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IZA DP No. 11580

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Luke Boosey
Florida State University

Sebastian Goerg
TU Munich, IZA and Max Planck Institute for Research on Collective Goods

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IZA – Institute of Labor Economics

Schaumburg-Lippe-Straße 5–9
53113 Bonn, Germany

Phone: +49-228-3894-0
Email: publications@iza.org

www.iza.org

ABSTRACT

The Timing of Discretionary Bonuses: Effort, Signals, and Reciprocity*

In a real-effort experiment, we investigate how the timing of discretionary bonuses affects the relationship between workers and managers. Average output is substantially higher if bonuses are paid in the middle rather than upfront or at the end, as workers increase first-period output to signal trustworthiness. In contrast, average output does not differ when the decision is made at the beginning or end. When the decision is made upfront, output increases after receiving a bonus but decreases substantially, if the bonus is not paid. This is consistent with negative reciprocity by workers who anticipate, but do not receive a bonus.

JEL Classification: M5

Keywords: discretionary bonuses, timing, experiment, reciprocity

Corresponding author:
Sebastian Goerg
TU Munich
Schulgasse 22
94315 Straubing
Germany
E-mail: s.goerg@tum.de

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1 Introduction

An increasing share of employees in the U.S are compensated, not only using fixed wages and salaries, but also by payments that depend on performance (Oyer, 2004; Lemieux, MacLeod and Parent, 2009). These additional payments are often implemented in the form of non-linear incentive contracts, such as bonuses paid upon meeting a pre-specified, observable target, like an annual sales quota (Steenburgh, 2008) or some other objective performance thresholds (see, e.g., Oyer, 2000; Herweg, Müller and Weinschenk, 2010). Yet, in many cases, managers may be reluctant to commit to one particular performance measure, or an objective measure may not even be available (Prendergast, 1999). Thus, managers often revert to discretionary bonuses, which are based on subjective (non-contractible) measures. In theory, discretionary bonuses can increase performance via reputation or the threat of terminating the relationship (e.g., Bull, 1987; MacLeod and Malcomson, 1989; Levin, 2003) or by providing credible feedback to the workers (e.g., Suvorov and Van de Ven, 2009; Fuchs, 2015). Empirically, they have been found to influence workers' performances via reciprocity, or the mere expectation of reciprocal behavior (see, e.g., Fehr, Klein and Schmidt, 2007; Nosenzo et al., 2016). Experimental studies that examine discretionary bonuses usually focus on the case in which the bonus decision is made after the performance of the workers is observed. As such, the timing of the bonus has not previously been examined. While there are recent studies on the timing of wage increases (e.g., Sliwka and Werner, 2017), little is known about how the timing of bonuses affects workers' performances. In this study, we causally investigate this question by exogenously varying the timing of the manager's bonus decision in a controlled laboratory experiment.

Our real-effort experiment is designed to separately identify the effects of two particular channels through which a bonus might influence workers' incentives. The first channel is based on the traditional rationale that the bonus can serve as a *reward* for past performance. The second channel reflects a *trust* rationale, whereby the bonus may be paid to trigger a reciprocal increase in effort from the worker, i.e., a gift exchange (Akerlof, 1982). In our experiment, a manager and a worker interact for two periods, during which the worker can spend time completing a series of real effort tasks or pursuing a real leisure option. The worker is paid a fixed wage, independent of performance, while the manager's revenue increases with the worker's output. Absent any performance-contingent pay, the manager faces a standard moral hazard problem: the worker has an incentive to shirk and spend all of his time on the leisure activity. We provide the manager with the option to pay a one-time, fixed, discretionary bonus. Our treatments vary the timing at which the bonus decision must be made. In our Start treatment, the manager makes the bonus decision at the beginning of the first period, before any effort is exerted. In our Middle treatment, the manager makes the bonus decision between the two periods, after the worker's first period output has been observed. Finally, in our End treatment, the manager makes the bonus decision at the end of the two periods, after the worker has made all effort decisions and total output has been observed. In addition, we implement a CONTROL treatment in which the bonus is not available, to serve as a baseline.

In general, data collected from the field would not allow for the separate identification of the *reward* and *trust* channels. Most labor relationships involve lengthy repeated interactions, in which both channels can operate at once. Furthermore, the effects of the bonus in field data may be confounded by career concerns or other factors that influence worker effort and morale. By using a controlled laboratory experiment, and varying the timing of the bonus decision, we can isolate the effects of the two channels. In the START treatment, only the *trust* channel is operative, while in the END treatment, only the *reward* channel is relevant. In contrast, the MIDDLE treatment provides a setting in which both channels can operate at the same time (without other confounds), as in most real-world labor relationships.

The comparisons between our main treatments allow us to examine how the timing of the bonus decision interacts with fairness and reciprocity concerns to increase worker performance. Thus, in order to form predictions for the experiment, we develop a stylized conceptual framework that incorporates prosocial and reciprocal preferences. In particular, we borrow heavily from the *Revealed Altruism* framework developed by Cox, Friedman and Sadiraj (2008) and incorporate fairness and social efficiency concerns using the quasi-maximin utility function proposed by Charness and Rabin (2002). Although the model is relatively simple and stylized, it provides several insights that match the observed patterns of behavior.

Our results provide broad support for the key predictions derived from the conceptual model. In all treatments, including the CONTROL, we observe positive output, consistent with prosocial and reciprocal preferences. In the START and MIDDLE treatments, managers pay the bonus between 50% and 60% of the time, while in END the bonus is paid just 18% of the time. Moreover, we observe a strong positive correlation between payment of the bonus and overall output within each treatment.[1]

Our most important result is that average total output is substantially higher in MIDDLE than in START and END. Thus, total output is higher when both the reward and trust channels are operative. In contrast, overall output levels in START and END neither differ significantly from each other nor from the total output observed in CONTROL. That is, when the bonus only operates through one of the two channels, there is (on average) no benefit from a discretionary bonus mechanism at all.

Nevertheless, the underlying behavior differs between START and END. In END, although there are a few who are highly productive, workers produce output levels comparable with those in the CONTROL treatment. This is consistent with the expectation that managers are unlikely to pay the bonus, unless they produce exceptionally high output. Moreover, such expectations

[1] We emphasize correlation here since the treatment determines the direction of the causality. When the bonus is paid in START, it generates significantly higher outputs than when the bonus is not paid. In contrast, in END, the direction of causality is reversed and higher output leads to a higher likelihood of the bonus being paid.

appear to be rational, given that the few workers who receive the bonus produced very high outputs. In contrast, in START, average output is higher than in CONTROL when the bonus is paid, but *substantially lower* than in CONTROL when the bonus is not paid. That is, compared to our baseline, we find evidence of negative reciprocity towards the manager's decision to not pay the bonus. Our interpretation is that workers in START adjust their expectations to internalize the bonus, and experience disappointment, which diminishes their prosocial preference, when it is not paid. This interpretation coincides with the intuition for the equilibrium predictions derived within our conceptual framework.

Related literature. There is a vast body of empirical and experimental literature investigating incentives and labor relationships (for reviews see Charness and Kuhn, 2011; Lazear and Oyer, 2012; Camerer and Weber, 2013). Out of this large body of literature, our paper relates first and foremost to the literature on reciprocity and implicit, or incomplete, contracts. This literature investigates how generous wages or unannounced 'gifts' impact, at least temporarily, worker effort (see, e.g., Fehr, Kirchsteiger and Riedl, 1993; Fehr, Gächter and Kirchsteiger, 1997; Charness, 2004; Gneezy and List, 2006; Bellemare and Shearer, 2009; Cohn, Fehr and Goette, 2014). In experimental labor markets, worker effort typically increases when managers have access to discretionary rewards (see, e.g., Fehr, Klein and Schmidt, 2007; Choi, 2013; Falk, Huffman and MacLeod, 2015; Nosenzo et al., 2016).[2] In these studies, the timing of the bonus decision is usually fixed. For example, Fehr, Klein and Schmidt (2007) compare, in a laboratory setting, an explicit incentive contract with both a trust contract, in which the manager chooses a wage to be paid upfront, and an implicit bonus contract where, in addition to the wage, the manager chooses a (discretionary) bonus to be paid at the end. While the trust contract results in lower performance than the incentive contract, combining the wage with a discretionary bonus leads to higher performance. In contrast to Fehr, Klein and Schmidt (2007), we manipulate the timing of the bonus decisions and control whether the reward and trust rationales are active simultaneously or in isolation.

However, the positive effects of additional payments are not only the result of the monetary value of the gift. Indeed, previous literature suggests that the gesture of giving leads, on its own, to in-kind responses. For example, Kosfeld and Neckermann (2011) show that purely symbolic awards result in positive performance increases, while Kube, Maréchal and Puppe (2012) find that non-monetary gifts lead to stronger performance increases than wage increases with the same monetary value. With regards to the timing of unexpected wage increases, Ockenfels, Sliwka and Werner (2015*b*) demonstrate that splitting unexpected wage increases into incremental increases influences workers' performances more than one equivalent increase at the outset of the task. Similarly, Sliwka and Werner (2017) investigate the timing of wage adjustments and show that workers' performances are higher under gradually increasing wage

[2]For discussions of bonuses versus fines see Fehr and Schmidt (2007) and Nosenzo (2016).

profiles, if these profiles are unknown in advance. They conclude that overall performance is affected by varying the timing of wage increases. Our study complements this research by investigating the timing of discretionary bonus payments.

While our setup allows for potential positive responses to paid or anticipated bonuses, it also allows for negative effects.[3] In particular, an anticipated but unpaid bonus can be viewed as equivalent to a surprise wage cut. Kube, Maréchal and Puppe (2013) demonstrate that unexpected wage cuts result in negative performance adjustments and that these adjustments are stronger than the positive response to unexpected wage increases. In a similar vein, Brandts and Solà (2001) argue that a deviation from payoffs that serve as reference points can result in negative reciprocity.[4] Broader empirical evidence further supports the idea that missing out on an expected (or anticipated) bonus has negative effects. For instance, Ockenfels, Sliwka and Werner (2015*a*) show that, in a large multinational company, managers' satisfaction and subsequent performances fall significantly if they are not paid a bonus.

We contribute to this literature by demonstrating that the timing of bonuses matters. In short-term relationships, managers are best served by using an interim bonus mechanism. It increases overall output by leveraging both the trust and reward channels. However, workers tend to internalize anticipated bonuses and, thus, not being paid a bonus results in a severe drop in worker output. As such, when an upfront bonus mechanism is introduced, managers should either pay the bonus or expect negative responses by the workers. In addition, allowing for bonuses to be paid at the beginning or the end of the relationship does not necessarily increase output beyond the level obtained in a regular fixed-wage environment without bonuses.

The remainder of the paper is organized as follows. In Section 2, we outline the design and procedures of our experiment. Section 3 develops our conceptual framework and derives predictions for the experiment. All of our results and the accompanying discussion are presented in Section 4, and we provide concluding remarks in Section 5.

2 Experimental Design

The experiment consisted of two parts, referred to as Task 1 and Task 2. During Task 1, participants knew that there was to be a Task 2, but did not receive any details or instructions until after Task 1 was completed.

[3] Additional side effects of bonuses discussed in the literature include the (inefficient) strategic timing of effort (Asch, 1990; Oyer, 1998), incorrect financial statements (Burns and Kedia, 2006; Efendi, Srivastava and Swanson, 2007), and increased cheating or misreporting (Schweitzer, Ordóñez and Douma, 2004; Cadsby, Song and Tapon, 2010; Gill, Prowse and Vlassopoulos, 2013).

[4] A similar dependence on fair reference points is emphasized by Cohn, Fehr and Goette (2014), who show in a field experiment that workers reciprocate a wage increase with an increase in effort *only* when they perceive the original wage to be unfair (relative to some expectation of the fair market wage). Thus, they argue that the increase in effort is driven more by the removal of the perceived unfairness (and elimination of negative reciprocity towards the firm) than by the activation of positive reciprocity.

Task 1. The first part of the experiment was identical across treatments. In Task 1, each participant was given 20 minutes to work on a series of summation tables. Each summation table had 5 rows and 5 columns with an integer between 1 and 9 in each cell. To complete a summation table, the subject needed to correctly compute the sum of all numbers in each row, in each column, and in the whole table.[5] For every table correctly completed during the period, the participant earned 10 ECU.

This part of the experiment served multiple purposes. First, it allowed the participants to gain experience working on the summation tables before the main part of the experiment. Second, since participants were not assigned to roles until the beginning of Task 2, those who were assigned to be managers in Task 2 were already familiar with the difficulty of the summation task undertaken by the worker. Finally, the performances in Task 1 provides a rough ability measure for each subject. Using Task 1 performances we can control for differences in ability between subjects when analyzing the data from Task 2. In the following, we will refer to the number of correctly solved tables in Task 1 as our ability measure.

Task 2. At the beginning of Task 2, participants were randomly matched into pairs and assigned to roles. Each pair consisted of a manager and a worker, and interacted for two periods, each of which lasted for 20 minutes. Before the interaction began, the manager received an initial endowment of 250 ECU (experimental currency units), part of which was then automatically used to pay the worker a fixed wage of 150 ECU, leaving the manager with 100 ECU.[6] During each period, the worker could choose to work on the real effort task or spend time browsing the internet. Thus, we provided workers with a real "on-the-job" leisure option to complement the use of a real effort task.[7] Similar to Corgnet, Hernán-González and Schniter (2015), we used the above mentioned summation tables as the real effort task and allowed participants to switch back and forth between the work task and the internet option. Experiments without outside options have only reduced implicit effort costs, reducing the realism of the task as well as the sensitivity to incentives (Corgnet, Hernán-González and Schniter, 2015; Goerg, Kube and Radbruch, 2018).[8] Each summation table completed by the worker generated a payoff of 10

[5] An example summation table is included with the instructions in Appendix D. Note that there were no penalties for incorrect responses or limits on the number of attempts. However, participants could not proceed to the next table until the current table was correctly completed.

[6] The wage of 150 ECU covered both periods of the interaction, i.e., the worker did not receive 150 ECU in each period.

[7] Managers were also provided with the option to browse the internet during each period. In addition, in order to simulate a work task for the managers, we gave them a series of slider sets to work on. The task involved moving the arrow on each slider to the midpoint of each line. We emphasized to all subjects that the slider tasks did not generate any value for anyone.

[8] Participants could not engage in both activities at the same time. Specifically, when a worker clicked the 'Internet' button to open a web browser, the current summation table was automatically hidden from view. To switch back to the summation task, the worker had to click a 'Back to Task' button, which automatically closed any open web browsers and restored the current table. This feature also facilitated the measurement of time spent working versus time spent on the leisure activity.

Table 1. Summary of Treatments

Treatment	Sessions	Subjects	Independent Obs.
START	4	96	48
MIDDLE	4	98	49
END	4	88	44
CONTROL	5	92	46

ECU for the manager, but nothing for the worker.

In addition, the treatments were implemented in Task 2. In the START-, MIDDLE-, and END-treatments the manager was given the option to pay a one-time fixed bonus of 50 ECU to the worker. Our three main treatments varied the timing of the manager's bonus decision. In START, the decision was made before the first period began. In MIDDLE, the decision was made between periods, after the worker's first-period output was reported. In END, the decision was made after the second period was completed and total output was reported. In all treatments, the timing of the manager's bonus decision was common knowledge and the manager's decision was announced to the worker immediately after it was made. Thus, in the three main treatments, the worker could earn either 200 ECU, if the bonus was paid, or 150 ECU, if it was not. Using y to denote the total output produced by the worker, the manager's payoff was given by $100 + 10y$ if the bonus was not paid, or $50 + 10y$ if the bonus was paid. In addition to the three main treatments, we conducted a CONTROL treatment, in which no bonuses were paid and the manager did not make any decisions. In CONTROL, payoffs were 150 for the worker and $100 + 10y$ for the manager.

Procedures. We conducted 17 sessions (four sessions per main treatment and five sessions of CONTROL) with a total of 376 participants. Table 1 summarizes the number of sessions, participants and independent groups (pairs in Task 2) for the four treatments.[9] All sessions were conducted in the XS/FS Laboratory at Florida State University and subjects were recruited from a pool of undergraduate students across different majors using ORSEE (Greiner, 2015). The experiment was programmed and implemented using zTree (Fischbacher, 2007). Participants were randomly seated and provided with written instructions, which were then read aloud by the same experimenter. Each session lasted for approximately 100 minutes and the subjects earned on average $19.37 (in US dollars). Throughout the experiment, earnings were denominated in experimental currency units (ECU). Participants were paid the sum of their Task 1 and Task 2 payoffs. The total earnings were converted into US dollars at the end of the experiment using an exchange rate of 10 ECU = $0.40.

[9]The number of observations differs slightly between treatments because of no shows.

3 A Conceptual Model

In this section, we provide a stylized conceptual framework to illustrate how the bonus timing impacts reciprocity and how the workers can signal to the managers that they can be trusted to provide high output. The subsequent analysis provides some theoretical foundation for the experimental predictions introduced in Section 3.3.

3.1 The Model

Consider a manager, m, and a worker, w, who interact for two periods. Before the first period, the manager is given an endowment, E, and (automatically) pays the worker a fixed wage, W. In period $t = 1, 2$, the worker chooses output $y_t \in [0, \bar{y}]$. Each unit of output produced by the worker generates revenue, x, for the manager, but is costly to the worker (in terms of concentration or effort costs and forgone leisure). We assume that the cost function is convex, of the quadratic form, $c(y) = 0.5cy^2$, where $c > 0$ and $y = y_1 + y_2$ is total output across the two periods.

The manager has the option to pay the worker a one-time, fixed bonus, B. We let $a \in A = \{0, 1\}$ denote the manager's decision, where $a = 1$ indicates that she paid the bonus. The resulting material payoffs for the manager and worker are given, respectively, by

$$\pi_m = E - W - aB + xy,$$
$$\pi_w = W + aB - c(y).$$

Preferences. To keep the intuition relatively simple, we assume that the manager is a self-interested, profit-maximizing agent with no concern for social efficiency or reciprocity. In Appendix B, we discuss the impact of relaxing this assumption, by allowing for the manager to be prosocial (and reciprocal). In short, even if we allow for some prosocial and reciprocal managers, the environment is structured in such a way that predictions should not change substantially, unless managers are extremely prosocial.

In contrast, we assume that each worker can be either a selfish type or a prosocial type. We model the worker's preferences using the *Revealed Altruism* approach developed in Cox, Friedman and Sadiraj (2008). The worker's preferences are defined over the vector of material payoffs, (π_m, π_w) for the two players. The selfish type cares only about maximizing own material payoff, while the prosocial type possesses a preference for fairness and social efficiency. Moreover, in the spirit of Cox, Friedman and Sadiraj (2008), the prosocial type is also reciprocal, in the sense that the strength of her prosocial preference responds to the relative generosity of any previous actions taken by the other player.[10]

[10]Common models of other-regarding preferences are distributional (or consequentialist) models (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000), belief-dependent intentions-based models (Rabin, 1993; Dufwenberg

In order to capture the preferences of the prosocial type, we use the quasi-maximin utility function proposed by Charness and Rabin (2002). That is, the prosocial type's preferences are represented by the utility function

$$u(\pi_m, \pi_w) = \begin{cases} \pi_w + \gamma(1-\delta)\pi_m & \text{if } \pi_w < \pi_m \\ (1-\delta\gamma)\pi_w + \gamma\pi_m & \text{if } \pi_w \geq \pi_m, \end{cases}$$

with $\gamma \in [0, 1]$, $\delta \in (0, 1)$.[11] Let $\mathcal{P}$ denote the set of all Charness & Rabin (CR) preferences.

Following Cox, Friedman and Sadiraj (2008), we incorporate reciprocity by allowing for second-movers in a sequential game to acquire different preferences based on the generosity of the first-mover's action. We refer the reader to Cox, Friedman and Sadiraj (2008) for the full technical details of their approach. In brief, there are two key elements to the incorporation of reciprocity. First, they define a partial ordering, *more altruistic than* (MAT) on the set of preferences. Restricting attention to the class of CR preferences, they show that, for any two preferences $P, Q \in \mathcal{P}$, P MAT Q (on the full domain of payoff vectors, $\mathbb{R}^2_+$) if and only if

$$\gamma_P \geq \gamma_Q \max\left\{\frac{1}{1+\gamma_Q(\delta_P - \delta_Q)}, \frac{1-\delta_Q}{1-\delta_P}\right\}.$$

To further simplify our analysis, we assume that $\delta_P = \delta_Q = \delta_0$ for all admissible CR preferences.[12] With this assumption, the condition above reduces to P MAT Q if and only if $\gamma_P \geq \gamma_Q$. In other words, more altruistic preferences are equivalent to an increase in the relative weight placed on the welfare term (and thus a decrease in the relative weight on own material payoff).

The second key element of the approach in Cox, Friedman and Sadiraj (2008) is a partial ordering of *actions* in terms of generosity, *more generous than* (MGT). The basic idea is that actions of the first mover are judged in terms of the maximum potential payoffs they generate for the second mover. In our setting, this has the very natural implication that paying the bonus is always perceived to be more generous than not paying the bonus.

Combining these two key features, Cox, Friedman and Sadiraj (2008) introduce reciprocity as follows. For any two actions available to the first-mover, the more generous action results in the second-mover acquiring more altruistic preferences. Thus, in our environment, the worker would acquire preferences with a lower γ if the manager previously chose not to pay the bonus.

and Kirchsteiger, 2004; Falk and Fischbacher, 2006), and action-based reciprocity models (Cox, Friedman and Gjerstad, 2007). Refer to Cooper and Kagel (2016) for a survey of the experimental literature on other regarding preferences.

[11]For this class of preferences, utility is a weighted sum of own material payoff and a social welfare term $W(\pi_m, \pi_w)$. The parameter γ represents the relative weight placed on $W(\pi_m, \pi_w)$ instead of own material payoff. The social welfare term itself is a weighted sum of the worst-off player's payoff (representing a concern for fairness) and the sum of both players' payoffs (representing a concern for efficiency), with δ being the relative weight placed on the former.

[12]That is, the relative weight placed on the worst-off player's payoff rather than social surplus is fixed for all possible preference types.

Intrinsic preferences & reciprocity. We assume that the prosocial worker type has intrinsic prosocial preferences, $P_0 \in \mathcal{P}$, with corresponding preference parameters (γ_0, δ_0). Furthermore, when the worker is the first-mover (or the only mover) in the game, his preferences are P_0. Following Cox, Friedman and Sadiraj (2008), reciprocity only affects the worker's preferences when he moves after the manager made her bonus decision.

Thus, in our Control and End treatments, the worker's preferences are P_0. In the Start and Middle treatments, we let γ_B and γ_{NB} denote the preferences acquired by the prosocial worker after the bonus is paid and not paid, respectively. As discussed above, $\gamma_B \geq \gamma_{NB}$, which leads naturally to the prediction that output produced by the prosocial worker is higher after the bonus is paid than it is after the bonus is not paid.

However, since we want to be able to make comparisons between treatments, we also seek to understand how γ_B and γ_{NB} compare with the intrinsic parameter, γ_0. In this respect, Cox, Friedman and Sadiraj (2008) provide no explicit guidance. Consequently, we extend their framework in a very natural way to accommodate the required comparison.

First, consider the Start treatment. We compare the worker's payoff opportunity sets after each bonus decision in Start, to the payoff opportunity set faced by the worker in End, where he is the first-mover. In End, *at the time of his decision*, the worker faces a maximum *possible* payoff of $W + B$.[13] In Start, after the bonus is paid, the worker faces the same maximum possible payoff of $W + B$. As such, we assume that the worker acquires preferences $P_B = P_0$ after the bonus is paid in Start. In contrast, after the bonus is not paid, the maximum possible payoff for the worker is W, which implies that P_{NB} is such that $\gamma_{NB} < \gamma_0$.[14]

Second, consider the Middle treatment. At the beginning of the first period, the prosocial worker has intrinsic preferences P_0. The worker then chooses first-period output and, after observing this output, the manager chooses whether or not to pay the bonus. Since there is no more generous action available to the manager than paying the bonus, we assume that the worker's preferences remain P_0 after the bonus is paid. That is, if the manager takes the most generous action available to her, the prosocial worker does not become any less prosocial. In contrast, when the manager chooses not to pay the bonus ($a = 0$) in Middle, the worker acquires the less altruistic preferences, P_{NB}, as is the case in the Start treatment after the bonus is not paid.

This feature of our model extends beyond the scope of the approach in Cox, Friedman and Sadiraj (2008), although it borrows key insights from their framework. The key implication is that, within our conceptual framework, the decision not to pay the bonus in the Start and Middle treatments generates *negative reciprocity*, relative to the prosocial worker's intrinsic preferences, P_0. This implication is consistent with the intuition that workers internalize antici-

[13] Note that this is the case even if the worker rationally anticipates that the manager will not pay the bonus in End, since preferences only respond to the generosity of *past* actions taken by the manager.

[14] To simplify the exposition, we assume throughout the analysis that preferences become *strictly* less altruistic when the bonus is not paid, although the assumption is not required.

pated bonuses. That is, when the worker anticipates, but does not receive a bonus, it erodes his intrinsic prosocial preferences. Note that an alternative conjecture for our setup would be that the worker experiences an *increase* in the strength of his prosocial preference after the bonus *is* paid, especially given that the ex ante payoff structure puts the manager at an initial disadvantage relative to the worker.[15] However, in our view, the interpretation of negative reciprocity when the bonus is not paid is more congruent with the spirit of Cox, Friedman and Sadiraj (2008). Moreover, it is consistent with recent theory and evidence relating to the importance of anticipation and expectations for reciprocal behavior (Brandts and Solà, 2001; Kube, Maréchal and Puppe, 2013; Cohn, Fehr and Goette, 2014; Ockenfels, Sliwka and Werner, 2015*a*; Macera and te Velde, 2017).

Information. We assume that the prosocial type's intrinsic preference parameters (γ_0, δ_0) are common knowledge. Moreover, the parameters acquired by the prosocial worker after the bonus is paid, γ_B, and not paid, γ_{NB}, are also commonly known. Nevertheless, we introduce incomplete information by assuming that the manager does not know the worker's true type. Let $\mu \in (0, 1)$ denote the true fraction of selfish types in the population. Then, let q denote the manager's private belief about the probability that the worker is selfish, where q is drawn from a distribution $F(\cdot)$ on $[0, 1]$ with mean μ. Although beliefs are private information, we assume that the distribution $F(\cdot)$ is commonly known.

3.2 Equilibrium Analysis

Next, we consider the equilibrium behavior in each of the extensive form games generated by our treatments. As a baseline, we start with the Control treatment in which the bonus is not made available to the manager. In this case, only the worker makes a decision.

The Control treatment. Let y^c denote the output chosen by the worker in Control. For the selfish type, the optimal effort is obviously $y^c = 0$. On the other hand, the prosocial type chooses the optimal output, given his intrinsic preference P_0. Thus, the prosocial type chooses output to solve

$$\max_{y} \quad u_0(\pi_m(0, y), \pi_w(0, y)).$$

Let y^* denote the solution to this maximization problem. We provide a full characterization of the solution in Appendix A. However, the key, intuitive observation is that y^* is (weakly) increasing in γ_0. Based on the true probability of the selfish type, μ, the expected output in

[15] At the beginning of the interaction, the worker receives the wage of 150 ECU, while the manager retains only 100 ECU of their endowment.

Control is then given by

$$\mathbb{E}[y^c] = (1 - \mu)y^*.$$

We use this as a benchmark against which to compare the expected equilibrium output in the other three treatments.

The End treatment. The analysis for the End treatment is also very straightforward, since the manager has no opportunity to display trust and the worker has no opportunity to reciprocate when the bonus decision is made at the end. Let y^e denote the output produced by the worker in End. Since the manager is a selfish, own-payoff maximizer, her optimal strategy is to not pay the bonus ($a = 0$), regardless of the output produced by the worker. Using backwards induction, the worker faces the same problem as in Control. The selfish type chooses $y^e = 0$. Furthermore, if he is the prosocial type, the worker has preferences P_0 and faces the exact same maximization problem as in Control, for which the optimal output is $y^e = y^*$. It follows that expected output in End is the same as in Control,

$$\mathbb{E}[y^e] = (1 - \mu)y^*.$$

Note that assuming the manager is always the selfish, payoff-maximizing type effectively precludes the *reward* rationale for paying the bonus. However, even if we allow for some reciprocal, prosocial types, provided their preference is not too strong, the bonus will only be paid if the worker produces exceptionally high output. Moreover, such high output will only be produced if the worker has extremely low effort costs, or an extremely high subjective belief that the manager is a prosocial type.

The Start treatment. In this case, reciprocity plays an important role, since the worker is the second-mover in the game. As such, the trust channel is highly relevant, while the reward channel is inactive. Consider the worker's optimal output after the bonus is not paid, which we denote by $y^s(0)$. The selfish type chooses $y^s(0) = 0$, while the prosocial type solves

$$\max_y \quad u_{NB}(\pi_m(0, y), \pi_w(0, y)),$$

where $u_{NB}(\pi_m(0, y), \pi_w(0, y))$ is defined for the preferences P_{NB} with $\gamma_{NB} < \gamma_0$. As shown for the characterization of y^* in Appendix A, the solution to this maximization problem is an increasing function of the preference parameter, γ. Thus, it follows that for the prosocial type in Start, $y^s(0) \leq y^*$.

After the bonus is paid, the worker's optimal output, $y^s(1)$, is also 0 for the selfish type.

The prosocial type, on the other hand, solves

$$\max_{y} \quad u_0(\pi_m(1,y), \pi_w(1,y)).$$

Since the bonus payment increases the worker's payoff and reduces the manager's payoff, it is straightforward to show that the solution to this problem is higher than y^*. Thus, for the prosocial type in Start, $y^s(1) > y^*$. As for the case of y^*, we provide the full characterization of $y^s(1)$ in Appendix A.

Working backwards to the manager's decision, the manager will prefer to pay the bonus if and only if the expected difference in total output after paying the bonus versus after not paying the bonus generates at least enough revenue to cover the bonus. That is, the manager will pay the bonus if and only if

$$(1-q)(y^s(1) - y^s(0)) \geq \frac{B}{x}.$$

Rearranging and defining $\Delta y^s = y^s(1) - y^s(0)$ gives

$$q \leq 1 - \frac{B}{x \Delta y^s}.$$

Thus, the bonus will be paid only when the manager's belief that the worker is selfish is sufficiently low, allowing them to trust the worker to provide high effort. Notice also that the bonus will never be paid if $\Delta y^s \leq B/x$. Thus, in order to focus on the non-trivial implications of reciprocity, we make the following assumption.

Assumption 1. *The optimal total output levels for the prosocial worker satisfy*

$$\Delta y^s = y^s(1) - y^s(0) > \frac{B}{x}.$$

Assumption 1 ensures that, at the very least, when the manager knows the worker is prosocial with certainty, she will find it profitable to pay the bonus. Given the distribution for q, the probability that the bonus is paid is given by $F\left(1 - \frac{B}{x\Delta y^s}\right)$. Then the expected total output in Start is

$$\mathbb{E}[y^s] = (1-\mu)\left[y^s(0) + F\left(1 - \frac{B}{x\Delta y^s}\right) \cdot \Delta y^s\right].$$

The comparison between $\mathbb{E}[y^s]$ and $\mathbb{E}[y^e]$ is ambiguous. Depending on the probability the bonus is paid and the relative differences between $y^s(1)$, y^*, and $y^s(0)$, it is possible to have expected total output be higher or lower than $(1-\mu)y^*$. Thus, we consider it an empirical question whether average total output will be higher in Start than in End or Control. However, we show next that the expected total output in the Middle treatment is unambiguously higher than expected total output in Start.

The Middle **treatment.** In this case, worker reciprocity again plays an important role. However, unlike in the Start treatment, the worker can also use first-period output to send a signal about his type to the manager before she makes her bonus decision. Thus, the worker has the opportunity to signal that he can be trusted to generate a high output in the second period if the bonus is paid. Given the assumption that the manager is a selfish, payoff-maximizer, the only reason why the manager will pay the bonus in Middle is if it ensures that expected second-period output will be sufficiently higher after the bonus than after no bonus. In what follows, we use the Perfect Bayesian Equilibrium solution concept in the game induced by the Middle treatment. The manager updates her beliefs about the worker's type and how much she can trust the worker to provide a high output based on the observed first-period outputs. As a result, there can be separating equilibria, in which the workers signal their types with different first period outputs, or pooling equilibria, in which selfish and prosocial types produce the same first period output. In what follows, we will focus on the pooling equilibria. In Appendix A.4, we provide the analysis for the separating equilibria and show that, given our choice of experimental parameters and a reasonable assumption about effort costs, a separating equilibrium is unlikely to emerge.

Let $y_1^m > 0$ denote the first-period output, which serves, in principle, as a signal about the worker's type. We consider the pooling equilibria in which the selfish and prosocial types pool on the same first-period output, y_1^m. This means that managers cannot update their beliefs about the worker's type. In the second period, the selfish type produces $y_2 = 0$, regardless of the bonus decision. Following the same argument as in the analysis for separating equilibria, the prosocial type chooses $y_2^m(1, y_1^m) = \max\{0, y^s(1) - y_1^m\}$ after the bonus is paid, and $y_2^m(0, y_1^m) = \max\{0, y^s(0) - y_1^m\}$ after the bonus is not paid. Thus, the manager chooses to pay the bonus if and only if

$$q \leq 1 - \frac{B}{x\Delta y_2^m(y_1^m)},$$

where $\Delta y_2^m(y_1^m) = y_2^m(1, y_1^m) - y_2^m(0, y_1^m)$. At this stage, it is useful to introduce another assumption.

Assumption 2. *Suppose that the distribution of manager's beliefs $F(\cdot)$, and the preference parameters γ_0 and γ_{NB} are such that*

$$y^s(0) \leq \left[\frac{2B}{c} F\left(1 - \frac{B}{x\Delta y^s}\right)\right]^{0.5}.$$

This assumption guarantees that, if $y_1^m \leq y^s(0)$ and thus $\Delta y_2^m(y_1^m) = \Delta y^s$, then the selfish type will not prefer to choose $y_1 = 0$ rather than y_1^m. There exists an upper bound on how high first-period output (the signal y_1^m) can be before the selfish type prefers to separate and produce nothing. Assumption 2 simply ensures that the upper bound is high enough to ensure that an equilibrium exists. As such, it is a sufficient (although not necessary) condition for existence of the pooling equilibria described in the next proposition.

Proposition 1 characterizes all of the pooling equilibria in which $y_1^m \leq y^s(0)$, for the game generated by the Middle treatment.

Proposition 1. *Suppose that Assumption 2 is satisfied. Then, in the game generated by the* Middle *treatment, for any $y_1^m \in [y^s(1) - \bar{y}, y^s(0)]$, there exists a pooling equilibrium in which*

(i) both the selfish and prosocial types of worker choose $y_1 = y_1^m$

(ii) the selfish type chooses $y_2 = 0$, regardless of the bonus decision,

(iii) the prosocial type chooses $y_2^m(1, y_1^m) = y^s(1) - y_1^m$ and $y_2^m(0, y_1^m) = y^s(0) - y_1^m$

(iv) and the manager chooses $a = 1$ if and only if $q \leq 1 - \frac{B}{x\Delta y^s}$.

Several key observations can be made from Proposition 1. First, the condition under which the manager chooses to pay the bonus is identical to the condition for the Start treatment. As such, the expected frequency of the bonus being paid should be identical for Start and for Middle. Second, the equilibrium level of total output can be calculated as follows,

$$\mathbb{E}[y^m] = (1 - \mu) \left[F\left(1 - \frac{B}{x\Delta y^s}\right) \Delta y^s + y^s(0) \right] + \mu y_1^m = \mathbb{E}[y^s] + \mu y_1^m.$$

Thus, expected total output is strictly higher in Middle than in Start, for any pooling PBE in the game generated by the Middle treatment. Furthermore, the increase in expected total output is driven entirely by the signaling output produced by the selfish types in the first period of the interaction.

To summarize, in the Middle treatment, expected total output is higher than in Start. This also holds for the separating equilibria analyzed in Appendix A.4. In short, the informative signal in the separating equilibria allows for the efficient payment of bonuses only to prosocial types, which raises the expected total output. In the pooling equilibria, there is no informative signaling, but the selfish types must produce sufficient first-period output in order to pool with the prosocial types, which raises expected overall output.

3.3 Experimental Predictions

To aid with the exposition, we summarize the experimental predictions arising out of the preceding theoretical analysis. Note that since subjects are randomly assigned to treatments, the predictions are made under the assumption that the distribution of intrinsic preference parameter types among the subjects who are workers is the same across all of our treatments.

Our first prediction concerns the frequency with which the bonus is paid. In End, the bonus is never paid in equilibrium, while in Middle and in Start, the equilibrium expected frequency of the bonus is strictly positive. Moreover, if the two types of workers play according to a pooling equilibrium in Middle, the frequency of the bonus should be the same in Middle and Start.[16]

Prediction 1. *The bonus is paid more frequently in* Middle *and* Start *than in* End*. Moreover, assuming players follow the pooling equilibrium in* Middle*, the frequency of the bonus is the same for* Start *and* Middle*.*

The remaining predictions concern output. As shown in the previous section, expected total output is equal to $(1-\mu)y^*$ in both the Control treatment and the End treatment. This leads to our second prediction.

Prediction 2. *Average total output is the same for* Control *and* End*.*

Third, whether using the separating equilibria or pooling equilibria to provide predictions for Middle, expected total output is higher than in Start, based on the comparison of $\mathbb{E}[y^m]$ and $\mathbb{E}[y^s]$.

Prediction 3. *Average total output is higher in* Middle *than in* Start*.*

Fourth, consider the comparison between Start and Control. According to our conceptual model, (expected) equilibrium total output after the bonus is not paid in Start should be lower than in Control, where the bonus is not even introduced, due to the negative reciprocity associated with the manager's deliberate decision not to pay the bonus. At the same time, (expected) equilibrium total output after the bonus is paid in Start should be higher than in Control, due to the prosocial worker's intrinsic preferences for fairness and efficiency.

Prediction 4. *Average total output in* Start *is higher (lower) after the bonus is paid (not paid) than it is in* Control*.*

This prediction captures the key implication of our extension to the framework in Cox, Friedman and Sadiraj (2008); that workers internalize the anticipated bonus, and reciprocate negatively to the manager's decision not to pay the bonus.

4 Results

We begin by examining the bonus decisions made by managers in the three main treatments. We then compare average total output across treatments and analyze the differences between

[16] If workers play according to a separating equilibrium in Middle, it is unclear whether the frequency of the bonus will be higher or lower than in Start. However, given our experimental parameters and a reasonable cost parameter, c, the condition required for a separating equilibrium is unlikely to be satisfied in our setting.

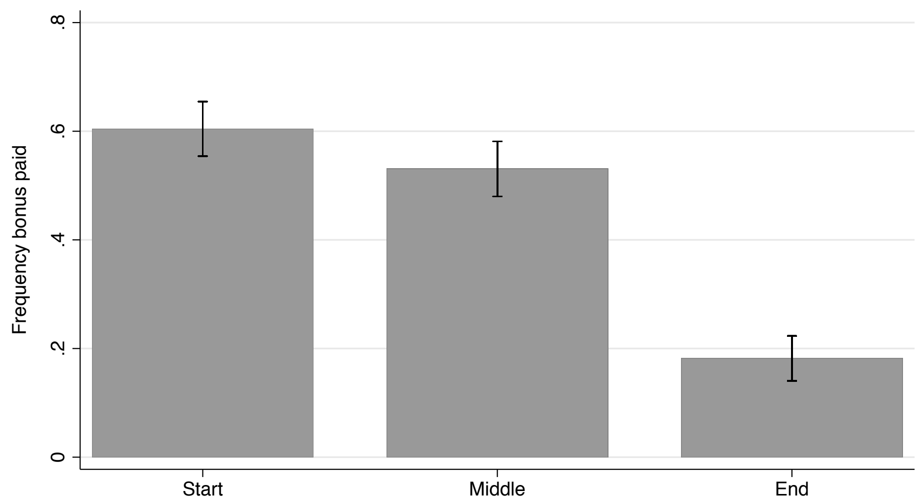

Figure 1. Frequency of the Bonus by Treatment

total output when the bonus is paid and not paid. Following the main results for total output, we show that results exhibit a very similar pattern when the outcome variable of interest is time spent on the work task (or the leisure activity), rather than output produced. Throughout the analysis, unless otherwise specified, each manager-worker pair represents one independent observation.

4.1 Bonus decisions

Figure 1 shows the fraction of bonuses paid across the three exogenous treatments. Consistent with Prediction 1, managers paid the bonus significantly less often in End (8 out of 44 managers) than in either of Start (29 out of 48) or Middle (26 out of 49). Using the Fisher's exact test, we confirm significant differences for Start vs. End ($p = 0.000$) and Middle vs. End ($p = 0.001$). However, there are no significant differences in the frequency of the bonus between Start and Middle ($p = 0.541$).

In Table 2, we report the marginal effects for Probit regression models. In all of the models, the dependent variable is the probability of the bonus being paid, Pr[bonus]. In Model (1), we confirm the treatment differences reported above. Both the Start and Middle treatments significantly increase the probability of the bonus, compared to the End treatment (the omitted category). In Models (2)–(4), we consider the three treatments separately. For the Middle and End treatments (Models (3) and (4), respectively), we include Observed Output as an explanatory variable.[17] We include Manager's Ability as an explanatory variable, to control for the possibility that managers with higher ability (as measured by Task 1 performance) might

[17]Note that Observed Output is Period 1 Output in Middle and Total Output in End.

have higher output standards, and might therefore be less likely to pay the bonus.

Table 2. Probit Regression: Explaining the Manager's Bonus Decision

	(1) Overall	(2) START	(3) MIDDLE	(4) END
MIDDLE	-0.0527			
	(0.101)			
END	-0.389***			
	(0.0879)			
Manager's Ability	-0.0255	-0.0166	-0.0393	-0.00604
	(0.0165)	(0.0287)	(0.0277)	(0.0134)
Observed Output			0.0476*	0.0285***
			(0.0256)	(0.0103)
Pseudo R-squared	0.117	0.006	0.087	0.286
Observations	141	48	49	44

Marginal effects with robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.10

The coefficient estimates indicate that Manager's Ability has no statistically significant effect on the probability of the bonus, either overall or in any of the treatments. On the other hand, as expected, the probability of the bonus in MIDDLE is increasing in the worker's first period output ($p = 0.064$), while the probability of the bonus in END is strongly, significantly increasing in the worker's total output ($p = 0.000$). In line with our Prediction 1, we conclude our first result:

Result 1. *The bonus is paid significantly less often in the* END *treatment than in the* START *or* MIDDLE *treatments. The frequency of bonuses paid in* START *and* MIDDLE *does not differ significantly.*

While these results are in line with Prediction 1, they say nothing regarding the reason for the differences in bonus frequencies. For instance, the lower frequency of the bonus in END might be due to the opportunistic behavior of the managers, or an indication that overall output levels were very low in END, compared with the other treatments. In the next section, we show that the former is the more likely explanation, since average output levels are (comparatively speaking) no lower in the END treatment than in the START treatment.

4.2 Total Output

We begin this section by comparing average total output across treatments. Table 3 shows that average and median total output is highest in the MIDDLE treatment, and very similar between CONTROL, START, and END.[18] Consistent with Prediction 2, we find no significant

[18]Refer to Table C.1 in the Appendix for the mean and median by period.

Table 3. Worker Output by Treatment

	CONTROL	START	MIDDLE	END
Mean	7.74	7.54	9.98	8.30
Median	5	7.5	9	8.5
SD	7.55	6.21	5.74	5.63
Observations	48	49	44	46

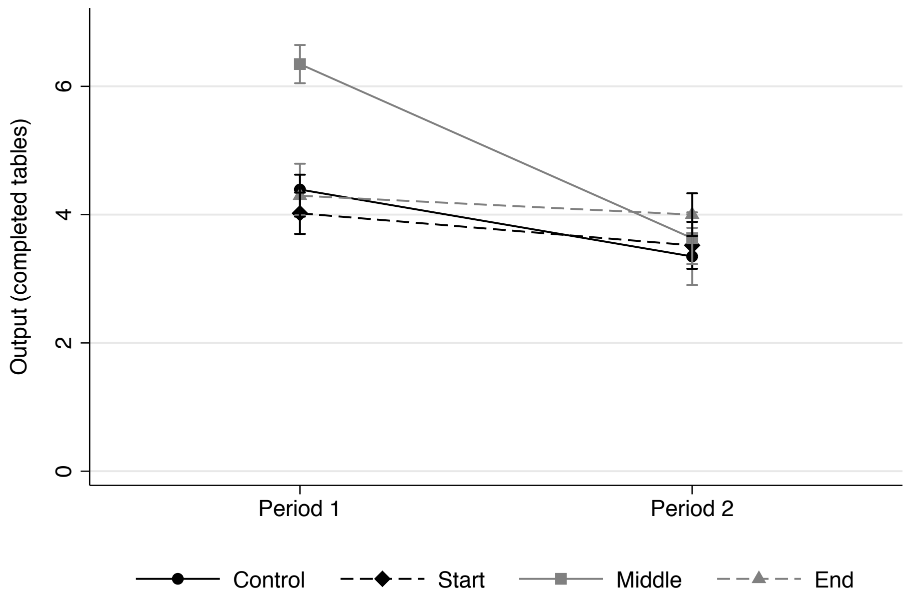

Figure 2. Output over time by Treatment

difference between END and CONTROL ($p = 0.294$, Wilcoxon ranksum test). In addition, we find no significant differences between any of the other pairwise comparisons involving START, END, and CONTROL. Consistent with Prediction 3, average total output is significantly higher in MIDDLE than in START ($p = 0.056$).[19]

Further evidence is provided by Figure 2, which presents average output over time. The figure shows that the higher average total output in MIDDLE is driven by first period output. Output in the first period is significantly higher in MIDDLE than in all other treatments (all $p < 0.01$, Wilcoxon ranksum test) while output in the second period does not differ significantly between any treatment (all pairwise comparison with $p > 0.19$).[20] This is consistent with the equilibrium analysis provided by our conceptual model in Section 3.2. In particular, in a pooling

[19] We also find that output is significantly higher in MIDDLE than in CONTROL, with $p = 0.007$, and higher in MIDDLE than in END, although the difference is not statistically significant ($p = 0.305$).

[20] In the first period, average output levels in START, END, and CONTROL do not differ significantly (all $p > 0.62$).

Table 4. OLS: Treatment Effects on Worker Output

	Total Output	Output per Period		
	(1)	(2)	(3)	(4)
START	0.471	0.235	0.235	-0.580
	(1.251)	(0.622)	(0.623)	(0.982)
MIDDLE	2.615**	1.308**	1.308**	3.814***
	(1.142)	(0.568)	(0.569)	(1.047)
END	-0.107	-0.0535	-0.0535	-1.176
	(1.280)	(0.636)	(0.637)	(0.980)
Worker's Ability	0.959***	0.480***	0.480***	0.480***
	(0.163)	(0.0809)	(0.0810)	(0.0813)
SecondPeriod			-1.166***	-1.043**
			(0.242)	(0.455)
START × SecondPeriod				0.543
				(0.596)
MIDDLE × SecondPeriod				-1.671**
				(0.738)
END × SecondPeriod				0.748
				(0.600)
Constant	1.297	0.648	2.397***	2.214***
	(1.059)	(0.527)	(0.656)	(0.829)
R-squared	0.236	0.182	0.207	0.225
Observations	187	374	374	374
Cluster		187	187	187

CONTROL serves as the omitted baseline, robust standard errors in parentheses
Models 2–4 include clusters on the subject level
*** p<0.01, ** p<0.05, * p<0.1

equilibrium, both selfish and prosocial worker types should work relatively harder in the first period, in order to signal that they are the prosocial (reciprocal) type. In the second period, the selfish types should shirk, prosocial types who do not receive the bonus should produce little (or nothing) due to the negative reciprocity generated by the manager's decision, and only the prosocial types who receive the bonus should continue to produce (at a similar level) in the second period. These findings are all in line with Predictions 2 and 3.

Finally, support for these results is also provided by additional regression analyses. In Model (1) of Table 4 we estimate the effects of the different treatments on the total output while controlling for a worker's ability. Models (2) – (4) report estimates based on output in a single period. All models include controls for workers' ability and they indicate that a worker's ability has a positive, statistically significant effect on total output. Moreover, Model (1) shows that, after controlling for workers' ability, total output is significantly higher in MIDDLE than in CONTROL (p = 0.023), START (p = 0.052), and END (p = 0.014). Model (2) confirms these results based on the per-period output. The coefficient estimates are also robust to the introduction of a SecondPeriod dummy variable in Model (3), which has a significant negative effect, as suggested by Figure 2. Furthermore, adding the interaction terms between treatment and period in Model (4) confirms that the treatment effects are realized in the first period, when workers in MIDDLE generate (on average) about two more tables than in the other three treatments. We summarize our findings with the following result.

Result 2. *Average total output is significantly higher in* MIDDLE *than in all other treatments. This is mostly driven by higher output in the first period. Average output does not differ significantly between the* START*,* CONTROL*, and* END *treatments, overall, or in either period.*

4.3 Total Output separated by Bonus Decision

In this section, we explore the relationship between the manager's bonus decision and the worker's output decisions. First, we compare average total output across treatments, conditional on the bonus decision. Figure 3 shows the average total output for each treatment, both when the bonus is paid, and when it is not paid.[21] For the purposes of comparison, we also include the CONTROL treatment, where the bonus was not available.

First, notice that within each treatment, there is strong positive correlation between total output and the decision to pay the bonus (in all three bonus treatments: $r > 0.46$ and $p < 0.01$, point biserial correlation).[22] In each treatment, the average total output for workers with a bonus is significantly higher than for workers without the bonus (all $p < 0.01$, Wilcoxon ranksum test). In all three of the main treatments, the difference is greater than five tables, which corresponds to the output value of the bonus. A second interesting observation is that the highest average total output is observed when the bonus is paid in the END treatment. However, this should be expected, since the bonus decision is made after total output is observed, and thus, even if some managers are prosocial and reciprocal, in the few cases where the bonus is paid, it should only be paid because total output was very high.[23]

The most important results illustrated by Figure 3 are concerned with Prediction 4. Compared with average output in CONTROL, we find that average output in START is higher when the bonus is paid ($p = 0.034$, Wilcoxon ranksum test), but *substantially lower* when the bonus is not paid ($p = 0.014$). This provides strong support for Prediction 4. While the increase in average total output after the bonus is paid could be explained by other-regarding concerns and positive reciprocity, the decrease after the bonus is not paid can only be explained by negative reciprocity, consistent with our conceptual framework. This result is especially strong, considering that our experimental design places the manager at an ex-ante disadvantage with respect to the material payoffs. As such, the alternative conjecture that workers are sympathetic to (or

[21] Table C.2 in Appendix C reports the average output by treatment and by bonus decision, both overall and by period.

[22] Again, we emphasize correlation here since the treatment determines the direction of the causality.

[23] For completeness, the total number of tables produced by the workers who received the bonus in END were 10, 10, 12, 13, 15, 15, 18, and 18. That is, no manager was willing to pay the bonus in END unless it resulted in *at least* an equal share of the revenue generated by the worker's output.

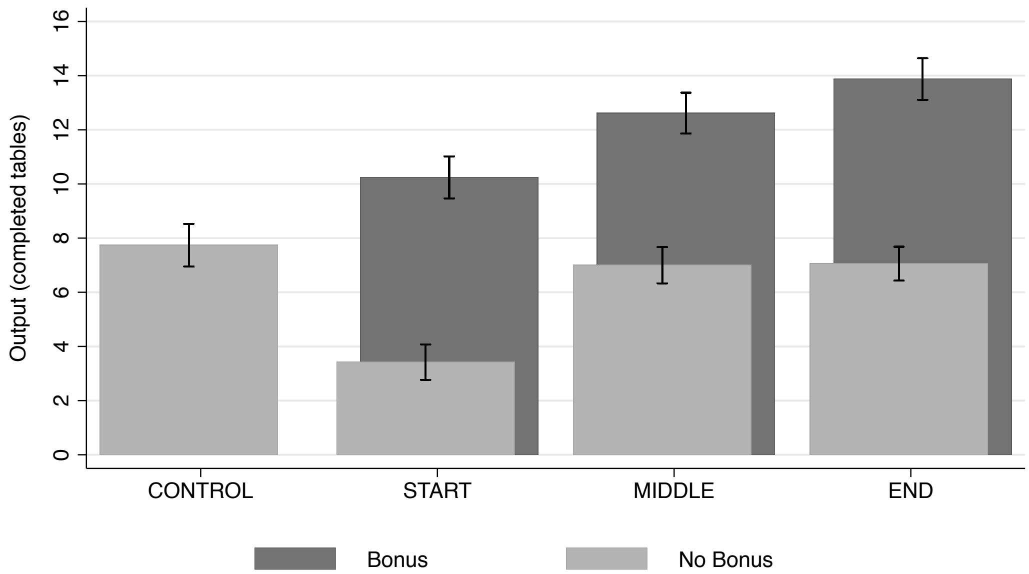

Figure 3. Average Total Output by Bonus Decision

at least less likely to blame) a manager who chooses not to pay the bonus in START is not well supported. Our results indicate that even when this consideration is plausible, the prosocial preferences of the workers still sour when the bonus is not paid. We summarize these findings in the following result.

Result 3. *Compared with the* CONTROL *treatment, average total output in* START *is significantly higher when the bonus is paid, but also significantly lower when the bonus is not paid, consistent with Prediction 4 and with the influence of negative reciprocity on the workers' prosocial preferences.*

Finally, we compare the worker output levels in each period of the MIDDLE treatment after the bonus is paid and not paid, respectively. Figure 4 shows that, consistent with our theoretical predictions, the output produced in the second period plummets after the bonus is not paid ($p < 0.001$, Wilcoxon signed-rank test), just as in the START treatment. In our conceptual framework, this decline is driven by two factors. One is the presence of selfish worker types who revert to zero effort in the second period, no matter what. The other is the negative reciprocity that erodes the prosocial workers' preferences and leads to low effort after unsuccessfully signaling in the first period.

In contrast, after the bonus is paid in MIDDLE, we observe only a slight decline in second period output compared to first period output ($p < 0.044$, Wilcoxon signed-rank test). This is also consistent with the presence of some selfish types, who revert to producing no output in

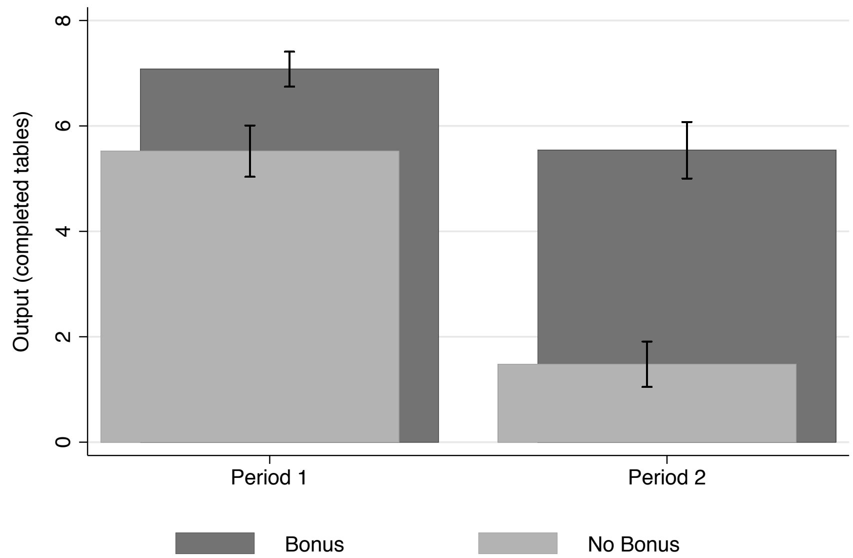

Figure 4. Average Output by Bonus Decision and by Period in MIDDLE

the second period, even after receiving the bonus.[24] Yet, second period output with a bonus remains significantly above the output without a bonus ($p < 0.001$, Wilcoxon ranksum test).

4.4 Total time spent on the leisure activity

All of our results in the previous sections use completed tables as the workers' performance measure. However, in providing the workers with a real leisure option, we also kept track of the amount of time they spent on the leisure activity instead of the work task. This provides us with an alternative measure of worker effort. Using time spent on the leisure activity as our dependent variable, we can replicate all of the results reported above.

Figure 5 shows the fraction of workers using the leisure activity over time during the first and second period. In addition, Figure C.1 in Appendix C shows the average amount of time spent on the leisure activity (across both periods) in the four treatments. An initial observation is that subjects spend a considerable amount of time on the leisure option. The total available time across the two periods of the interaction is 40 minutes (2400 seconds). The average time spent on the leisure activity in all four treatments was more than half of this time. More importantly, the comparison of behavior across treatments very closely mirrors Predictions 2 and 3, reframed in terms of average leisure time instead of average total output. Workers spent significantly less time browsing the internet in MIDDLE than in START ($p = 0.064$, Wilcoxon ranksum test) or

[24]Note that it is also possible that the slight decline after the bonus is paid could be due to the prosocial types, if the first period signal is more than half of the 'optimal' output level for a worker who receives the bonus. In this case, second period output, which in our conceptual framework is given by $y_2^m(1, y_1^m) = \max\{0, y^s(1) - y_1^m\}$ would be less than y_1^m.

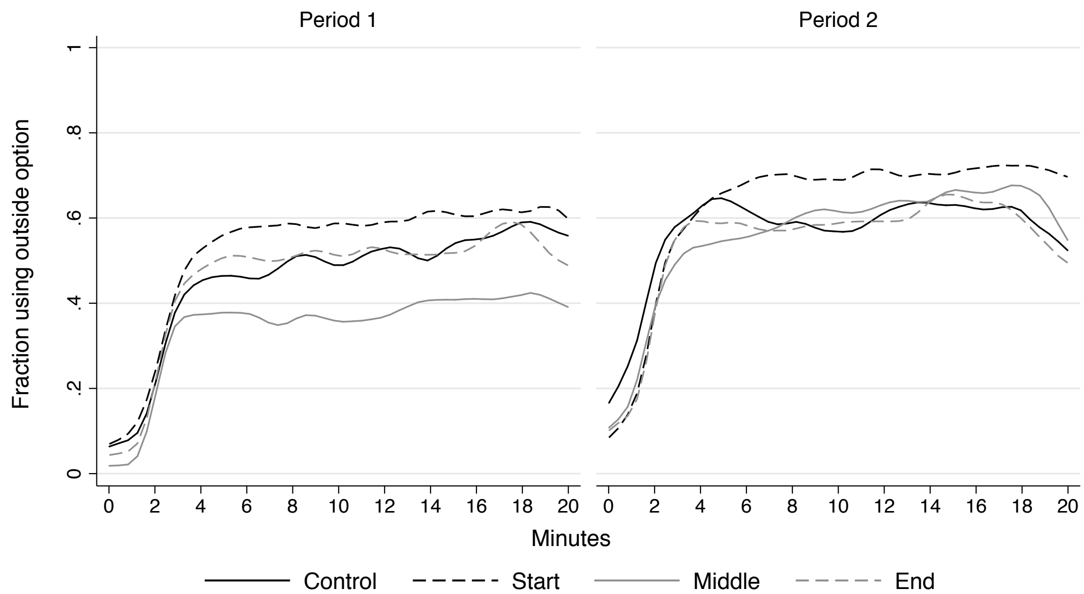

Figure 5. Fraction of workers using the outside option (graph smoothed)

Control ($p = 0.066$). They also spent less time on leisure, on average, than in End, although the overall difference between averages is not statistically significant ($p = 0.841$). Similarly, we do not find any significant differences between Control and End in terms of time spent on the leisure activity, consistent with Prediction 2.

Again, Figure 5 illustrates that these differences are driven by the first period: at any time during the first period a smaller fraction of workers is using the leisure activity in Middle than in any other treatment. Thus, the time spent on the leisure activity in the first period is significantly lower in Middle than in Control ($p < 0.01$, Wilcoxon ranksum test), Start ($p < 0.001$), and End ($p = 0.016$). Generally, workers spend significantly more time on the leisure activity in the second period than in the first period (in each treatment $p < 0.03$, Wilcoxon signed-rank test). Similar to output, we observe no significant differences between treatments for the time spent on the leisure activity in the second period (all pairwise comparisons $p > 0.20$, Wilcoxon ranksum test).

When we separate the sample by the bonus decision, we find for all treatments that the time spent on leisure is significantly lower when the bonus is paid than when it is not paid (see Figure C.2 in Appendix C; in each treatment $p \leq 0.0137$, Wilcoxon ranksum test). Moreover, the average time spent on leisure is substantially higher in Start than in Control when the bonus is not paid ($p < 0.01$), and lower than in Control when the bonus is paid ($p < 0.1$). This is also consistent with Prediction 4 derived from our conceptual framework, where the failure to pay the bonus in Start generates negative reciprocity in comparison to the Control treatment, while the decision to pay the bonus motivates a decrease in time spent on leisure to accommodate the prosocial worker's preferences for fairness and efficiency.

We summarize these findings in the following result.

Result 4. *Our analysis of the leisure activity is in line with our observations based on the output. In the first period, workers in* MIDDLE *spend on average significantly less time on the leisure activity than in the other treatments. In the second period, workers in all treatment spend on average similar amounts of time on the leisure activity. Furthermore, after the bonus is not paid, workers display negative reciprocity by spending significantly more time on the leisure activity.*

5 Conclusion

Using a real-effort experiment, we investigated how the timing of bonus payments impacts the relationship between workers and managers. We demonstrate that the bonus timing influences the likelihood of the managers granting the bonus as well as the output produced by the workers. Average total output is substantially higher in the MIDDLE-treatment than in the START- and END-treatments. The overall higher output is mostly driven by performance in the first of the two periods. In addition, overall output levels in START and END neither differ significantly from each other nor from the total output observed in CONTROL. Separating the workers by bonus-decision in START shows that average output is higher than in CONTROL when the bonus is paid, but substantially lower when it is not. In END, workers anticipate that managers are very unlikely to pay bonuses, and if only for very high output levels, and thus they are not willing to produce high output. Our results on output are also in line with the usage of the leisure option. In the MIDDLE-treatment subjects spend, on average, less time on the leisure activity than in the START- and END-treatments. Again, this result is driven by first period behavior.

Our results have at least three important implications regarding the use of discretionary bonuses. First, our results suggest that, in short-term relationships, managers are best served by using an interim bonus mechanism if their goal is to generate high output. The underlying reason is, quite intuitively, to leverage the mutual trust and reward channels. It provides a setting in which the bonus can both serve as a reward to motivate an increase in effort in the early stages (even by selfish types), whilst still serving an instrumental role in triggering an increase in effort in the latter stages by reciprocal types. Relatedly, in longer-term, repeated relationships, our results also suggest that managers should frame a discretionary bonus mechanism in a way that emphasizes both the reward and trust rationales, in order to maximize the impact on worker effort.

Second, workers tend to internalize anticipated bonuses. As such, in a repeated dynamic setting, once a bonus mechanism is introduced, managers should either continue to pay the bonus or expect negative responses by workers. In this respect, our findings are consistent with some recent theoretical and empirical studies stressing the importance of expectations for the nature of reciprocity. The work that most closely fits with the spirit of our interpretation is a theoretical study by Macera and te Velde (2017). They develop a model of expectations-based, reference-dependent reciprocity and focus on the differences in equilibrium behavior in a gift exchange setting when agents can or cannot anticipate the gift. One of the key conclusions from their model is that gifts are *cursed*, in that if they are paid once, they must be paid forever. The intuition is that if a gift creates expectations of future gifts (in the parlance of our conceptual framework, the agents internalize the bonus), the agents will respond negatively when their expectations are left unfulfilled, even to the extent that effort will be lower than if no gift were paid in the first place.[25] In our setting, where the worker is always aware of the availability of the bonus, it follows that the payment of the bonus may serve, not necessarily as a means of triggering positive reciprocity, but as a way of preventing negative reciprocity.

Third, and related to the previous point, introducing discretionary bonuses does not necessarily increase average output beyond the levels observed in a regular fixed wage environment. This finding is based on the comparison of our bonus treatments with our control treatment which mimics such an environment. On average, output levels, if the bonus decision is upfront or at the very end of the work relationship, do not differ significantly from those generated in the complete absence of bonuses.

In this paper, we focused on a situation where managers decide about bonus payments, but not the timing of this decision. This is a common feature at larger corporations where bonuses for all employees are announced at the same time during bonus seasons. However, if the timing were endogenously chosen by the manager it could be interpreted as a signal of trust (payment at the beginning of contract) or distrust (payment at the end of contract) towards the worker. This on its own might impact the relationship (c.f., Falk and Kosfeld, 2006; Herold, 2010; Dickinson and Villeval, 2008; Kajackaite and Werner, 2015). Thus, a natural next step for this research agenda is to investigate the impact of endogenously determined timing of bonus decisions.

[25]Another related study by Netzer and Schmutzler (2014) shows that, using an intentions-based equilibrium model of reciprocity, equilibrium outcomes in a setting with one selfish and one reciprocal player are always characterized by mutual unkindness, rather than positive reciprocity.

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A Additional Theoretical Analysis

A.1 Characterization of optimal output, y^* in Control

Recall the prosocial type's maximization problem,

$$\max_{y} \quad u_0(\pi_m(0,y), \pi_w(0,y)).$$

Further, recall that

$$u_0(\pi_m(0,y), \pi_w(0,y)) = \begin{cases} \pi_w(0,y) + \gamma_0(1-\delta_0)\pi_m(0,y) & \text{if } \pi_w(0,y) < \pi_m(0,y) \\ (1-\delta_0\gamma_0)\pi_w(0,y) + \gamma_0\pi_m(0,y) & \text{if } \pi_w(0,y) \geq \pi_m(0,y) \end{cases}.$$

Let $\hat{y}$ be such that $\pi_w(0,y) \geq \pi_m(0,y)$ if and only if $y \leq \hat{y}$ and note that, given our experimental parameters and the assumed form of our cost function,

$$\hat{y} = \frac{x}{c}\left(\sqrt{1 + \frac{2c(2W-E)}{x^2}} - 1\right)$$

For all $y < \hat{y}$, the worker's utility is increasing in y as long as

$$y < \overline{z}_0 := \frac{x}{c}\left(\frac{\gamma_0}{1-\delta_0\gamma_0}\right),$$

while for all $y \geq \hat{y}$, the worker's utility is increasing in y only as long as

$$y < \underline{z}_0 := \frac{x}{c}\left(\gamma_0(1-\delta_0)\right).$$

Notice that each of $\overline{z}_0$ and $\underline{z}_0$ is increasing in γ_0. Furthermore, $\underline{z}_0 < \overline{z}_0$. Then, it follows that y^* is given by

$$y^* = \begin{cases} \overline{z}_0 & \text{if } \overline{z}_0 < \hat{y}, \\ \hat{y} & \text{if } \underline{z}_0 < \hat{y} \leq \overline{z}_0, \\ \underline{z}_0 & \text{if } \hat{y} \leq \underline{z}_0, \end{cases}$$

and thus, that y^* is an increasing function of γ_0.

A direct corollary of this is that $y^s(0)$, which is the solution to the manager's problem when γ_0 decreases to γ_{NB}, must be lower than y^*.

A.2 Characterization of optimal output after the bonus, $y^s(1)$ in Start

In this case, the prosocial type's maximization problem is

$$\max_{y} \quad u_0(\pi_m(1,y), \pi_w(1,y)),$$

with

$$u_0(\pi_m(1,y), \pi_w(1,y)) = \begin{cases} \pi_w(1,y) + \gamma_0(1-\delta_0)\pi_m(1,y) & \text{if } \pi_w(1,y) < \pi_m(1,y) \\ (1-\delta_0\gamma_0)\pi_w(1,y) + \gamma_0\pi_m(1,y) & \text{if } \pi_w(1,y) \geq \pi_m(1,y) \end{cases}.$$

Let $\tilde{y}$ be such that $\pi_w(1,y) \geq \pi_m(1,y)$ if and only if $y \leq \tilde{y}$. It is straightforward to show that

$$\tilde{y} = \frac{x}{c}\left(\sqrt{1 + \frac{2c(2(W+B)-E)}{x^2}} - 1\right).$$

For all $y < \tilde{y}$, worker's utility is increasing in y as long as

$$y < \overline{z}_0 := \frac{x}{c}\left(\frac{\gamma_0}{1-\delta_0\gamma_0}\right),$$

while for all $y \geq \tilde{y}$, the worker's utility is increasing in y only as long as

$$y < \underline{z}_0 := \frac{x}{c}\left(\gamma_0(1-\delta_0)\right).$$

These are the same cutoffs as for the case where the bonus is not paid. Thus, $y^s(1)$ is given by

$$y^s(1) = \begin{cases} \overline{z}_0 & \text{if } \overline{z}_0 < \tilde{y}, \\ \tilde{y} & \text{if } \underline{z}_0 < \tilde{y} \leq \overline{z}_0, \\ \underline{z}_0 & \text{if } \tilde{y} \leq \underline{z}_0, \end{cases}$$

and since $\tilde{y} > \hat{y}$, $y^s(1) \geq y^*$ for any parameters γ_0, δ_0.

A.3 Proof of Proposition 1

Consider the second period of the interaction. As argued in the text, the selfish worker type will choose $y_2 = 0$, independent of the bonus decision. In contrast, the prosocial type will choose $y_2^m(1, y_1^m) = \max\{0, y^s(1) - y_1^m\}$.

Suppose $y_1^m \leq y^s(0)$. Then $y_2^m(1, y_1^m) = y^s(1) - y_1^m$ and $y_2^m(0, y_1^m) = y^s(0) - y_1^m$, such that $\Delta y_2^m(y_1^m) = \Delta y^s$. Thus, the probability that the manager chooses $a = 1$ after observing y_1^m will be $F(1 - B/(x\Delta y^s))$.

Consider the manager's beliefs at any other level of first-period output, $y_1 \neq y_1^m$. We could choose any beliefs off the equilibrium path. For instance, we might suppose that the manager holds the belief that the worker is the selfish type for all $y_1 \neq y_1^m$. However, these beliefs do not seem reasonable for $y_1 > y_1^m$, since any such y_1 would be dominated by choosing $y_1 = 0$ for the selfish type. Thus, suppose beliefs are that the worker is the selfish type for all $y_1 < y_1^m$ and that the worker is the prosocial type for all $y_1 \geq y_1^m$. Then, in order to ensure that the selfish type will prefer to pool rather than produce $y_1 = 0$, we must have

$$W + BF\left(1 - \frac{B}{x\Delta y^s}\right) - 0.5c(y_1^m)^2 \geq W$$
$$\Rightarrow \qquad y_1^m \leq \left[\frac{2B}{c}F\left(1 - \frac{B}{x\Delta y^s}\right)\right]^{0.5}.$$

Next, suppose that $y_1^m > y^s(1)$. Then $y_2^m(1, y_1^m) = 0$ and the manager, knowing that neither type will produce any output in the second period, will choose not to pay the bonus in Middle. In such a case, the selfish type would strictly prefer to choose $y_1 = 0$, rather than y_1^m. Thus, we must have $y_1^m \leq y^s(1)$.

Finally, suppose $y^s(0) < y_1^m \leq y^s(1)$. In principle, there may exist some pooling equilibria in this range, for y_1^m sufficiently close to $y^s(0)$. In this case, we would have $\Delta y_2^m(y_1^m) = y^s(1) - y_1^m$ and the probability of the bonus being paid after y_1^m given by $F(1 - B/(x(y^s(1) - y_1^m))$. This entails a lower probability of the bonus being paid. As such, it will be *more difficult* to ensure that the selfish type prefers to pool, as expected when y_1^m is higher. Indeed, as y_1^m approaches $y^s(1) - (B/x)$, it becomes impossible to retain the incentive for selfish types to pool.

A.4 Separating equilibria in the Middle treatment

Suppose that the two types choose different first-period output levels. In any such separating equilibrium, types are perfectly revealed and thus the selfish type will never be paid the bonus. We consider the full specification of updated beliefs (including off-path beliefs) to be $\hat{q} = 1$ if $y_1 < y_1^m$ and $\hat{q} = 0$ if $y_1 \geq y_1^m$, where y_1^m is the first-period output chosen by the prosocial type. In any such equilibrium, it is obvious that the selfish type will choose $y_1 = 0$, the manager will choose not to pay the bonus if $y_1 = 0$, and the selfish type will choose $y_2 = 0$ in the second period (regardless of the bonus decision).

Now consider the prosocial worker type. The manager's updated beliefs place full weight on the prosocial type (i.e., updated beliefs are $\hat{q} = 0$), and thus she will pay the bonus if and only if

$$y_2^m(1, y_1^m) - y_2^m(0, y_1^m) \geq \frac{B}{x},$$

where, $y_2^m(a, y_1^m)$ denotes the optimal second-period output for the prosocial worker as a function of the bonus decision a and his own first-period output y_1^m.

Just as discussed for the pooling equilibria in the main text, for the prosocial worker, the optimal second-period output in MIDDLE after the bonus is paid is given by

$$y_2^m(1, y_1^m) = \max\{0, y^s(1) - y_1^m\}.$$

In other words, the prosocial worker chooses second-period output to make up the difference (if any) between his first-period signal, y_1^m, and the optimal total output level for START after the bonus, $y^s(1)$. If the signal is higher than $y^s(1)$, optimal second-period output is 0.

Similarly, after the bonus is not paid,

$$y_2^m(0, y_1^m) = \max\{0, y^s(0) - y_1^m\}.$$

That is, the prosocial worker chooses second-period output to make up the difference (if any) between the signal, y_1^m, and $y^s(0)$. Again, if the signal is higher than $y^s(0)$, optimal second-period output is 0.

In order to characterize the set of separating equilibria, we need to account for two constraints. First, the signal y_1^m needs to be high enough that the selfish worker type does not prefer to pool with the prosocial type. Second, if the signal is too high, such that $y_1^m > y^s(1) - \frac{B}{x}$, the worker's optimal second-period output will not be high enough for the manager to want to pay the bonus. Formally, in any separating equilibrium, we must have $y_1^m \in \left[\left(\frac{2B}{c}\right)^{0.5}, y^s(1) - \frac{B}{x}\right]$. It is straightforward to see then that an equilibrium exists only if this interval is non-empty.

The following proposition characterizes the set of possible separating equilibria.

Proposition 2. *Consider the game generated by the* MIDDLE *treatment, and suppose* $y^s(1) \geq \left(\frac{2B}{c}\right)^{0.5} + \frac{B}{x}$. *Then there exists a separating equilibrium in which*

(i) the selfish type of worker chooses $y_1 = y_2 = 0$,

(ii) the prosocial type chooses $y_1 = y_1^m$ *where* $\left(\frac{2B}{c}\right)^{0.5} \leq y_1^m \leq y^s(1) - \frac{B}{x}$,

(iii) the prosocial type chooses $y_2^m(1, y_1^m) = y^s(1) - y_1^m$ *and* $y_2^m(0, y_1^m) = \max\{0, y^s(0) - y_1^m\}$,

(iv) the manager chooses $a = 1$ *if and only* $y_1 \geq y_1^m$.

If $y^s(1) < \left(\frac{2B}{c}\right)^{0.5} + \frac{B}{x}$, *then no separating equilibrium exists.*

Thus, whenever a separating equilibrium exists, along the equilibrium path the bonus is always paid to the prosocial type and never paid to the selfish type. As such, the expected frequency of the bonus is simply $1-\mu$ and the expected total output in MIDDLE (for a separating equilibrium) is given by

$$\mathbb{E}[y^m] = (1 - \mu)y^s(1).$$

Since $y^s(1) > y^* > y^s(0)$, comparing with START, CONTROL, and END, the expected total output in MIDDLE is strictly higher under any separating equilibrium, as well as in the pooling equilibria.

How reasonable is it to focus on pooling equilibria? Given our experimental parameters, $B = 50$, $x = 10$, and a reasonably high cost parameter of $c = 0.5$, a separating equilibrium exists if and only if $y^s(1) \geq 19.1421$. That is, workers would need to produce just over 19 tables after receiving the bonus in the START treatment. Given our own attempts to solve the summation tables in the two 20 minute periods, this threshold is difficult to meet. Furthermore, if the cost parameter is, more reasonably, a little bit lower, the cutoff value below which a separating equilibrium ceases to exist is even higher. Finally, given the observed output across all treatments never reaches such a high level, we believe we were justified in considering the pooling equilibria to provide a more plausible basis for our experimental predictions.

B Generalizing the Model to include Prosocial Managers

In this section, we consider the implications of generalizing the model introduced in the main text, by allowing the managers to be either a selfish type or a prosocial type. We focus on the intuition as to how the analysis in the main text changes with this generalization. In part, this is because the full, general analysis quickly becomes divided into multiple cases (within cases) depending on the relative parameter values. Nevertheless, we spend a little more time on the END treatment, where the generalization provides some explanation for why the bonus might be paid on occasion in the END treatment, when total output is very high. For the other main treatments, the discussion is focused on explaining why the predictions between treatments are not substantially affected.

Suppose the preferences for the prosocial manager type are represented by the Charness and Rabin (2002) utility function

$$v(\pi_m, \pi_w) = \begin{cases} \pi_m + \lambda(1-\delta)\pi_w & \text{if } \pi_m < \pi_w \\ (1-\delta\lambda)\pi_m + \lambda\pi_w & \text{if } \pi_m \geq \pi_w, \end{cases}$$

with $\lambda \in [0, 1]$, $\delta \in (0, 1)$. As for the workers, we assume $\delta = \delta_0$ for all admissible preferences of this form. Thus, these preferences are analogous to the prosocial worker's preferences, with λ (instead of γ) used to represent the strength of the manager's prosocial concern.

Further, assume that the prosocial manager type has an intrinsic preference parameter λ_0. The implications of reciprocity for the manager's preferences depend, as in the main text, on the treatment. In CONTROL, the manager is passive and thus the predictions are unchanged. For the other three main treatments, we consider the implications in turn.

The END treatment. In END, the prosocial manager types may choose to pay the bonus if they are sufficiently prosocial and total output is sufficiently high. Reciprocity, as introduced through the Revealed Altruism framework, implies that the manager's prosocial concern depends on the level of output produced by the worker. For simplicity, suppose that the most generous output choice ($y = 2\overline{y}$) results in no change to the prosocial manager type's intrinsic preference, such that $\lambda_y = \lambda_0$ if $y = 2\overline{y}$. For any other total output $y < 2\overline{y}$, λ_y is increasing in y, such that the lower the total output produced by the worker, the lower the manager's prosocial concern.

As in the main text, the selfish manager type will never pay the bonus. For the prosocial manager type, the optimal decision is to pay the bonus ($a = 1$) if and only if $y \geq y^\dagger$ where $y^\dagger$ is given by

$$y^\dagger = \frac{x}{c}\left(\sqrt{1 + \frac{2c\left(2W + \frac{1-\lambda^\dagger(1-\delta)}{\delta\lambda^\dagger}B - E\right)}{x^2}} - 1\right),$$

and $\lambda^\dagger = \lambda_y \geq \frac{1}{1+\delta}$ at $y = y^\dagger$. Note that if $\lambda_0 \leq 0.5$, then it is impossible to have $\lambda^\dagger \geq \frac{1}{1+\delta}$, and the bonus will never be paid. In particular, this implies that the prosocial manager must place *more weight* on the welfare term than on her own payoff, in order for the bonus to ever be paid in END. Furthermore, even supposing that $\lambda_0 > 0.5$ and that $\lambda^\dagger$ satisfies the condition above, output must be sufficiently high to induce a bonus. Formally, the prosocial manager type will pay the bonus if and only if $y \geq y^\dagger$.

Consider the parameters of our experiment, and suppose $c = 0.5$. Then $y^\dagger$ is given by

$$\begin{aligned} y^\dagger &= 20\left(\sqrt{1 + \frac{50(1 + \frac{1-\lambda^\dagger(1-\delta)}{\delta\lambda^\dagger})}{100}} - 1\right) \\ &= 20\left(\sqrt{1 + 0.5\left(1 + \frac{1-\lambda^\dagger(1-\delta)}{\delta\lambda^\dagger}\right)} - 1\right). \end{aligned}$$

The term $(1 - \lambda^\dagger(1-\delta))/(\delta\lambda^\dagger)$ is between 1 and 2 since $\lambda^\dagger \geq \frac{1}{1+\delta}$ and $\delta \in (0, 1)$. If we consider $\delta = 0.5$, the condition requires $\lambda^\dagger \geq \frac{2}{3}$. For instance, suppose $\delta = 0.5$ and $\lambda^\dagger = 0.7$. Then,

$$y^\dagger = 11.17.$$

If instead $\delta = 0.2$, the condition requires $\lambda^\dagger \geq \frac{5}{6}$. Fix $\delta = 0.2$ and $\lambda^\dagger = 0.85$. Then,

$$y^\dagger = 11.25.$$

Thus, with sufficiently high prosocial preference parameters (i.e., substantially higher weight on the social welfare component than on own payoffs), the prosocial manager type may be willing to pay the bonus if total output is sufficiently high.[26] This gives some justification for the (few) instances in which the bonus was paid by subjects in the END treatment.

Working backwards, consider the two worker types. We assume that each worker forms beliefs about the manager's type. Let r denote the worker's belief (probability) that the manager is selfish and let ρ denote the true probability of a manager being the selfish type. Further assume that the worker's belief is privately observed, but drawn (independently) according to a commonly known distribution $G(\cdot)$ with mean ρ. The selfish type will choose $y = y^\dagger$ (or the

[26] As the cost parameter c decreases, the threshold $y^\dagger$ for any given parameters will increase, although still within a reasonable range.

smallest integer greater than $y^\dagger$) if he believes the manager to be prosocial with sufficiently high probability. Specifically, the selfish worker type will prefer to choose $y = y^\dagger$ over $y = 0$ if and only if

$$1 - r \geq \frac{c}{2B}(y^\dagger)^2.$$

Given the distribution of workers' beliefs, this implies that the selfish worker type will produce $y^\dagger$ with probability $G(1 - \frac{c}{2B}(y^\dagger)^2)$.

Now consider the prosocial worker type. The optimal level of output is slightly less straightforward in this case. Depending on parameters, the prosocial type may choose y^*, $y^\dagger$ or $y^s(1)$ (i.e. the same as the optimal level of output after the bonus is paid in the Start treatment). Intuitively, if the worker's belief about the probability that the manager is selfish is low enough, and if increasing output y^e above the threshold for the bonus, $y^\dagger$ increases the welfare term by relatively more than it reduces π_w, then the prosocial worker may prefer to increase his output from y^* to $y^s(1)$. Overall, this implies that with some probability (albeit potentially very small), the prosocial worker type will produce more effort than when the manager is always selfish.

To summarize, if prosocial managers are sufficiently prosocial (place more weight on the welfare term than on own payoff) after relatively high output, and workers' beliefs about the probability that the manager is selfish are low enough, we can expect relatively high output levels and payment of the bonus. Most notably, this gives some rationale for why bonuses may be paid in the End treatment, but only when total output is high and, even then, only if the manager is the prosocial type. If the combined probability of all of these conditions being satisfied is relatively low, the resulting impact on expected output should be an increase, compared with Control, although it may not be very significant.

The Start treatment. Consider the Start treatment next. In this case, worker behavior does not change. Neither does the behavior of the selfish manager type. However, a manager who is prosocial may nevertheless follow a different strategy from the selfish type. Recall that the prosocial worker type will choose $y^s(1)$ after the bonus is paid and $y^s(0)$ after the bonus is not paid. Just as for the selfish manager type, the decision to pay or not pay the bonus for a prosocial manager will depend on her belief about whether the worker is selfish or prosocial, q, as well as the difference between these output levels, $\Delta y^s = y^s(1) - y^s(0)$. More specifically, the manager will choose to pay the bonus if and only if her belief q is below a threshold value. For the selfish type, the threshold is $1 - (B/x\Delta y^s)$. For the prosocial type, the threshold belief will be lower. As a result, the likelihood of the bonus being paid will increase, which in turn will increase expected output relative to the case in which all managers are selfish.

As in the main text, the comparison with Control and End remains ambiguous, although it suggests a greater chance for average output in Start to exceed average output in Control.

The MIDDLE **treatment.** Finally, consider the MIDDLE treatment. As for START, worker output in the second period is unchanged. Provided first period output does not exceed $y^s(0)$, second period output will simply bring total output up to $y^s(1)$ (if the bonus is paid in MIDDLE) or $y^s(0)$ (if it is not paid). Similarly, the behavior of the selfish manager type will be unchanged. For a prosocial manager type, the same intuition that lowers the threshold belief for paying the bonus in the START treatment suggests that, in the case of a pooling equilibrium, a prosocial manager type will simply be more likely to pay the bonus for any given first-period output level, y_1^m.

Again, the effect of allowing for a prosocial manager type would be to increase the probability of the bonus being paid and, possibly, the first-period output signal, which also leads to an increase in expected output in MIDDLE. Compared with START, it would take substantially more work to show the conditions under which we can ensure that expected total output would remain higher under MIDDLE than under START. However, for all reasonable assumptions regarding preference parameters and beliefs of the managers, the expected increase in the payment of bonuses and the level of total output would not be enough to reverse the prediction that $\mathbb{E}[y^m] > \mathbb{E}[y^s]$.

C Additional Tables and Figures

Table C.1. Worker Output by Treatment

	Control	Start	Middle	End
A. Period 1 Output				
Mean	4.39	4.02	6.35	4.30
Median	4	4.5	6	4
SD	3.86	3.16	2.95	3.07
B. Period 2 Output				
Mean	3.35	3.52	3.63	4.00
Median	1	3.5	3	4.5
SD	4.28	3.58	3.99	3.12
C. Overall Output				
Mean	7.74	7.54	9.98	8.30
Median	5	7.5	9	8.5
SD	7.55	6.21	5.74	5.63
Observations	48	49	44	46

Table C.2. Average Total Output by Bonus Decision and Treatment

		No Bonus			Bonus		
	Control	Start	Middle	End	Start	Middle	End
Period 1	4.39	2.11	5.52	3.78	5.28	7.08	6.63
Period 2	3.35	1.32	1.48	3.28	4.97	5.54	7.25
Total	**7.74**	**3.42**	**7.00**	**7.06**	**10.24**	**12.62**	**13.88**
Obs.	46	19	23	36	29	26	8

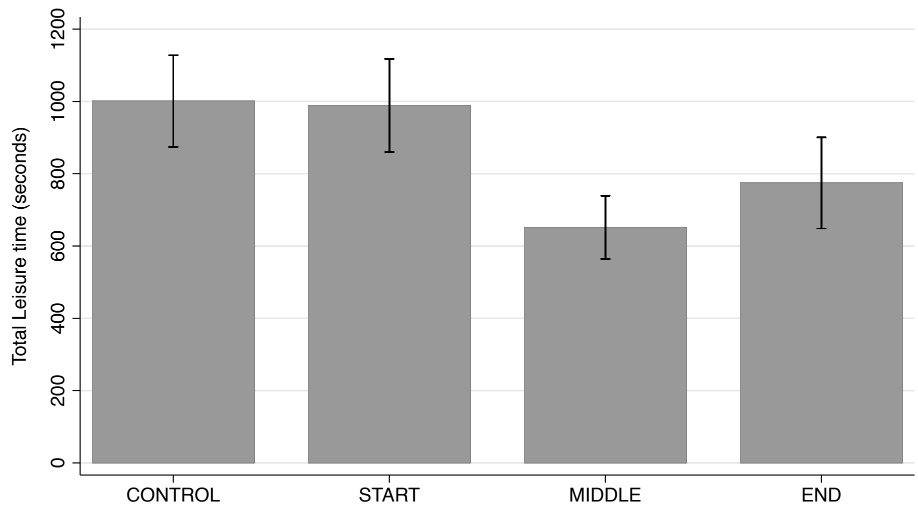


Figure C.1. Total Leisure time across Treatments

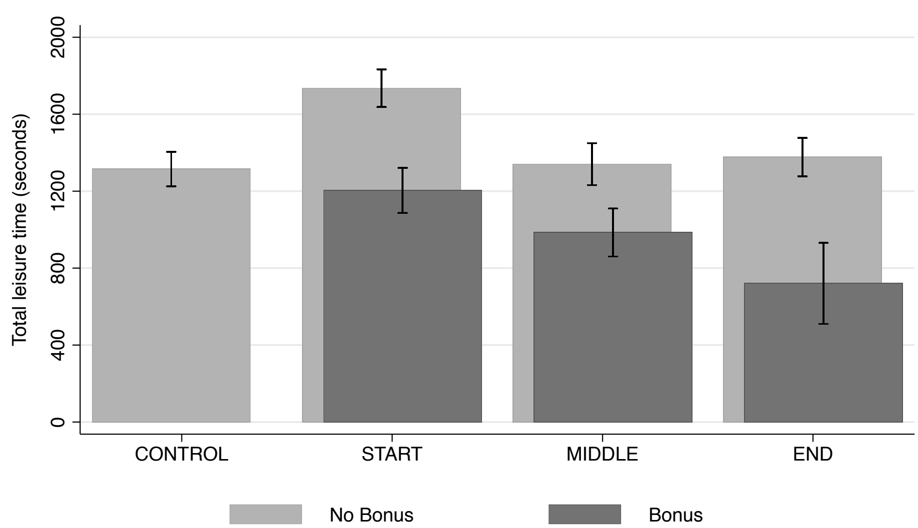


Figure C.2. Total Leisure time across Treatments, separated by bonus decision

D Experimental instructions

In this section, we provide a copy of the instructions used for the Start treatment. The one section that differed in the Middle and End treatments is italicized and the differences are explained in footnotes. Note also that the accompanying screenshot was also altered to match the treatment. The instructions for the Control treatment were identical, except for the fact that all references to the Bonus or the Bonus Decision were eliminated.

Experiment Instructions

Thank you for participating in this experiment. Please give us your full attention and do not attempt to communicate with the other participants during the course of the experiment. These instructions describe how the experiment will proceed, and explain how you can earn money in the experiment, so please read along and listen carefully. During the experiment, you may not use any kind of calculator, your cell phone, or any pen & paper.

Your earnings in the experiment will be denominated in experimental currency units (called **ECUs**). At the end of the experiment, these earnings will be converted to US dollars using the exchange rate of 10 ECUs = $0.40. At the end of the experiment, you will be paid your earnings (in dollars) from the experiment, in addition to the show-up fee of $10. The experiment consists of two parts, called Task 1 and Task 2. The instructions to Task 2 will be read after Task 1 is completed.

Task 1

Task 1 of the experiment consists of a single period that lasts for 20 minutes. During this time, a series of tables (called Summation tables) will appear, one at a time, on the screen in front of you. Each table has 5 rows and 5 columns and each cell of the table contains an integer from 1 to 9. An example is shown in Figure 1.

7	1	6	7	8	
4	7	2	9	3	
1	3	6	2	8	
2	4	9	5	9	
4	7	7	2	2	

Figure 1. An example Summation table

The object of the task is to calculate the following:

(1) For each row, add up all the numbers in that row and enter your answer in the empty box to the right of the row (these are the **row totals**).

(2) For each column, add up all the numbers in that column and enter your answer in the empty-box below the column (these are the **column totals**).

(3) Add up all 25 of the numbers in the table and enter your answer in the empty box at the bottom-right of the table (this is the **Table total**).

Note that the **Table total** can be calculated by adding together the 5 **row totals**. It can also be calculated by adding together the 5 **column totals**. However, adding together the 5 row totals **and** the 5 column totals will give you an incorrect number for the Table total, since you will be double counting all of the numbers.

To correctly complete a Summation table, you must enter the correct answer for all of the row totals, all of the column totals, and the Table total.

Figure 2 shows an example of the screen during Task 1. Once you have entered a response into each empty box, click the "Check your answer" button.

- If all of your responses are correct, the message displayed will read "Your response was CORRECT" and a new Summation table will appear (see Figure 3a).
- If one of your entries is incorrect, a message will appear that "Your response was NOT CORRECT. Please try again". The numbers you entered will still be shown in the boxes, so you can check to find the mistake, make any necessary corrections, then click the "Check your answer" button again until all of your responses are correct (see Figure 3b).

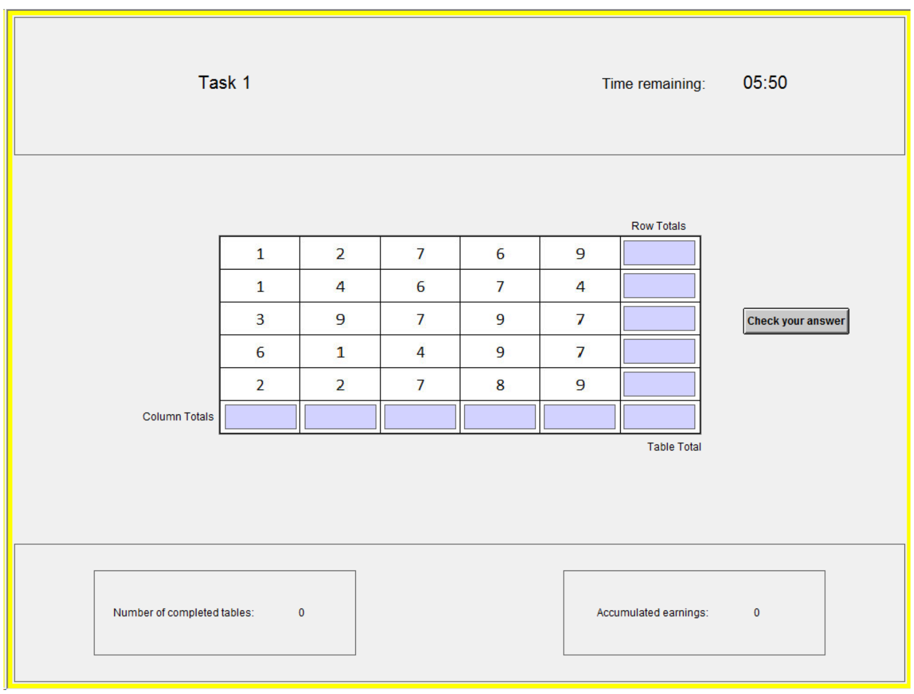


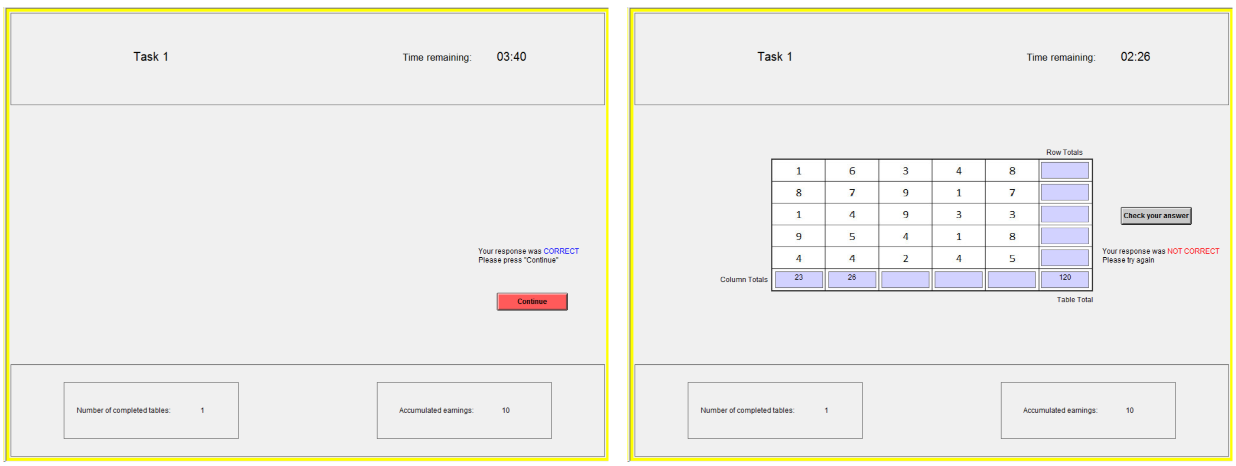
Figure 2. Screenshot of Task 1

For every correctly completed Summation table, you will earn **10 ECUs.** At the bottom of the screen, the "Number of completed tables" shows you how many tables you have correctly completed during the period. The "Accumulated earnings" shows you the total number of ECUs you have earned during the period, which are calculated as

$$\textbf{Accumulated earnings} = \textbf{Number of completed tables} \times \textbf{10 ECUs}$$

There is no penalty for submitting an incorrect response and there is no limit to the number of times you can click the "Check your answer" button. However, you will only earn money, and a new Summation table will only appear, after you have correctly completed the current table.

In the top panel of the screen you will see a clock displaying the time remaining in the period. When the time expires, the software will verify the number of Summation tables that you completed correctly, and display the number and your earnings on a Task 1 Results screen.



(a) After a correct response

(b) After an incorrect response (empty boxes)

Figure 3. Messages after you click to "Check your answer"

Task 2

For Task 2, you will be randomly paired with another individual. In each pair, one of you will be randomly assigned to the role of "the Manager", and the other will be assigned to the role of "the Worker". Task 2 consists of 2 periods, and each period lasts for 20 minutes.

At the beginning of Task 2, the Manager will receive 250 ECUs. However, out of this 250 ECUs, the Manager pays a one-time salary of 150 ECUs to the Worker. The Manager may keep the remaining 100 ECUs.

The Bonus Decision

Before period 1 begins, the Manager will be given the option to pay a bonus of 50 ECUs to the Worker. The Bonus Decision screen is shown in Figure 4. After the bonus decision is selected and confirmed by the Manager, the decision will be announced to both players. If the Manager chooses 'Yes' (to pay the bonus), then another 50 ECUs will be transferred from the Manager's account to the Worker's account. If the Manager chooses 'No' (not to pay the bonus), then no such transfer will be made.[27]

What can the Worker do during Task 2?

In each period, the Worker may choose to spend time completing a series of Summation tables (as in Task 1) or to browse the internet. **The Summation tables correctly completed by the Worker generate earnings for the Manager, but do not generate any earnings for the Worker.**

The Worker may switch back and forth between the Summation tables and the internet browser by clicking on the "Internet" button and the "Back to task" button, shown in Figure

[27] The corresponding text for MIDDLE was as follows.

"After period 1 ends, the Results from period 1 will be reported to both the Worker and the Manager. Then, before period 2 begins, the Manager will have the option to pay a bonus of 50 ECUs to the Worker. The Bonus Decision screen is shown in Figure 4. After the choice is confirmed by the Manager, the decision will be announced to both players. If the Manager chooses 'Yes' (to pay the bonus), then another 50 ECUs will be transferred from the Manager's account to the Worker's account. If the Manager chooses 'No' (not to pay the bonus), then no such transfer will be made."

The corresponding text for END was:

"After both periods are finished, the Worker's Results from period 1 and period 2 will be reported to both the Worker and the Manager. Then the Manager will have the option to pay a bonus of 50 ECUs to the Worker. An example of the Bonus Decision screen is shown in Figure 4. After the choice is confirmed by the Manager, the decision will be announced to both players. If the Manager chooses 'Yes' (to pay the bonus), then another 50 ECUs will be transferred from the Manager's account to the Worker's account. If the Manager chooses 'No' (not to pay the bonus), then no such transfer will be made."

In addition, the screenshot of the Manager's Bonus Decision was altered to match the treatment. See Figures 7 and 8 at the end of the instructions.

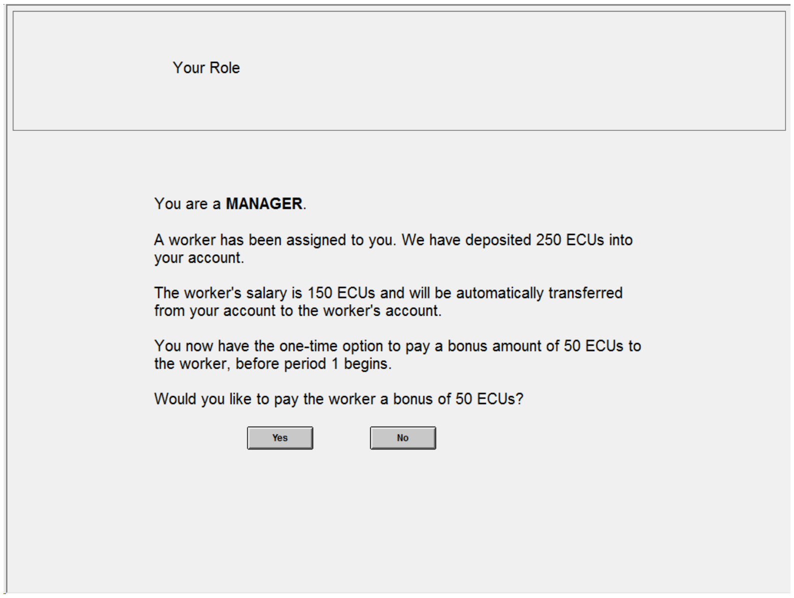


Figure 4. The Manager's Bonus Decision

5. You may switch between activities at any time, as many times as you like during the period. However, you cannot work on the Summation tables and browse the internet at the same time. Specifically,

- when you click the "Internet" button, a web browser will automatically open and the current Summation table will disappear from view;
- when you click the "Back to task" button, all web browsers will be automatically closed and the current Summation table will reappear on your screen (including any entries you had made before clicking the Internet button).

At the end of each period, all web browsers will close automatically.

Each Summation table correctly completed by the Worker generates **10 ECUs** in revenue for the Manager. In the bottom panel, the Worker can see how many Tables have been completed in each period, the revenue generated in each period, and the total revenue generated for the Manager. The Worker can also see his salary for Task 2 (150 ECUs) and the bonus received (50 if the Manager chose to pay the bonus, 0 if the Manager chose not to pay the bonus).

What can the Manager do during Task 2?

During each period, the Manager may choose to work on completing a series of Slider sets or to browse the internet. A Slider set consists of 8 sliders on the screen, as shown in Figure 6. To successfully complete a Slider set, for each of the 8 sliders you must slide the arrow from the left end to the '50' position (exactly halfway), then click the "Check your answer" button. If you

(a) Summation tables

(b) Internet browsing

Figure 5. The Worker's Activity Options

have correctly moved the arrow to the '50' position in each of the 8 sliders, you will receive a message that "Your response was correct" and after you click "Continue", a new Slider set will appear.

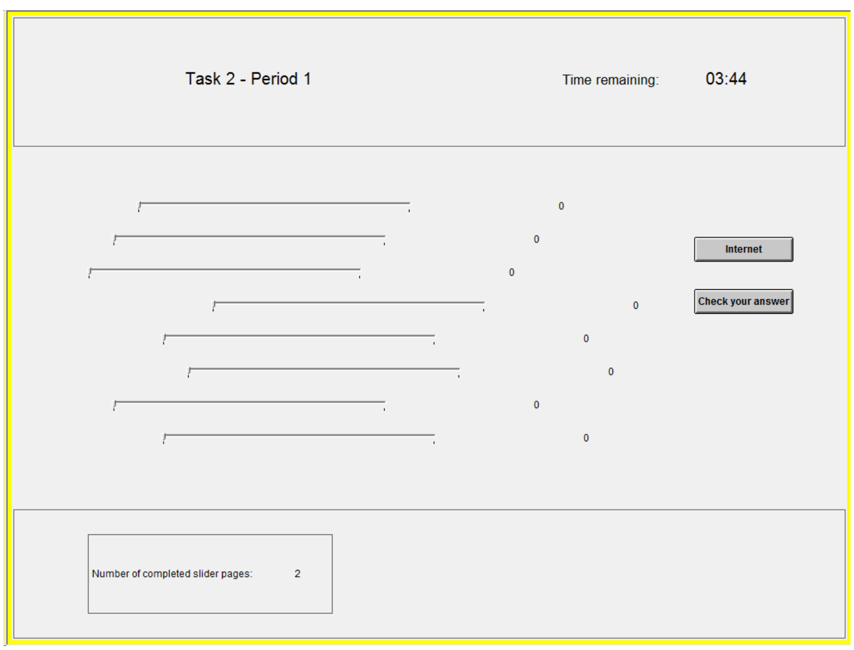


Figure 6. An example of a Slider set

At the beginning of each period, the Manager must successfully complete two Slider sets (that is, two screens, each with 8 sliders) before gaining access to the Internet option. **After two Slider sets are completed,** you may switch back and forth between the Internet browser and the Slider sets by clicking the "Internet" button and the "Back to task" button. However, you cannot work on the Slider sets and browse the internet at the same time. Specifically, when you click the "Internet" button, a web browser will automatically open and the current Slider set will disappear from view; when you click the "Back to task" button, all web browsers will be automatically closed and the current Slider set will reappear on your screen.

Completing the Slider sets does not generate any earnings. That is, the Manager does not earn any ECUs for correctly completing a Slider set.

Earnings from Task 2

The Worker receives the salary, 150 ECUs, regardless of the number of correctly completed Summation tables. In addition, if the Manager chooses to pay the bonus, then the Worker receives an additional 50 ECUs. Thus,

the Worker's Task 2 earnings (in ECUs)

$$= \begin{cases} \textbf{150} & \textbf{if the bonus is NOT PAID} \\ \textbf{200} & \textbf{if the bonus is PAID} \end{cases}$$

The Manager receives 250 ECUs before Task 2 begins, and pays the salary of 150 ECUs to the Worker. For each Summation table correctly completed by the Worker, the Manager earns 10 ECUs. In addition, if the Manager chooses to pay the bonus, then his earnings are reduced by an additional 50 ECUs. Thus,

the Manager's Task 2 earnings (in ECUs)

$$= \begin{cases} \textbf{100 + (10} \times \textbf{\# completed tables)} & \textbf{if the bonus is NOT PAID} \\ \textbf{50 + (10} \times \textbf{\# completed tables)} & \textbf{if the bonus is PAID} \end{cases}$$

For example, suppose that the Manager chose to pay the bonus to the Worker, and that the Worker completed 3 Summation tables in Period 1 and 5 Summation tables in Period 2. Then

- the Worker's Task 2 earnings will be $150 + 50 = 200$ ECUs;
- the Manager's Task 2 earnings will be $250 - 150 - 50 + \big(10 \times (3 + 5)\big) = 130$ ECUs.

Using the Internet

While you are browsing the internet, you may not download any software or use any online calculators. Your usage of the internet will be confidential and all browser history will be erased after the experiment. Your browser history will not be collected or used in any way as data for the experiment.

Your use of the internet is subject to the same acceptable use standards set by the University for accessing the internet on campus. Furthermore, during Task 2, there will be a proctor in the room. If you are using the internet in an inappropriate manner, or accessing material that may be considered offensive to another participant, you will receive a warning and will be asked to leave the website you are on. If you receive a second warning, you may be asked to leave the experiment.

Some examples of acceptable use include accessing your email, Twitter, or Facebook account, reading news articles, class websites, sports news websites or blogs. You will be able to watch videos on Youtube but the audio has been disabled, so you will not be able to hear the sound or listen to any other media on the web.

If you are browsing the internet during Task 2, you may not always be able to see the clock showing the time remaining in the period. Therefore, during both periods in Task 2, a countdown timer will be displayed by the projector on the screen at the front of the room. When the period ends, all web browsers will automatically be closed and you will be returned to the experiment program.

Overall Earnings

Your overall earnings from the experiment will be the sum of your Task 1 and Task 2 earnings. These earnings will be exchanged into US dollars at the rate of 10 ECUs = $0.40 and added to the show-up fee, which is $10.

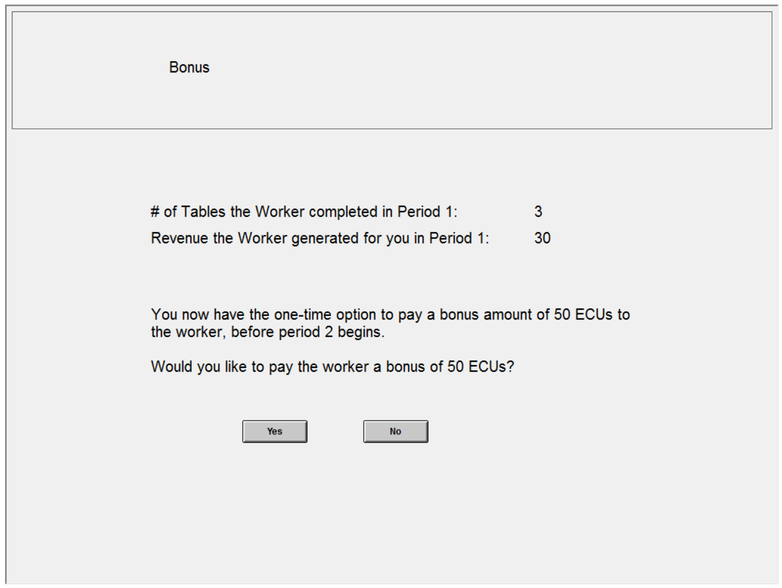


Figure 7. The Manager's Bonus Decision (Middle)

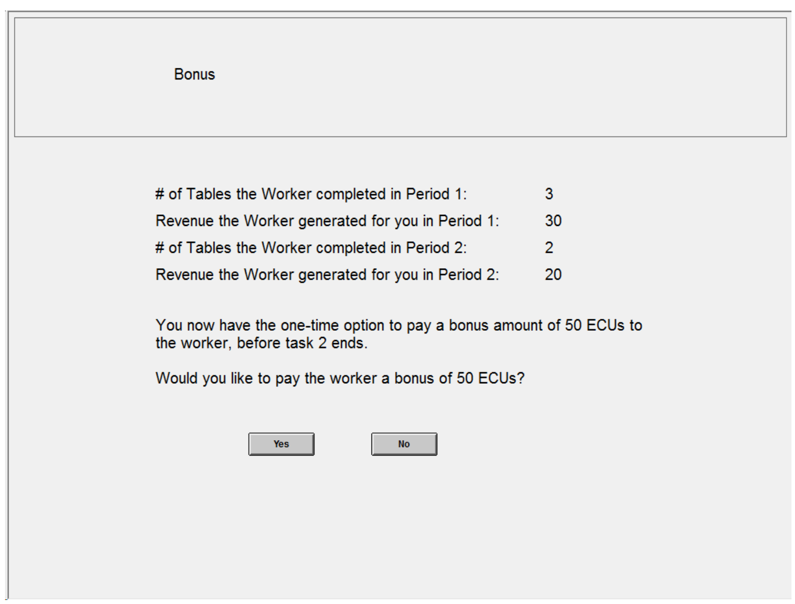


Figure 8. The Manager's Bonus Decision (End)