \right)^{-1/2}, \quad s\alpha_H^B \theta = \frac{R}{\alpha_H^B \theta} - \frac{\theta}{2} \left(\frac{R}{\alpha_H^B} \right)^{-1/2}.$$

Q.E.D.

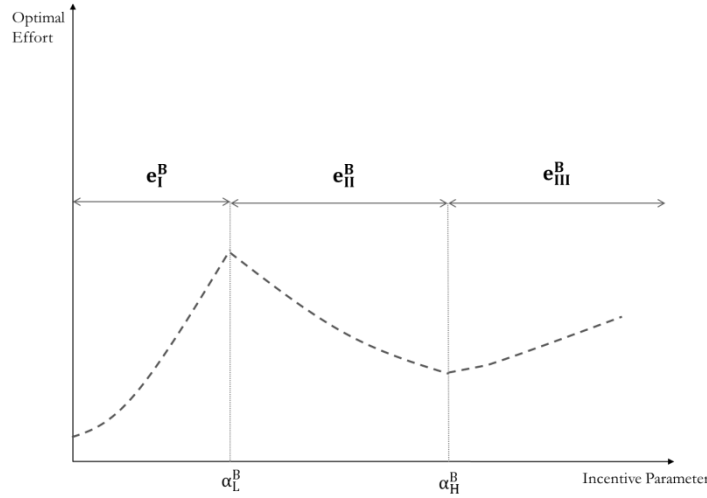


FIGURE B.5.- Optimal effort as a function of incentives (Baseline case).

In the goal setting case the agent's sum of intrinsic and extrinsic utility is given by:

$$u(y, g, \lambda, \alpha) = V_E(y, \alpha, R, s) + V_I(y, g, \lambda) = \begin{cases} \alpha y - \lambda(-y - g)^{1/2} & \text{if } y < \min\left\{\frac{R}{\alpha}, g\right\}, \\ R + s(\alpha y - R) - \lambda(-y - g)^{1/2} & \text{if } \frac{R}{\alpha} \leq y \leq g, \\ \alpha y + (y - g)^{1/2} & \text{if } g < y < \frac{R}{\alpha}, \\ R + s(\alpha y - R) + (y - g)^{1/2} & \text{if } y > \max\left\{\frac{R}{\alpha}, g\right\}. \end{cases}$$

Note that we have to consider two cases separately: (i) $g < R/\alpha$ (Lemma 3 in the main text) and (ii) $g \geq R/\alpha$.

Proof of Lemma 3

If $g < R/\alpha$ the worker maximizes

$$u(y, g, \lambda, \alpha) = V_E(y, \alpha) + V_I(y, g, \lambda) = \begin{cases} \alpha y - \lambda(-y - g)^{\frac{1}{2}} & \text{if } y \leq g, \\ \alpha y + (y - g)^{\frac{1}{2}} & \text{if } g < y < \frac{R}{\alpha}, \\ R + s(\alpha y - R) + (y - g)^{\frac{1}{2}} & \text{if } y \geq \frac{R}{\alpha}. \end{cases}$$

The worker chooses e so as to maximize $u(y, g, \lambda, \alpha) - c(e)$. Thus the FOC conditions are given by:

$$\alpha\theta + \lambda\frac{\theta}{2}(g - y)^{-\frac{1}{2}} = \frac{y}{\theta} \quad \text{if } y \leq g, \quad (\text{B8})$$

$$\alpha\theta + \frac{\theta}{2}(y - g)^{-\frac{1}{2}} = \frac{y}{\theta} \quad \text{if } g < y < \frac{R}{\alpha}, \quad (\text{B9})$$

$$s\theta\alpha + \frac{\theta}{2}(y - g)^{-\frac{1}{2}} = \frac{y}{\theta} \quad \text{if } y \geq \frac{R}{\alpha}. \quad (\text{B10})$$

We can compute the optimal y and g applying the same techniques that we used to solve Proposition 1. Thus, we calculate g^* as the maximum goal that the worker can attain and $y^* > g^*$ as the associated production (see Figure B.6).

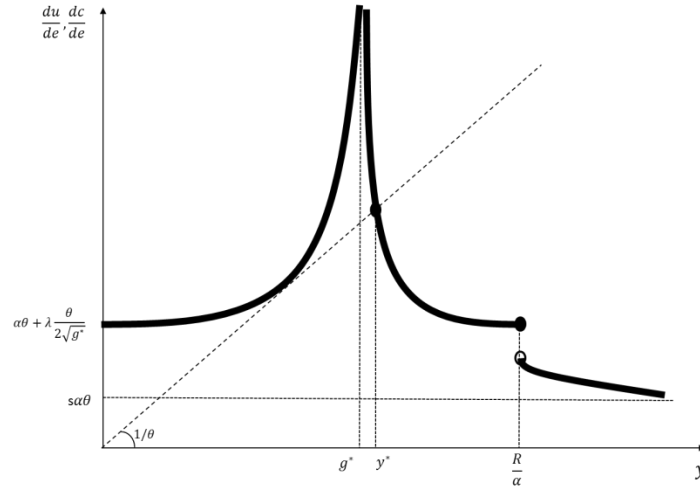


FIGURE B.6- Plot of g^* and y^* when $g < \frac{R}{\alpha}$.

As we did in Proposition 1, we obtain g^* by deriving both sides of (B8) with respect to y and, using (B9) we get:

$$g^* = \alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3}.$$

We can compute the worker's optimal effort using g^* as:

$$\begin{cases} e_I^{GS} = \alpha\theta + \frac{\theta}{2}(\theta e_I^{GS} - g^*)^{-1/2} & \text{if } \alpha\theta e_I^{GS} < R, \\ e_{II}^{GS} = \frac{R}{\alpha\theta} & \text{if } \alpha\theta e_I^{GS} \leq R \leq \alpha\theta e_{III}^{GS}, \\ e_{III}^{GS} = s\alpha\theta + \frac{\theta}{2}(\theta e_{III}^{GS} - g^*)^{-1/2} & \text{if } \alpha\theta e_{III}^{GS} > R. \end{cases}$$

We represent the non-monotonic relationship between effort and incentives in Figure B.7, where $\alpha_L^{GS} = \{\alpha: e_I^{GS} = e_{II}^{GS}\}$ and $\alpha_H^{GS} = \{\alpha: e_{II}^{GS} = e_{III}^{GS}\}$ are given by the following implicit equations:

$$\alpha_L^{GS}\theta = \frac{R}{\alpha_L^{GS}\theta} - \frac{\theta}{2}\left(\frac{R}{\alpha_L^{GS}} - g^*\right)^{-1/2}, \quad s\alpha_H^{GS}\theta = \frac{R}{\alpha_H^{GS}\theta} - \frac{\theta}{2}\left(\frac{R}{\alpha_H^{GS}} - g^*\right)^{-1/2}$$

Q.E.D.

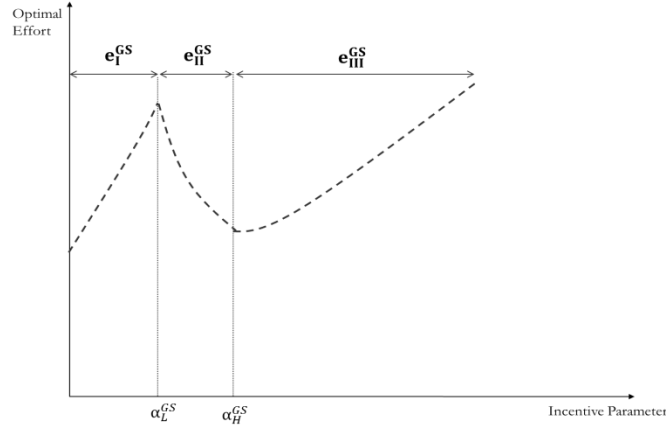


FIGURE B.7.- Optimal effort as a function of incentives (Goal setting case).

Proof of Corollary 2

It follows directly from Lemma 2 and Lemma 3.

Q.E.D.

In the following lemma we derive the optimal effort level with goal setting in case (ii) $g \geq R/\alpha$:

Lemma B2. Given parameters α , R , s , λ and θ the worker's optimal effort with goal setting ($g \geq R/\alpha$) is given by the following implicit equations:

$$\begin{cases} e_I^{GS} = \alpha\theta + \frac{\theta}{2}(\theta e_I^{GS} - g^*)^{-1/2} & \text{if } \alpha < \alpha_L^{GS}, \\ e_{II}^{GS} = \frac{R}{\alpha\theta} & \text{if } \alpha_L^{GS} \leq \alpha \leq \alpha_H^{GS}, \\ e_{III}^{GS} = s\alpha\theta + \frac{\theta}{2}(\theta e_{III}^{GS} - g^*)^{-1/2} & \text{if } \alpha > \alpha_H^{GS}. \end{cases}$$

where $\alpha_L^{GS}\theta = \frac{R}{\alpha_L^{GS}\theta} - \frac{\theta}{2}\left(\frac{R}{\alpha_L^{GS}} - g^*\right)^{-\frac{1}{2}}$, $s\alpha_H^{GS}\theta = \frac{R}{\alpha_H^{GS}\theta} - \frac{\theta}{2}\left(\frac{R}{\alpha_H^{GS}} - g^*\right)^{-\frac{1}{2}}$, and

$$g^* = \begin{cases} s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{\frac{2}{3}} & \text{if } \frac{R}{\alpha} < s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{\frac{2}{3}}, \\ \frac{R}{\alpha} & \text{if } s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{\frac{2}{3}} \leq \frac{R}{\alpha} < \alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{\frac{2}{3}}. \end{cases}$$

Proof of Lemma B2.

If $g \geq R/\alpha$ the worker maximizes

$$u(y, g, \lambda, \alpha) = V_E(y, \alpha) + V_I(y, g, \lambda) = \begin{cases} \alpha y - \lambda(-y - g)^{\frac{1}{2}} & \text{if } y \leq \frac{R}{\alpha}, \\ R + s(\alpha y - R) - \lambda(-y - g)^{\frac{1}{2}} & \text{if } \frac{R}{\alpha} \leq y < g, \\ R + s(\alpha y - R) + (y - g)^{\frac{1}{2}} & \text{if } y \geq g. \end{cases}$$

The worker chooses e so as to maximize $u(y, g, \lambda, \alpha) - c(e)$. Thus the FOC conditions are given by:

$$\alpha\theta + \lambda\frac{\theta}{2}(g - y)^{-\frac{1}{2}} = \frac{y}{\theta} \quad \text{if } y \leq \frac{R}{\alpha}, \quad (\text{B11})$$

$$s\theta\alpha + \lambda\frac{\theta}{2}(g - y)^{-\frac{1}{2}} = \frac{y}{\theta} \quad \text{if } \frac{R}{\alpha} \leq y < g, \quad (\text{B12})$$

$$s\theta\alpha + \frac{\theta}{2}(y - g)^{-\frac{1}{2}} = \frac{y}{\theta} \quad \text{if } y \geq g. \quad (\text{B13})$$

We can compute the optimal y and g applying the same techniques used to derive Proposition 1 and Lemma 3. Thus, we calculate g^* as the maximum goal that the worker can attain and $y^* > g^*$ the associated production (see Figure B.8). In this case we have either an interior ($g^* > R/\alpha$) or a corner solution ($g^* = R/\alpha$).

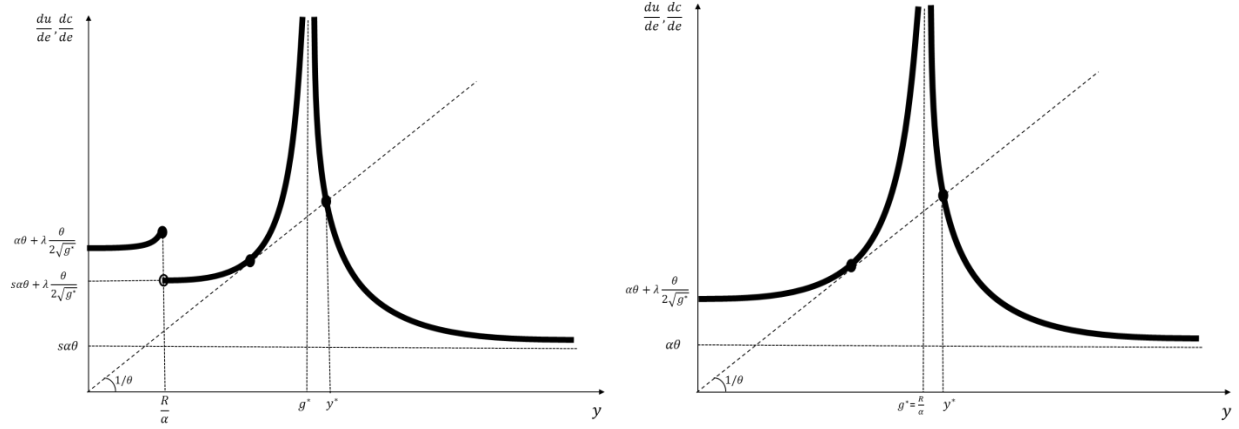


FIGURE B.8- Plot of g^* and y^* when $g^* > R/\alpha$ (left panel) and when $g^* = R/\alpha$ (right panel).

When $g < R/\alpha$, we know by Lemma 3 that:

$$g^* = \alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3}.$$

Similarly, when $g > R/\alpha$, g^* can be obtained by deriving both sides of (B12) with respect to y and, using (B13), we get:

$$g^* = s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3}.$$

Therefore, when $g \geq R/\alpha$ the optimal goal is given by:

$$g^* = \begin{cases} s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3} & \text{if } \frac{R}{\alpha} < s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3}, \\ \frac{R}{\alpha} & \text{if } s\alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3} \leq \frac{R}{\alpha} < \alpha\theta^2 + 3\left(\frac{\lambda\theta^2}{4}\right)^{2/3}. \end{cases}$$

We can compute the worker's optimal effort using g^* :

$$\begin{cases} e_I^{GS} = \alpha\theta + \frac{\theta}{2}(\theta e_I^{GS} - g^*)^{-1/2} & \text{if } \alpha\theta e_I^{GS} < R, \\ e_{II}^{GS} = \frac{R}{\alpha\theta} & \text{if } \alpha\theta e_I^{GS} \leq R \leq \alpha\theta e_{III}^{GS}, \\ e_{III}^{GS} = s\alpha\theta + \frac{\theta}{2}(\theta e_{III}^{GS} - g^*)^{-1/2} & \text{if } \alpha\theta e_{III}^{GS} > R. \end{cases}$$

Now, $\alpha_L^{GS} = \{\alpha: e_I^{GS} = e_{II}^{GS}\}$ and $\alpha_H^{GS} = \{\alpha: e_{II}^{GS} = e_{III}^{GS}\}$ are given by the following implicit equations:

$$\alpha_L^{GS\theta} = \frac{R}{\alpha_L^{GS\theta}} - \frac{\theta}{2} \left(\frac{R}{\alpha_L^{GS}} - g^* \right)^{-\frac{1}{2}}, \quad s\alpha_H^{GS\theta} = \frac{R}{\alpha_H^{GS\theta}} - \frac{\theta}{2} \left(\frac{R}{\alpha_H^{GS}} - g^* \right)^{-\frac{1}{2}}.$$

Q.E.D.

APPENDIX C (For Online Publication)
Debriefing Questionnaire

In the baseline [goal setting] treatment, we asked:

- When you were subject B, did you set a goal -number of correct tables- for yourself [which was different from the goal assigned to you by subject C]? (Yes/No)
- If so, please explain when and how you set that goal.

In the goal setting treatment, we asked:

- Which criteria did you use to set your goal to participant B when you were participant C?
- What do you think was the effect of your goal on participant B production? (1-very negative, ..., 7-very positive)
- What do you think was the effect of your goal on participant B motivation? (1-very negative, ..., 4-none, ..., 7-very positive)
- How would you feel if you had produced less than your goal?
- How would you feel if you had produced more than (or as much as your) goal?
- When you were participant C, was the goal you assigned to participant B affected by the goals (if any) you had been assigned by other participants in previous periods?

In half of the goal setting sessions, we also asked:

- What was your level of effort BEFORE achieving your goal? (1-very low, ..., 4-moderate, ..., 7-very high)
- What was your level of effort AFTER achieving your goal? (1-very low, ..., 4-moderate, ..., 7-very high)

APPENDIX D (For Online Publication)

Additional analyses

Goal setting effect controlling for dynamics

TABLE D.1. Poisson regression with random effects for production controlling for dynamics.

First half of the experiment	Coefficients
Intercept	1.451***
Goal Setting Dummy	0.089**
No Goal Dummy	0.083
Summation skills	0.043***
<u>Dynamics</u>	
Goal assigned in previous period	-0.004
Goal achieved in previous period ²⁷	-0.028
Role in previous period ²⁸	-0.002
Incentives in previous period	0.001
<u>Incentive dummies</u>	
Average incentives	0.094**
High incentives	0.143***
Number of observations	n = 336
Wald test	156.16
Prob > χ^2	<0.001

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

Goal setting effect controlling for social preferences

We elicited social preferences à la Bartling et al. (2009) by asking participants to make four choices between two possible allocations of money between themselves and another anonymous participant with whom they were randomly matched. The allocation decisions are described in Table D.2. Option A always yielded an even distribution of money (\$2 to the self and the other participant). Option B yielded uneven payoffs: (\$2, \$1), (3\$, \$1), (2\$, \$4), and (3\$, \$5) in Games 1, 2, 3 and 4, respectively. We classify participants following Bartling et al. (2009) into four social preferences categories as is described in the last column of the table. Prosocial types prefer to distribute income equal distributions even when they have the possibility to earn more than the other participants as is the case in Game 2. Envy types dislike earning less than the other participant and choose Option A in the last two games even if it implies a lower payoff to themselves (Game 4).

²⁷ This dummy variable takes value 1 if the goal was achieved in the previous period and value 0 otherwise.

²⁸ This dummy variable takes value 1 if the participant was assigned the role of worker in the previous period and value 0 otherwise.

TABLE D.2. Social preferences elicitation (Bartling et al. 2009).

Game	<u>Option A</u> Payoff self, Payoff other	<u>Option B</u> Payoff self, Payoff other	Social preferences type if choice is <u>Option A</u>
1	\$2,\$2	\$2,\$1	Prosociality
2	\$2,\$2	\$3,\$1	Costly Prosociality
3	\$2,\$2	\$2,\$4	Envy
4	\$2,\$2	\$3,\$5	Costly Envy

TABLE D.3. Poisson regression with random effects for production controlling for social preferences.

First half of the experiment	Coefficients
Intercept	1.378***
Goal Setting Dummy	0.101**
No Goal	0.049
Summation skills	0.042***
<u>Social preferences</u> ²⁹	
Prosociality	-0.015
Costly prosociality	0.070
Envy	-0.023
Costly Envy	-0.019
<u>Incentive dummies</u>	
Average incentives	0.108**
High incentives	0.146***
Number of observations	n = 384
Wald test	144.09
Prob > χ^2	<0.001

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

²⁹ Similar results are obtained if we classify participants as egalitarians, behind- and ahead-averse as is suggested in Bartling et al. 2009.