Self-chosen goals, incentives, and effort*

Philip Brookins[†] Sebastian J. Goerg[‡] Sebastian Kube[§]

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Abstract

In a series of randomized field experiments, we investigate the interplay between self-chosen work goals and monetary incentives, and its effects on work performance. Employees are observed in a natural work environment. They have to do a simple but effort-intense task, where output is perfectly observable. A regular piecerate contract serves as a benchmark. In our goal treatments, workers are asked in addition to choose a non-binding output goal. We observe that the use of personal work goals leads to a significant output increase. Strikingly, the positive effect of self-chosen goals can persist even without performance-contingent monetary incentives, i.e., without the piecerate. However, then the impact of self-chosen goals depends on the exact size of the goals and the difficulty of the task. Our results suggest that work contracts where workers set goals themselves can help to improve performance; even in the absence of explicit monetary incentives.

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[†]Max Planck Institute for Research on Collective Goods, Bonn, Germany, and Crowd Innovation Lab, Harvard University, Cambridge, USA. Email: brookins@coll.mpg.de.

[‡]Florida State University, Tallahassee, USA, and IZA - Institute of Labor Economics, Bonn, Germany, and Max Planck Institute for Research on Collective Goods, Bonn, Germany. Email: sgoerg@fsu.edu.

[§]University of Bonn, Bonn, Germany, and IZA - Institute of Labor Economics, Bonn, Germany, and Max Planck Institute for Research on Collective Goods, Bonn, Germany. Email: kube@uni-bonn.de.

1 Introduction

> *"The greatest danger for most of us is not that our aim is too high and we miss it, but that it is too low and we reach it."*
>
> attributed to Michelangelo (1475–1564)

> *"[A Goal] is the desired end state the individual reaches for; it is the ultimate aim of one's adopted action, the very cause of the action; it is the purpose toward which one is striving; it is the reason for doing and thinking."*
>
> Gordon B. Moskowitz and Heidi Grant (2009)

Goals are involved in many everyday situations. For example, people set a target weight when on a diet; learning goals are formulated and practiced in schooling; savings plans are used in order to purchase expensive consumption goods; countries agree on emission targets to protect the environment; central banks set target inflation rates; quota systems are introduced to promote gender equality; firms make use of management styles that involve milestones on production, sales or consumers' satisfaction; etc. Despite the omnipresence and thus the seeming importance of goals, their systematic investigation is rather a recent development in economics (e.g., Huffman and Götte, 2007; Koch and Nafziger, 2011, 2016; Corgnet, Gómez-Miñambres and Hernán-Gonzalez, 2015; Dalton, Gonzalez and Noussair, 2016). This development will be summarized here, as to provide both an overview of and a potential taxonomy for the existing economic models of goal setting. Moreover, we report results from a field experiment on the *endogenous* selection of goals in a natural work environment, and on the impact of these self-chosen goals on work effort.

Studying *self-chosen* goals is particularly interesting since the economic literature frequently focuses on goals that are set exogenously, i.e., by someone else.[1] These papers rely on models that build on (variations of) loss aversion and reference-dependent preferences: goals provide a reference point against which (psychological) gains and losses are evaluated (e.g., Koch and Nafziger, 2011). Thus, on a broader level our research relates to the more general research on reference-dependent preferences (e.g., Kőszegi and Rabin, 2006; Abeler et al., 2011), because explicitly choosing a goal might be interpreted as setting a reference point against which gains and losses are evaluated.

Yet, these basic economic models of goal-setting behavior are difficult to reconcile with the situation of setting a *non-binding* goal for oneself.[2] In this situation, it is tempting

[1] The literature on endogenous goals, which mostly relies on time-consistency problems, will be discussed in detail in the related literature section below.

[2] We refer to a non-binding goal as a goal that does not carry a monetary component *per se*; i.e., that does not trigger an additional monetary payment once it is reached. By contrast, goals that trigger a

to set oneself only a minimal goal if no monetary incentives are tied to the goal size, because falling short of (exceeding) the reference point of the chosen goal would create a loss (gain) in utility otherwise. This raises the question if people indeed do so, and if not how to alter the theoretical models as to account for the behavioral pattern of setting a challenging goal for oneself.

To shed light on actual goal-setting behavior, we use data from a series of natural field experiments that allow us to disentangle the effects of self-chosen goals and monetary incentives on work performance. All treatments in our 2×3 factorial design (task difficulty × incentives) were conducted in the same effort-intense work environment. Between treatments, we varied in a controlled manner the underlying monetary incentives and whether workers had to set a personal work goal. More precisely, we hired workers to help in the process of restructuring a large library. It was a one-time job and each worker was only employed for a single working day. The task, which was either of HIGH DIFFICULTY or LOW DIFFICULTY, was to search the library shelves for specific books from a given list. Wage payments consisted of a fixed wage and, in some treatments, an additional piece-rate component. In treatment PIECERATE, €0.10 was paid for each book found by the worker. The same piece-rate was used in treatment PIECERATE+GOAL. The only difference was that, before workers started searching for the books, we asked them for their expectation about the number of books they thought they would find during the working day. Their stated belief was then referred to as their personal work goal. Neither missing nor attaining the self-chosen work goal, however, yielded monetary consequences. The same goal-setting procedure was used in treatment GOAL, but compared to the other two treatments, there was no piecerate component and workers received only the fixed wage.

Given our treatment manipulations, the difference in behavior between PIECERATE and PIECERATE+GOAL thus identifies the effect of a self-chosen goal, holding monetary incentives constant. Moreover, the comparisons to treatment GOAL help us to identify the effectiveness of self-chosen goals per se. Additionally, the manipulation of the task difficulty allows to determine the robustnesses of our results. We find that self-chosen work goals significantly affect workers' output. Under both HIGH and LOW task difficulty, the average productivity in treatment PIECERATE+GOAL is 15-17% higher than in PIECERATE. By contrast, the comparison between PIECERATE and GOAL depends on the task difficulty: with a HIGH DIFFICULTY we observe a 17% higher output while with a LOW DIFFICULTY the difference is only 2%.

bonus payment are studied empirically in two companion papers (Goerg and Kube 2012; Goerg, Kube and Radbruch 2016). The latter features *exogenous* goals that are set by a principal rather than by the agent himself; see also Herweg, Muller and Weinschenk (2010) for a theoretical analysis.

With respect to the sizes of the self-chosen goals, we find that goals are generally higher in Piecerate+Goal than in Goal. At the same time, within a given treatment the goals do not differ significantly between the High and Low Difficulty task, which suggests that workers do not adequately adjust their goals to the task difficulty. Compared to the actual output, goals are thus easier to attain in the Low Difficulty task. Taken together, these observations suggest that i) workers' performance is shaped by both the monetary incentives and the non-monetary goal achievement, and that ii) workers' goal-setting is shaped by the monetary incentives. These findings are consistent with a simple model of goal setting that we will introduce in Section 3. Before that, we provide on overview of the existing economic goal-setting models in Section 2. Section 4 introduces the design of our natural field experiment. Section 5 presents our results. We conclude with a discussion in Section 6.

2 Goal Setting in Economics

The study of goals within economics has lead to a rapidly growing number of publications with diverse applications. Hence, goals have successfully been applied to topics such as social comparisons Falk and Knell (2004), energy consumption (Harding and Hsiaw, 2014), workplace behavior (Corgnet, Gómez-Miñambres and Hernán-Gonzalez, 2015), and educational performances of college students (van Lent and Souverijnz, 2016; Clark et al., 2016).

Broadly speaking, the literature on goals can be divided into two categories: *exogenously imposed goals* by a principal and *self-chosen goals* picked directly by an agent. *Exogenously imposed goals* can take the form of binding goals with monetary consequences (a bonus) or as non-binding goals where attainment has no additional consequences. Gómez-Miñambres (2012) and Corgnet, Gómez-Miñambres and Hernán-Gonzalez (2015) provide models for the latter situation in which a manager assigns a non-binding goal that functions as reference point for workers' intrinsic motivation. Using a lab experiment, Corgnet, Gómez-Miñambres and Hernán-Gonzalez (2015) test their model in a principal-agent setting. In their experiment managers indeed decide to use challenging but attainable goals and workers respond to these goals with increased output and reduced leisure activities.

The paper at hand fits into the category of *self-chosen goals* which have been shown to be a source of internal motivation to attenuate the self-control problem of hyperbolic discounters. Hsiaw (2010, 2013) models this in the context of an optimal stopping problem over an infinite time horizon, where uncertainty about outcomes generates an option value of waiting. In this model, by providing a reference point, goal-setting attenuates the

tendency to undervalue the option and to stop too early. A similar approach is presented in Koch and Nafziger (2011) who, too, study self-control problems. In their two-period model, goals are set in the first period and later used to evaluate the outcome in the second period. Assuming that agents care about reaching the reference standard set by the goal, goals become binding and help to overcome the self-control problem. If agents face minor uncertainty about their productivity they should bracket their goals narrowly (e.g., daily work goals) and they should bracket broadly (e.g., monthly work goals) if they face significant uncertainty (Koch and Nafziger, 2016).

Corresponding empirical evidence of goals being used as an efficient self-disciplining device is provided by Kaur, Kremer and Mullainathan (2010, 2015), suggesting that individuals indeed tend to use self-disciplining devices. They find that a fraction of workers in an Indian data-entry firm voluntarily agrees to incur a monetary loss when falling short of a self-chosen production target. Dalton, Gonzalez and Noussair (2016) provide further evidence with a lab-experiment. They investigate a self-chosen goal contract in which reaching the goal is backed up with monetary incentives, i.e., yielding a bonus when the self-chosen goal is reached. There, the self-chosen goal contract is more cost effective than a piece rate contract and workers choose goals which they tend to outperform. We complement this literature by providing causal evidence from the field demonstrating that self-imposed goals can be effective if attainment does not result in additional payments and even further in the total absence of any monetary incentives.

Table 1 summarizes the existing economic literature that includes theoretical models of goal setting. For each study, we provide details regarding model type, goal type (e.g., exogenously or endogenously set) and the specific type of setting at hand. More specifically, i) **goal type** discriminates between studies that feature exogenous goals, which are taken as given by the individual, and endogenous goals, which the agent sets for himself.[3] ii) **Reference-dependent preferences** indicates studies where an agent's utility depends on her performance relative to a standard, which in the present paper, is the agent's goal or a function of the goal. iii) **Present-biased individuals** are typically captured by a "many selves" model in which the agent at different points in time values payoffs differently. For example, at time $t = 0$ an individual places equal weights on the benefit and cost of their future efforts, whereas the same individual at time $t = 1$ places higher weights on the costs of current efforts as compared to current benefits. iv) **Loss aversion** describes models where losses loom larger than benefits. v) Another dimension where economic models on goal setting differ is in assuming **diminishing sensitivity**:

[3]A third type of goal exists not touched on by the studies in Table 1, known as participatory goals. Participatory goals are goals which are determined by two agents simultaneously, such as between an employee and her employer.

As the absolute difference between output and the reference point increases, so does the associated payoff in absolute utility.[4] vi) Finally, **consumption utility** indicates models where agents derive utility directly from their output, e.g., pecuniary incentives, letter grades, etc. This is different from intrinsic or psychological utility which agents derive in the presence of goal-setting.

Not included in Table 1 is the recent work on labor supply and wage shocks, which implicitly deals with self-chosen goals as well (e.g., Camerer et al., 1997; Fehr and Götte, 2007; Huffman and Götte, 2007; Farber, 2008; Crawford and Meng, 2011). The main message from these studies is that temporary wage increases (e.g., windfall gains or increased productivity) can lead to a reduction in labor supply, arguing that such patterns could be a result of workers trying to achieve a certain daily income target. Our study differs insofar as our workers explicitly state their goals, and as these goals are on production rather than on income. Our findings suggest that implicit income targets can be replaced with an explicit production goal. This could potentially even mitigate the detrimental effects of income targets on efforts, though future studies would need to have treatments in which, for example, the piecerate or the production technology is varied to provide conclusive answers.

Outside of Economics, research on goals has a long tradition and is still flourishing (for excellent comprehensive reviews, see, e.g., Locke and Latham, 2002, 2006, 2013; Moskowitz and Grant, 2009). In particular, the literature in Psychology primarily focuses on the motivational and cognitive aspects of goals and the basic processes which translate goals into actions – distinguishing goals from (and relating them to) other motivational constructs. It is also exploring differences in goal contents, stressing that goals should be feasible and S.M.A.R.T. (Specific, Measurable, Attainable, Relevant and Timed). Furthermore, it is investigated how goals are regulated and pursued with the corresponding consequences. Almost all of these studies have consistently demonstrated that individuals' behavior is indeed affected by goals.[5] Our paper ties nicely with this literature by exploring the interaction between motivation, self-chosen goals, and monetary incentives.[6]

[4]Put differently, the marginal benefit of exceeding the reference point is smaller the further away from the reference point. This also holds in the domain of losses.

[5]Sometimes negatively, see Ordóñez et al. (2009) or for a concise survey Goerg (2015).

[6]For example, the recent comprehensive reference work for "The Psychology of Goals" edited by Moskowitz and Grant (2009) does not include a single instance of the terms "monetary incentive" or "contract". We are not aware of any study in this area that has focused on the interplay between self-chosen work goals and economic incentive contracts. What has been studied are different contracts with exogenously imposed (binding or non-binding) goals, e.g., Lee, Locke and Phan (1997) or Corgnet, Gómez-Miñambres and Hernán-Gonzalez (2015), or the influence of the general goal "to make money" on behavior, e.g., Aarts, Gollwitzer and Hassin (2004).

Study	Goal Type: Endogenous	Goal Type: Exogeneous	Reference dependence	Present-biased individuals	Loss aversion	Diminishing sensitivity[†]	Consumption utility	Empirical analysis	Setting[‡]
Falk and Knell (2004)	✓		✓			+	✓	✓	2
Wu et al. (2008)		✓	✓		✓	+/−			4
Jain (2009)	✓		✓	✓			✓		4
Suvorov and van de Ven (2009)	✓	✓	✓	✓	✓		✓		4
Hsiaw (2010)	✓		✓	✓			✓		4
Koch and Nafziger (2011)	✓		✓	✓	✓		✓		4
Gómez-Miñambres (2012)		✓	✓		✓	+	✓		1
Hsiaw (2013)	✓		✓	✓			✓		4
Harding and Hsiaw (2014)	✓		✓	✓		+/−		✓	3
Corgnet et al. (2015)		✓	✓		✓	+/−	✓	✓	1
Clark et al. (2016)	✓		✓	✓	✓		✓	✓	2
Dalton et al. (2016)	✓		✓		✓	+/−	✓	✓	1
Koch and Nafziger (2016)	✓		✓	✓	✓		✓		4
Hsiaw (2016)	✓		✓	✓	✓		✓		4
Lent and Souverijn (2016)	✓	✓	✓					✓	2
This paper	✓		✓		✓	+/−	✓	✓	1

[†] + denotes denotes diminishing sensitivity in the domains of gains and − in the domains of losses.
[‡] Each study can be broken down into one of the following settings:
1 - Workplace incentives, 2 - Educational improvement, 3 - Energy conservation, 4 - General environment

Table 1: Summary of goal-setting models.

3 A Simple Model of Goalsetting

In this section, we present a simple model of motivation through goal-setting from which we generate testable predictions. We consider a production environment in which a single worker is incentivized to exert high effort by either monetary incentives (PIECERATE) or self-chosen goals (GOALS), or both (PIECERATE+GOALS).

In addition to a fixed wage payment $w_F \geq 0$, a single risk-neutral agent is incentivized to exert high effort $e \geq 0$ by either a pay-for-performance contract, or asked to choose a non-binding production goal g, or both. The pay-for-performance contract offers a piece-rate of $w_p > 0$ for each unit of output $y = ae$ produced, where $a \in (0, 1]$ represents the ability of the individual. We assume that effort costs are strictly convex and given by $c(e) = de^2/2$, where $d \in \{d_L, d_H\}$ is the task difficulty parameter and $d_H > d_L > 0$.[7] Reaching or failing to reach the self-chosen goal does not affect the agent's utility through triggering monetary compensation, but it does affect the agent's intrinsic utility $v(y, g, s)$, which is given by

$$v(y, g, s) = \begin{cases} \psi(g, s)(y - g)^{1/2} & \text{if } y > g \\ -\lambda\psi(g, s)(-(y - g))^{1/2} & \text{if } y \leq g \end{cases}, \tag{1}$$

where $\lambda > 1$ represents the coefficient of loss-aversion (Kahneman and Tversky, 1979), and $\psi(g, s)$ is the goal commitment function to capture the intensity of goal commitment, which depends on the agents own personal standard $s > 0$ in the following way

$$\psi(g, s) = \begin{cases} sg & \text{if } g > s \\ 0 & \text{if } g \leq s \end{cases}. \tag{2}$$

There are several important features of this particular form of intrinsic utility. First, note that $v(\cdot)$ exhibits the main properties of the value function from prospect theory (Kahneman and Tversky, 1979): (i) the function is piecewise-continuous about the self-chosen goal, i.e., utility is separated into the domains of gains and losses with respect to the reference point g, (ii) there are diminishing gains, or losses, as $|y - g|$ increases, and (iii) agent's are assumed to be loss-averse, i.e., failing to reach the goal by a small amount $\epsilon > 0$ is more painful than surpassing it by the same amount. This functional form is beneficially not just for it's simplicity, but because empirical evidence supports the existence of these properties in the goal setting process (Heath, Larrick and Wu, 1999).

An additional feature is the goal commitment function $\psi(g, s)$ (which is also used

[7] For the purpose of the experiment, there is no exact way to estimate the precise form of the participant's cost function. For simplicity, and to be able to obtain predictions, we assume quadratic costs without loss of generality.

in Gómez-Miñambres, 2012). In the event that the goal selected is lower than or equal to their personal standard, the agent feels no commitment and receives no additional benefit from reaching her goal. However, for goals deemed challenging (i.e., $g > s$), the goal commitment function positively (negatively) impacts intrinsic utility provided she meets (does not meet) her goal. Thus, an agent with high standards sets high goals, and therefore has a larger commitment to her goal. Clearly, an agent would set herself only a challenging goal, i.e., $g > s$, because if not she forfeits any benefit she would receive from reaching her goal; which implies the goal commitment function is always given by $\psi(g, s) = sg$. It is natural to assume that the standard depends on the difficulty of the task at hand and the agent's ability. For simplicity, we will assume the following functional form $s(a, d) = \frac{a}{d}$. Thus, the standard is decreasing in task difficulty and increasing in ability.

The agent operates in only one of three possible incentive structures: Piecerate, Goals, or Piecerate+Goals. In the event the agent is only offered a piece-rate for each unit of output produced, the agent chooses an effort level $e = \frac{y}{a} > 0$ to maximize her total utility, which in this case is given by

$$u = w_F + w_p y - \frac{d}{2}\left(\frac{y}{a}\right)^2. \tag{3}$$

Equating marginal costs to marginal benefits, it is easy to see that the optimal level of output is $y^{PR} = a^2 w_P / d$.

In the other two cases of Goals and Piecerate+Goals, the agent faces a slightly more complex optimization problem. In addition to output, the agent chooses the size of her production goal $g > s > 0$. Thus, the agent now chooses an output-goal pair (y, g) to maximize her total utility subject to the constraint $g > s$. If the agent is incentivized by both pay-for-performance compensation and goals (Piecerate+Goals), her total utility is given by

$$u = \begin{cases} w_F + w_P y + \frac{ag}{d}(y-g)^{1/2} - \frac{d}{2}\left(\frac{y}{a}\right)^2 & \text{if } y > g \\ w_F + w_P y - \frac{\lambda ag}{d}(-(y-g))^{1/2} - \frac{d}{2}\left(\frac{y}{a}\right)^2 & \text{if } y \leq g \end{cases}, \tag{4}$$

Total utility is similar for the case when the agent is only motivated by goal-setting (Goals), but the piece-rate pay $w_P y$ is removed.

In either setting, three possibilities arise: (i) $y < g$, (ii) $y = g$, and (iii) $y > g$. First, note that it is never optimal for the agent to stop producing output at the moment she meets her goal (i.e., $y = g$). This is due to the discontinuity at $y = g$, in which marginal intrinsic utility tends to infinity as $y \to g^-$ and $y \to g^+$ for any $g \geq s$, implying the agent

would be better off with either $y < g$ or $y > g$.[8]

Suppose the agent chooses the pair (y, g) such that $y < g$. Then the agent fails to meet her goal and receives the following total utility

$$u = w_F + w_p y - \frac{\lambda a g}{d}(-(y-g))^{1/2} - \frac{d}{2}\left(\frac{y}{a}\right)^2. \tag{5}$$

Thus, the agent's maximizes (5) subject to $g > s$ and $g > y$. The first-order conditions are:

$$w_p + \frac{\lambda a g}{2d}(g-y)^{-1/2} - \frac{d}{a^2}y = 0 \tag{6}$$

$$-\lambda\frac{a}{d}(g-y)^{1/2} - \frac{\lambda a g}{2d}(g-y)^{-1/2} = 0, \tag{7}$$

Note that Eq. (7) implies that $\frac{3}{2}g = y$, which contradicts the assumption that $g > y$. Therefore, it is never optimal for the agent to produce output below her goal.

Finally, suppose $y > g$. Then the agent maximizes

$$u = w_F + w_p y + \frac{a g}{d}(y-g)^{1/2} - \frac{d}{2}\left(\frac{y}{a}\right)^2 \tag{8}$$

subject to $y > g$ and $g > s$. The first-order conditions are:

$$w_p + \frac{a g}{2d}(y-g)^{-1/2} - \frac{d}{a^2}y = 0 \tag{9}$$

$$\frac{a}{d}(y-g)^{1/2} + \frac{a g}{2d}(y-g)^{-1/2} = 0, \tag{10}$$

From Eq. (10) we find that $\frac{3}{2}g = y$, consistent with our assumption that $y > g$, which can be substituted into (9) to find the optimal pair (y^*, g^*).[9]

Based on the above model we expect individuals facing a Low Difficulty to produce more output than the ones facing a High Difficulty. In addition we expect individuals' abilities to be correlated with the produced output. Figures A.1 and A.2 in Appendix A demonstrate these intuitive results graphically. In addition, our goal and incentive manipulations yield the following testable hypothesis on the observed output :

[8] Holding output fixed, the same is true as the goal approaches output.

[9] The second-order sufficient conditions for the optimality of (y^*, g^*) require that $(-1)^k |H_k(y^*, g^*)| > 0$ for $k = 1, 2$, where H_k is the k^{th} leading principal minor of Hessian matrix $H = \begin{bmatrix} \frac{\partial^2 u}{\partial y^2} & \frac{\partial^2 u}{\partial y \partial g} \\ \frac{\partial^2 u}{\partial y \partial g} & \frac{\partial^2 u}{\partial g^2} \end{bmatrix}$. It is easy to verify that (y^*, g^*) is a maximum provided $g^* > \frac{1}{2}\left(\frac{a^2}{d(2+a)}\right)^2$.

Hypothesis 1 *Holding task difficulty and ability constant, the incentive structure ranking, from highest output to lowest, is:* PIECERATE+GOALS ≥ GOALS > PIECERATE.

Hypothesis 1 results from examining the output while keeping levels of difficulty and ability fixed. Based on the above model PIECERATE+GOALS should outperform GOALS, albeit by such a small amount that it might be empirically impossible to identify (therefore, we do not expect a strict inequality). However, both treatments, PIECERATE+GOALS and GOALS, should significantly outperform PIECERATE. The above ranking is a direct result of self-chosen goals and we will now focus on the goal setting itself. Analogously to the previous discussion on outputs, we expect individuals facing a LOW DIFFICULTY to choose higher goals than the ones facing a HIGH DIFFICULTY and individuals' abilities to be correlated with the chosen goal. Again, figures A.1 and A.2 of Appendix A demonstrate these intuitive results graphically. With regard to our incentive manipulation we expect the following ranking:

Hypothesis 2 *Holding task difficulty and ability constant, we expect (marginally) higher goals in* PIECERATE+GOALS *than in* GOALS.

Based on the above analyses we should observe the following relationship between output and goals:

Hypothesis 3 *Higher goals should lead to higher output.*

Our model shares similarities with recent theoretical contributions, but we differ in several important ways. First, we focus on self-chosen goals. Therefore, agents in our model have an additional choice variable, the size of the goal, on top of choosing how much effort they exert on the task. To capture the psychological or intrinsic utility an agent gains (loses) when the goal is (is not) reached, we assume that goals act as reference points that separate intrinsic utility into the domains of gains and losses.[10] Second, we modify the intrinsic utility function to capture the intensity to which the individual strives towards meeting her goal, commonly referred to as "goal commitment", which acts as a positive (negative) weight on the agent's intrinsic utility in the event that she exceeds (does not exceed) her goal (Gómez-Miñambres, 2012). Under this specification, we capture the realistic relationship that goals are positively correlated to personal standards.[11]

[10] See also Wu, Heath and Larrick (2008); Gómez-Miñambres (2012); Corgnet, Gómez-Miñambres and Hernán-Gonzalez (2015); Hsiaw (2010, 2013), or cp. Table 1 for more details and classifications of the common models used in the economic goal-setting literature.

[11] Without the assumption that workers take their standards into account when choosing goals, it is always optimal for the worker to choose the lowest possible goal, i.e., a production goal of zero, and to carry out the maximization with the sole choice variable effort.

Our model is most closely related to Wu, Heath and Larrick (2008), who in addition to reference-dependence, assume that the intrinsic utility exhibits the properties of the value function from prospect theory (Kahneman and Tversky, 1979), namely, loss aversion and diminishing sensitivity. However, we allow the agent to have full control over the size of their goal. In principle, they could even set themselves very low goals though it turns out that they will set themselves non-trivial goals, i.e., goals in excess of their own personal standard.[12]

4 Experimental Design

To empirically test the effectiveness of self-chosen goals on workers' performance, we conducted a series of field experiments. The experiments took place at the library of a German research institute and participants had to find books according to a list given to them. In the first set of the experiments, we benefited from the fact that the books in the library had to be rearranged. For this every book had to be located in the library shelves and then relocated to a new place in a different shelf.[13] The second set of the experiments was conducted in the same library after the rearrangement of the books. The rearrangement of the books was done to make it easier to find books and, therefore, the task is intentionally easier in the second set of the experiments. In the following we will refer to the experiments with the original arrangement of books as HIGH DIFFICULTY experiments and to the experiments with the new arrangement as LOW DIFFICULTY experiments. All other elements, treatments, and procedures, which we will describe in the following, were identical under HIGH DIFFICULTY and LOW DIFFICULTY

4.1 Treatments

We implemented three incentive under both HIGH DIFFICULTY and LOW DIFFICULTY yielding a 2×3 factorial design. In all schemes, subjects received a fixed payment of €22, but we manipulated the use of performance-related payments and self-chosen work goals. In PIECERATE workers receive a regular piecerate of €0.1 per produced output, i.e, each book relocated. In GOAL workers receive no additional payments beyond the fixed payment of €22. Instead we asked them for their expectation about the number

[12] An alternative to the assumption of workers deriving intrinsic utility from reaching their goal would be the use of a monetary bonus, which is increasing in goal size and paid contingent on reaching the goal (Dalton, Gonzalez and Noussair, 2016).

[13] In this section, we focus on those elements of the work environment that are of central importance for our study. Comprehensive descriptions of the background of the library's restructuring, procedural details, work task and payment instructions used in the different treatments are provided in the appendix.

of books they thought they would find during the working day. Their stated belief was then referred to as their personal work goal. Missing the self-chosen work goal yielded no monetary consequences. The third scheme PIECERATE+GOAL combines the features of the previous two schemes; workers receive a regular piecerate of €0.1 per produced output and are asked to specify their personal work goal.

In total 130 subjects participated in this study: 75 subjects in HIGH DIFFICULTY (25 in PIECERATE, resp. 20 in GOALS and 25 in PIECERATE+GOALS) and 60 subjects in LOW DIFFICULTY (20/20/20). About 57% of our subjects were male and the average age was about 23.4. On average, subjects earned 29.83 € in the HIGH DIFFICULTY and 33.89 € in the LOW DIFFICULTY treatments.

4.2 Procedures

The job to search the library for books and relocate them was advertised online and via posters as a one-time job opportunity, which would last 3.5 hours and pay a minimum of 22 €. Potential workers applied online. Actual workers were randomly selected from the pool of applicants. They were invited via email and asked to confirm the time slot that was allocated to them.

The experiments were carried out by a librarian, strictly following a fixed protocol. Upon arrival, the subject received a short manual describing the exact work task. After having read the written instructions, the subject got an extensive list of books to be searched. The subject's task was to work through the list sequentially: i) finding the corresponding book in the shelves, ii) scanning its ID at a workstation and then iii) placing it in a book trolley right next to the work station. The exact order of books as given by the list had to be kept, because books would later be relabeled and placed into the shelves according to this order by the librarians.[14] The books on the list were not ordered alphabetically, so that the probability of two successive books on the list being close to each other in the shelves was virtually zero. Note that the simple work task is well suited for a field experiment. It is easy to understand and output is sensitive to the worker's effort due to the physical component involved in moving mobile shelves and walking around in the library. Moreover, due to the digital timestamp that is created in the database whenever a book's ID is scanned at the workstation, we also have a precise electronic measurement of workers' performance over time.

After instructions were completed, workers had to do two supervised trials, i.e., each

[14]Consequently, afterwards the librarians had to control the order of the books and thereby checked the quality of the students' work. No complaints occurred; there was not a single reported incidence of quality problems.

subject had to search for two books and scan them at the workstation while a librarian was watching. This served three purposes. First, it ensured that each worker had understood the work task. Second, it provided workers with a rough estimate of how long they approximately need to find a book — which is important information for workers when they have to set themselves a goal. Third, the average time needed to find a book can be used to approximate subjects' general ability for this kind of task; allowing us to control for potential heterogeneity among individuals.[15] After subjects had left, the two trial books were put back in their original place, so that the ability measure was always based on the same two books.[16]

To avoid influences of the treatments on the ability measure, the exact payment scheme was announced only after the two trials. Like the task description, the scheme was handed out in written form and was additionally explained by a librarian. Subjects then could ask clarifying questions. Afterwards, if the treatment featured a self-chosen goal, subjects had to announce their personal goal and a post-it with it was attached to the display of the workstation. The librarian then started a timer before leaving the workplace, and the worker proceeded with the task for three hours. The workstation always displayed the current number of scanned books. Subjects were allowed to take a break whenever necessary. After exactly three hours, the librarian returned, checked the total amount of scanned books, calculated the total payoff accordingly and paid the subject. In the end, the subject had to complete a short employee questionnaire on work satisfaction and left. Each subject only participated once.

5 Results

Table 2 provides summary statistics on the time per book, i.e., speed of the worker, the workers' output, and the chosen goal size if applicable. The table reveals that, as expected, subjects worked faster and produced higher outputs under Low Difficulty than under High Difficulty. The comparisons of speed as well as outputs between the two difficulty levels are significant for each incentive treatment (all $p < 0.001$, two-sided

[15] Throughout this paper, ability is defined as the search time for the second trial-book (high ability thus corresponds to a low search time). Due to procedural issues, we are missing ability measures for 10 subjects.

[16] This was done to ensure the comparability of the measure between subjects. Moreover, it allows us to check whether the work task becomes easier over time. This could happen as shelves are successively cleared when more and more books are removed as the study proceeds. Yet, this does not seem to be the case. We find no general time trend in ability measures over the course of our study; neither in High Difficulty ($r = -0.09$ and $p = 0.475$, Spearman rank correlation between day of experiment and ability) nor Low Difficulty($r = 0.004$ and $p = 0.974$).

Fisher-Pitman permutation test for independent samples).[17]

Table 2: Summary Statistics

a. High Difficulty

	Time per Output (sec.)			Output			Goals		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Piecerate	113.5	111.1	26.9	102	101	20.6			
Goal	94	93.2	19.5	118.7	117.5	22.4	116.5	105	44.3
Piecerate+Goal	99.9	96.2	26.4	117.2	115	27.5	144	150	49.8

b. Low Difficulty

	Time per Output (sec.)			Output			Goals		
	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Piecerate	71	68.5	12.5	164.1	172.5	27.2			
Goal	68.8	70.3	13.6	167	158	29.6	115	100	55.7
Piecerate+Goal	60.3	59.8	10.2	192.9	189.5	25.9	150.5	155	47.3

In the following, we present our results with respect to the implemented treatments. We will start with workers' performances and investigate how fast they work and how much output they generate in the different treatments. Thereafter, we will focus on the two treatments with self-chosen goals. There, we will first investigate the determinants of the self-chosen goals, and then the influence of goals and monetary incentives on workers' output.

Figure 1 displays the workers' average speed, i.e., the time needed to produce one unit of output, through the course of the experiment. Under High Difficulty, subjects work faster if they work with self-chosen goals. Subjects need significantly more time in Piecerate to produce one unit of output than in Goal ($p = 0.006$) and Piecerate+Goal ($p = 0.078$). Working slower translates into a significantly smaller mean output of 102 in Piecerate compared to 118.7 in Goal ($p = 0.013$) and 117.2 in Piecerate+Goal ($p = 0.031$). Neither the speed nor the outputs differ significantly between Goal and Piecerate+Goal (speed $p = 0.414$ and output $p = 0.852$).

With Low Difficulty, subjects work faster in Piecerate+Goal than in Goal ($p = 0.031$) and Piecerate ($p = 0.004$). Thus, workers' mean output of 192.9 in Piecerate+Goal is significantly larger than the mean output of 167 in Goal ($p = 0.006$) and

[17]The Fisher-Pitman permutation test is a more powerful non-parametric alternative to the Wilcoxon-Mann-Whitney rank-sum test. For more details refer to Kaiser (2009). For the remainder of this paper, and if not otherwise reported, p-values are given for the two-sided Fisher-Pitman permutation test for independent samples.

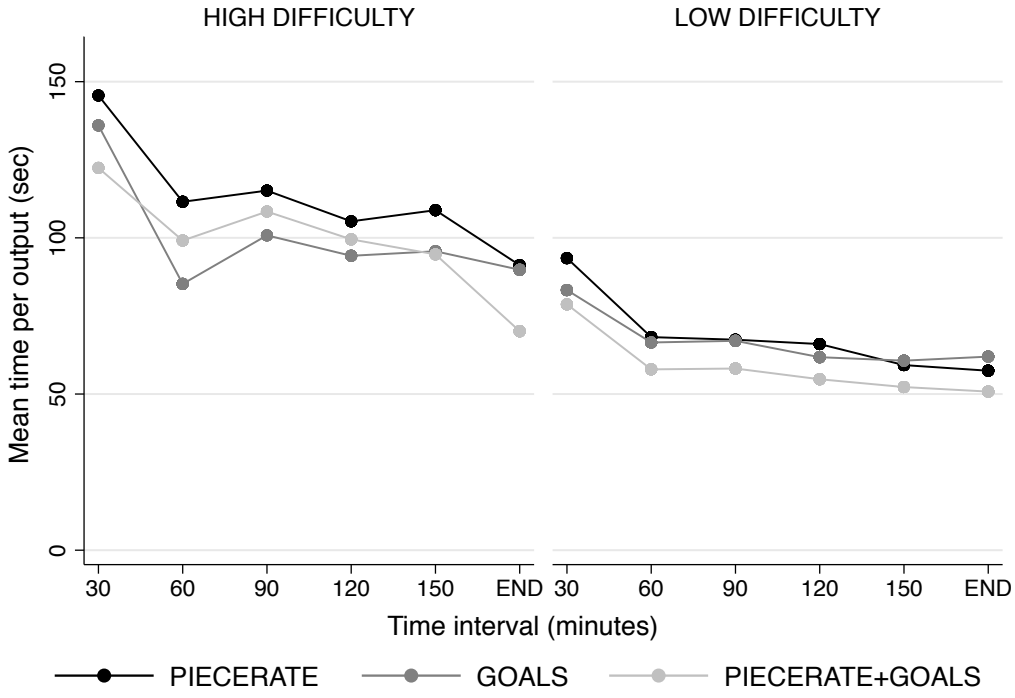


Figure 1: Mean time per output over the course of the experiment.

of 164.1 in Piecerate ($p = 0.001$). While workers in Goal were faster and produced higher outputs than in Piecerate in High Difficulty, this no longer holds in Low Difficulty; neither significant differences in speed ($p = 0.590$) nor in output ($p = 0.749$) are observed.

From the employer's perspective not only the produced output, but also the cost per produced output matters. In Piecerate and Piecerate+Goal workers earned a fixed wage of 22€ plus 10 Cent per unit of output produced, while in Goal they only received the fixed wage of 22€. Thus, the cost per output is significantly smaller in Goal than in Piecerate and Piecerate+Goal under both difficulty levels (for all comparisons $p < 0.001$).[18] Because of the higher output is the cost per book in Piecerate+Goal significantly smaller than in Piecerate ($p = .076$ in High Difficulty and $p = .002$ in Low Difficulty).[19]

Before taking a closer look at the chosen goals, we complement our non-parametric analyses with regression analyses, adding controls for other potential influences, in par-

[18]Cost per output with High Difficulty/Low Difficulty is .19/.24 Cents in Goal, .33/.24 Cents in Piecerate, and .30/.23 Cents in Piecerate+Goal.

[19]Of coure, if one would focus only on the marginal costs per book there would be no differences between Piecerate and Piecerate+Goal as we pay the exact same piecerate in both treatments. However, the marginal cost in Goal would still be lower, i.e., zero, as no piecerate is paid.

ticular individuals' ability as measured by the average time needed in the ability stage.[20] Table 3 gives the results of the estimated models using ordinary least squares (OLS).[21] Models 1, 3, 5, and 7 replicate our non-parametric results comparing speed and output in the treatments separately for HIGH and LOW DIFFICULTY. For the regressions comparing the time per output we utilize the full dataset which includes the time needed for each single unit of output; to control for within-subject correlation of times we cluster on the subject level. In Models 2, 4, 6, and 8 we add the individuals' time from the ability task, age, gender, and dummies for day of the week as additional controls. In addition, in the models utilizing the time data we control for learning the task by including the current output number and its square.[22]

As expected, the time needed at the ability stage is positively correlated with the time per output and negatively with the total output. Thus, subjects who are faster in the ability stage work faster on the task and produce a higher output. Neither gender nor age have a significant impact on speed or output. The rest of the table shows that our previously reported non-parametric results on speed and output are robust to the additional controls. Self-chosen goals in combination with monetary payoffs are a powerful way to increase output. But even without additional monetary incentives they can lead to higher output than a piecerate; or at least to a similar output at a lower cost. We thus conclude our first results:

Result 1 *Our results under* HIGH DIFFICULTY *are in line with hypothesis 1. Under both* PIECERATE+GOALS *and* GOALS *outputs are on similar levels and roughly 15% higher than under* PIECERATE.

Result 2 *Our results under* LOW DIFFICULTY *are partially in line with hypothesis 1. Output under* PIECERATE+GOALS *is again roughly 15% higher than under* PIECERATE. *However,* GOALS *results in a similar output level as* PIECERATE, *albeit at a lower cost.*

The previous part demonstrated that self-chosen goals can increase productivity. However, while average outputs in GOAL and PIECERATE+GOAL do not differ significantly under HIGH DIFFICULTY, they do differ significantly under LOW DIFFICULTY. Yet, the incentives in GOAL and PIECERATE+GOAL differ substantially: in GOAL, no monetary

[20] Ability neither differs significantly between treatments in HIGH DIFFICULTY ($p = 0.57$) nor in LOW DIFFICULTY ($p = 0.27$, both Kruskal-Wallis test).

[21] Table B.1 in the Appendix gives all coefficents.

[22] Subjects learn in this task and become better over time. In both HIGH and LOW DIFFICULTY are the coefficients for the current output number negative and its square positive. This implies that subjects become faster over time, but at a decreasing rate.

Table 3: OLS explaining Time per Output and Total Output

	High Difficulty				Low Difficulty			
	Time Per Output		Total Output		Time Per Output		Total Output	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Goal	-17.72**	-12.15***	16.70**	16.07**	-2.646	-2.769	2.950	1.506
	(8.744)	(4.038)	(6.464)	(6.516)	(4.583)	(3.532)	(8.984)	(8.781)
Piecerate+Goal	-14.29**	-9.465**	15.24**	13.09*	-10.10**	-11.34***	28.80***	29.60***
	(7.085)	(4.531)	(6.880)	(7.276)	(4.418)	(3.677)	(8.390)	(9.321)
Time Ability		0.0576**		-0.0931**		0.0476**		-0.159***
		(0.0239)		(0.0376)		(0.0224)		(0.0408)
Constant	108.5***	175.5***	102***	116.6***	69.51***	94.37***	164.0***	181.3***
	(4.348)	(23.44)	(4.119)	(33.20)	(3.433)	(19.72)	(6.080)	(39.26)
Controls	-	age, gender, #book, #book^2 day of week	-	age, gender day of week	-	age, gender, #book, #book^2 day of week	-	age, gender, day of week
Observations	7,853	7,147	70	64	10,479	9,867	60	56
Subjects	70	64	70	64	60	56	60	56
R-squared	0.001	0.014	0.097	0.234	0.001	0.005	0.188	0.453

Robust standard errors in parentheses. Clustering on subject level for the panel data of time per output.
$***p < 0.01$, $**p < 0.05$, $*p < 0.1$

incentives for additional outputs are provided while in PIECERATE+GOAL, the paid piecerate provides incentives for additional outputs. In the following, we will thus take a closer look at the interplay between self-chosen goals and incentives, in particular how the goal size is influenced by the two treatments GOAL and PIECERATE+GOAL.

Table 4: OLS EXPLAINING GOAL SIZE

	Goal	Goal	Goal	Goal
	(1)	(2)	(3)	(4)
PIECERATE+GOAL	31.29***	29.40***	32.41***	30.68***
	(10.64)	(10.79)	(10.41)	(10.50)
LOW DIFFICULTY	2.711	0.381	3.612	1.063
	(10.68)	(11.14)	(10.60)	(10.80)
Time Ability		-0.204**		-0.198**
		(0.0876)		(0.0834)
Male			22.90**	22.36**
			(10.62)	(10.73)
Age			-2.824	-3.294
			(2.682)	(2.608)
Constant	114.4***	148.8***	167.0**	211.9***
	(8.810)	(17.60)	(66.24)	(66.29)
Observations	85	81	85	81
R-squared	0.094	0.134	0.157	0.202

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Our data reveal that the size of the chosen goal is affected by the underlying incentive scheme. In line with hypothesis 2, goals tend to be higher when they coexist with additional incentives, i.e., a piecerate. With HIGH DIFFICULTY, the average goal of 144 books in PIECERATE+GOAL is significantly higher than the average goal of 116 books in GOAL ($p = 0.064$).[23] We observe the same pattern with LOW DIFFICULTY: on average subjects chose a goal of 150.5 in PIECERATE+GOAL which is significantly higher than the average chosen goal of 115 in GOAL ($p = 0.039$).

Interestingly, the goal size is influenced by the different incentives, but not by the difference in difficulty. The chosen goals in GOAL and PIECERATE+GOAL do not differ significantly between HIGH and LOW DIFFICULTY (for both $p > .68$). Still, the goal size is influenced by initial ability and gender. As expected, goal size and the time needed in the initial ability test are significantly correlated. Subjects who worked faster in the

[23]Note that the incentive schemes discussed in this paper trigger no (negative) monetary consequence if the goal is (not) reached.

ability test tend to chose higher personal goals ($r = -0.24$ and $p = 0.0306$, Spearman rank correlation). In addition, male workers tend to choose goals that are roughly 22 units higher than the ones chosen by female workers ($p = 0.064$).[24]

Table 4 demonstrate that these results can be confirmed with OLS regressions. Even when controlling for additional covariates (difficulty, ability, gender, and age) is the estimate for the goal size roughly 30 books higher in PIECERATE+GOAL than in GOAL. The difficulty has no significant impact on the chosen goal size. This suggests that workers do not adequately adjust their goals to the task difficulty.[25] Gender and the initial ability influence the chosen goal size and, as models 2, 3, and 4 demonstrate, they influence the chosen goal size independently of each other. We thus conclude our next result,

Result 3 *In line with hypothesis 2, subjects choose higher goals in* PIECERATE+GOAL *than in* GOAL. *In general, workers with higher ability tend to choose higher goals. In addition, male workers tend to choose higher goals than female workers, independent of ability.*

As we have shown, workers choose within GOAL and PIECERATE+GOAL similar goal sizes regardless of whether they work in the HIGH or LOW DIFFICULTY environment. Given the big differences between HIGH and LOW DIFFICULTY in workers' actual output, this results in significantly different rates of workers achieving their self-chosen goal. In GOAL, 55% of workers reach their goal under HIGH DIFFICULTY and 85% under LOW DIFFICULTY ($p = 0.038$, χ^2-test). In PIECERATE+GOAL only 32% of workers reach their goal under HIGH DIFFICULTY and 85% under LOW DIFFICULTY ($p < 0.001$, χ^2-test). With HIGH DIFFICULTY is the failure rate higher in PIECERATE+GOAL than in GOAL, but it does not reach conventional levels of significance ($p = 0.121$, χ^2-test). With LOW DIFFICULTY we observe identical failure rates under both incentive schemes.

Obviously, reaching a goal is highly correlated with the size of the goal ($r = -0.5458$ with $p < 0.001$, point-biserial correlation) — the smaller the goal, the higher the likelihood of reaching it. As previously demonstrated, male workers tend to choose significantly higher goals than female workers, even after controlling for initial ability, which translates into significantly different failure rates across gender. Overall, 52% of male workers reach their goal, which is a significantly lower success rate than among female workers with 74% ($p = 0.035$,χ^2-test). This difference is mostly driven by the behavior in the LOW DIFFICULTY environment, in which it is relatively easy to attain a high goal. All female

[24] We observe similar differences between female and male workers in both GOAL (103 vs.125) and PIECERATE+GOAL (135 vs. 158).

[25] Subjects need on average 37 seconds less in the ability stage under LOW DIFFICULTY ($p = 0.0014$). However, the coefficient for LOW DIFFICULTY is not significant even if we do not control for ability.

workers achieve their goal in Low Difficulty, while on average only 70% of males do ($p = 0.089$ in Goal and $p = 0.038$ in Piecerate+Goal, both χ^2-test). We summarize these observations as follows:

Result 4 *Workers are more likely to attain their goals under* Low *than under* High Difficulty. *On average, male workers fail more frequently to attain their self-chosen goals than female workers.*

Overall, and in line with hypothesis 3, is the chosen goal size significantly correlated with workers' output; the higher the goal the higher the output ($r = 0.273$ and $p = 0.012$, Spearman rank correlation). Figure 2 plots the relationship of goals and outputs for each incentive scheme in High and Low Difficulty environments.

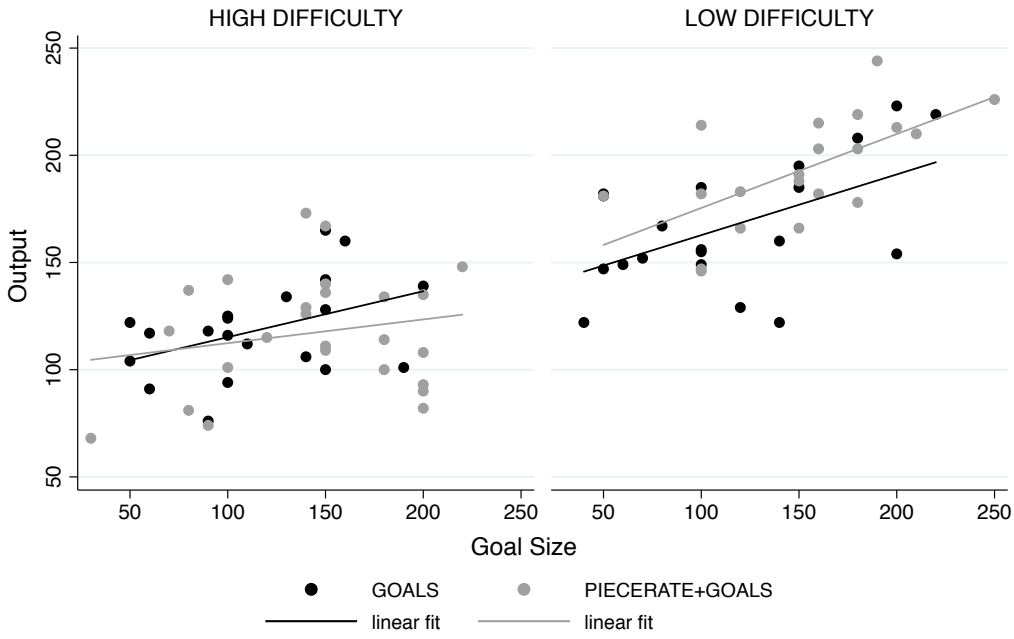


Figure 2: Relationship Goal Size and Output

The positive correlation between goals and output is significant for Goal with High and Low Difficulty, as well as for Piecerate+Goal with Low Difficulty (for all three treatments $r > 0.45$ and $p < 0.049$, Spearman rank correlation). However, they are not correlated in Piecerate+Goal with High Difficulty ($r = 0.07$ and $p = 0.739$, Spearman rank correlation). Table B.2 in the appendix shows OLS results regressing output and speed on goal size, ability, gender, and age for each treatment. The results confirm the positive effect of goal size on output in three of our four treatments and show that it is independent of ability.

Concerning the insignificant correlation between goal size and output in Piecerate+Goal under High Difficulty, note that only 32% of workers reach their goal in that treatment. Still, workers work faster with goals than without goals and consequently produce higher outputs in Piecerate+Goal than in Piecerate. One way of interpreting these findings is that goals are set too high in Piecerate+Goal under High Difficulty; and once workers realize this, the goals lose their motivational power while the monetary incentives of the piecerate keep their motivational power.

Along similar lines, our results under Low Difficulty suggest that goals can also be set too low. Compared to Piecerate, the output is significantly higher only in Goal+Piecerate, but not in Goal; although goals and output are significantly correlated in both treatments. Yet, goals are significantly higher in Goal+Piecerate than in Goal, suggesting that under Low Difficulty workers could have chosen (and attained) higher goals.

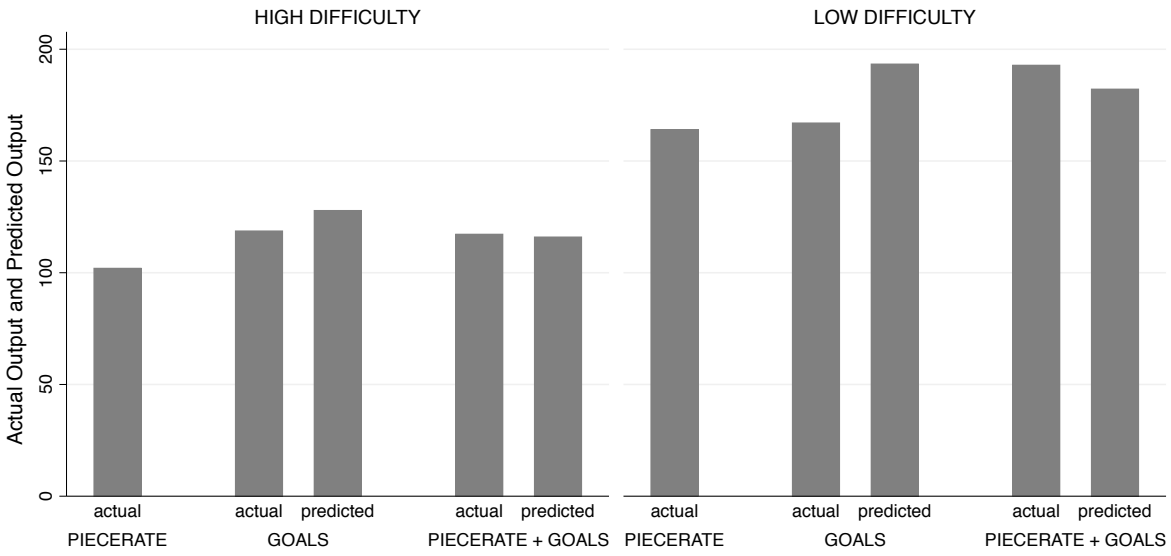
Thus, in a last step we will generate counterfactuals and analyze potential outcomes if workers would have chosen different goals. To produce counterfactuals we first separately estimate for both difficulty levels the influences on individuals' outputs Y_i with the following equation:

$$Y_i = \beta_0 + \beta_1 GoalSize_i + \beta_2 d_i^{\text{Goal}} + \beta_3 GoalSize_i \times d_i^{\text{Goal}} + \gamma \mathbf{X} + \epsilon_{\mathbf{i}}. \quad (11)$$

The output Y_i is determined by the chosen goal ($GoalSize_i$) and the goal scheme for which we control with an indicator (d_i^{Goals}) that is 1 in Goals and 0 in Piecerate + Goals. The interaction between the treatment indicator and the goal size controls for differences between treatments with respect to the impact of the goal size. The vector $\mathbf{X}$ controls for the additional individual specific characteristics of gender, age and time needed in the ability stage. In a second step, we predict output $\hat{Y}_i$ of worker i if a different goal would have been chosen. For this the actual goal is replaced with the average goal of the same ability quantile in the other goal treatment.[26] Figure 3 shows the results of this exercise and displays them next to the original outputs.

These counterfactuals do not change the comparisons under High Difficulty. Workers in Goal would have produced slightly higher outputs if they had chosen the average goal from Piecerate+Goal, yet the output would still not differ from the output in Piecerate+Goal ($p = 0.138$) and still be significantly higher than in Piecerate ($p < 0.001$). If workers in Piecerate+Goal would have chosen the average goal from

[26] Using the average goal per ability quantile leads to higher goals for high ability workers and lower goals for low ability workers. Qualitatively similar results are obtained if only the overall average goals of the treatments are used.



The predicted outputs $\hat{Y}_i$ are based on the estimation $Y_i = \beta_0 + \beta_1 GoalSize_i + \beta_2 d_i^{\text{Goal}} + \beta_3 GoalSize_i \times d_i^{\text{Goal}} + \gamma \mathbf{X} + \epsilon_\mathbf{i}$ done for each of the two difficulties. The prediction $\hat{Y}_i$ uses the mean goal of the same ability quantile of the other treatment.

Figure 3: Actual and Predicted Outputs in Both Studies

Goal it would have had only a negligible impact on the output which would still be significantly higher than the one in Piecerate ($p = 0.004$) and insignificant compared to the one in Goal ($p = 0.598$).

In Low Difficulty comparisons with the counterfactuals look different for Goal. If in Goal workers would have chosen the higher goals of Piecerate+Goal it would have lead to significantly higher outputs than in Piecerate ($p < 0.001$). Average output would then be very similar to the one in Piecerate+Goal ($p = 0.936$). The comparisons in Piecerate+Goal are not different with the counterfactuals. While output would have decreased with the average goal from Goal it would still have been higher than the outputs in Piecerate ($p = 0.007$) and Goal ($p = 0.023$).

Result 5 *In line with hypothesis 3 accurately sized goals lead to higher output. The output in* Goal *is very sensitive to the goal size and suffers under "badly" chosen goals. However, in* Piecerate+Goal *monetary incentives guarantee that workers work hard even when the chosen goals turn out to be unattainable or too low.*

6 Discussion and conclusions

In this paper, we explored how behavior is affected by self-chosen work goals when the goal attainment yields no additional monetary consequences. Our benchmark was a regular piece-rate contract without goals. When adding self-chosen goals to the piece-rate contract we observed a significant, both from a statistical and economical point of view, increase in outputs. In the absence of a piece rate, the performance of self-chosen goals depended on the task difficulty; compared to the benchmark, output was higher in a high difficulty environment, but similar in a low difficulty environment. Given our data, this difference was caused by workers failing to correctly adjust their goals to the difficulty of the work environment. This resulted in goals that were too low in the work environment with low difficulty, which impeded the effectiveness of goals in the absence of a piece rate.

Taken together, our results suggest that self-chosen personal work goals can increase performance. Their impact is more robust in the presence of monetary incentives — a finding which is consistent with evidence from exogenously assigned goals in principal-agent settings (Corgnet, Gómez-Miñambres and Hernán-Gonzalez, 2015) — but even in the complete absence of performance-based monetary incentives, self-chosen goals can still induce the same or even higher performances as a regular (and more expensive) piece-rate contract. Our results from two experimental waves with two different levels of task difficulty suggest that particularly the latter depends on the details of the work task. Naturally, it is thus an open question how these findings extend to different work environments and work tasks. In this respect, a very promising avenue for future research might be the study of long-term work relationships. Doing so would allow to study potential dynamics in repeated goal-setting: on the one hand, feedback from past performance might allow workers to tailor their goals more precisely to the difficulty of the work task, thus strengthening the positive effects of self-chosen goals; on the other hand, ratchet effects might induce workers to hold back effort or to set goals that are too low as to shape the outcome of future interactions, thus hampering the positive impact of goals on performance (Frank and Obloj, 2014).[27]

As we laid out in Section 3, the existing economic models rely on different approaches to motivate goal setting behavior. Thus, running experiments that involve repeated goal setting would also allow to study the underlying behavioral channels in more detail. The same is true for team environments, where the mere presence of peers (e.g., Falk and

[27]Ratchet effects might by particularly pronounced in dynamic incentive systems where future wage payments depend on current performance. With respect to work contracts that involve goals, this could be the case if goals are exogenously assigned by the principal and goal attainment triggers additional bonus payments, which are all cases that are not covered by our treatments.

Ichino, 2006; Bandiera, Barankay and Rasul, 2010), potential externalities on others' wages (e.g., Bandiera, Barankay and Rasul, 2005) or even the coexistence of individual and joint team goals might affect individual goal setting behavior. Controlled treatment manipulations along these dimensions would not only be interesting in themselves, but would also allow to explore how reference levels (e.g., the own personal standard in our model) are formed or how they evolve over time. This, in turn, could then be used to adapt economic models of goal setting, e.g., to take into account subjects' problems to pick goals that are in line with their actual productivity potential. We hope that the overview over the existing economic goal literature that we reported here, as well as our own work, provides a solid foundation for performing these next natural steps.

Finally, our collection of insights gained from existing papers on goal setting at the workplace (Section 2) and from our own results are potentially interesting when it comes to the design of incentive schemes from an applied management perspective. For example, should a manager try to elicit high efforts solely from monetary incentives, relying only on pay-for-performance? Should workers additionally be motivated by using self-chosen or exogenously assigned goals? How can certain performance levels be achieved in a cost-efficient manner? Of course, the answers to these questions ultimately rest on the exact characteristics of the work environment and the workforce.[28] Still, in view of the existing findings we believe that the introduction of a mechanism where workers choose and explicitly state their own work goals could be worth a try; in particular if these goals are not backed up by additional monetary incentives as to minimize the risk of incentives backfiring (Bowles, 2009).

References

Aarts, Henk, Peter M Gollwitzer, and Ran R Hassin. 2004. "Goal contagion: perceiving is for pursuing." *Journal of Personality and Social Psychology*, 87(1): 23–37.

Abeler, Johannes, Armin Falk, Lorenz Goette, and David Huffman. 2011. "Reference points and effort provision." *American Economic Review*, 101(2): 470–492.

Bandiera, Oriana, Iwan Barankay, and Imran Rasul. 2005. "Social preferences and the response to incentives: Evidence from personnel data." *Quarterly Journal of Economics*, 120(3): 917–962.

[28]For example, recall that male workers in our sample tended to choose higher goals than female workers and consequently a substantial fraction of male workers failed to attain their goals (see also Dalton, Gonzalez and Noussair, 2016, for similar findings).

Bandiera, Oriana, Iwan Barankay, and Imran Rasul. 2010. "Social incentives in the workplace." *Review of Economic Studies*, 77(2): 417–458.

Bowles, Samuel. 2009. "When economic incentives backfire." *Harvard Business Review*, March: 8b–8c.

Camerer, Colin, Linda Babcock, George Loewenstein, and Richard Thaler. 1997. "Labor supply of New York City cabdrivers: One day at a time." *Quarterly Journal of Economics*, 112(2): 407–441.

Clark, Michiel, David Gill, Victoria Prowse, and Mark Rush. 2016. "Using goals to motivate college students: Theory and evidence from field experiments." *IZA Discussion Paper*, No. 10283.

Corgnet, Brice, Joaquín Gómez-Miñambres, and Roberto Hernán-Gonzalez. 2015. "Goal setting and monetary incentives: When large stakes are not enough." *Management Science*, 61(12): 2926–2944.

Crawford, Vincent P, and Juanjuan Meng. 2011. "New york city cab drivers' labor supply revisited: Reference-dependent preferences with rational-expectations targets for hours and income." *American Economic Review*, 101(5): 1912–1932.

Dalton, Patricio S, Victor Gonzalez, and Charles N Noussair. 2016. "Self-chosen goals: Incentives and gender differences." *Working Paper*.

Falk, Armin, and Andrea Ichino. 2006. "Clean evidence on peer effects." *Journal of Labor Economics*, 24(1): 39–57.

Falk, Armin, and Markus Knell. 2004. "Choosing the Joneses: Endogenous goals and reference standards." *The Scandinavian Journal of Economics*, 106(3): 417–435.

Farber, Henry S. 2008. "Reference-dependent preferences and labor supply: The case of New York City taxi drivers." *American Economic Review*, 98(3): 1069–1082.

Fehr, Ernst, and Lorenz Götte. 2007. "Do workers work more if wages are high? Evidence from a randomized field experiment." *American Economic Review*, 97(1): 298–317.

Frank, Douglas H., and Tomasz Obloj. 2014. "Firm-specific human capital, organizational incentives, and agency costs: Evidence from retail banking." *Strategic Management Journal*, 35(9): 1279–1301.

Goerg, Sebastian J. 2015. "Goal setting and worker motivation." *IZA World of Labor*, August: 178.

Goerg, Sebastian J., and Sebastian Kube. 2012. "Goals (th)at work: Goals, monetary incentives, and workers' performance." *Working Paper*.

Goerg, Sebastian J., Sebastian Kube, and Jonas Radbruch. 2016. "The effectiveness of incentive schemes in the presence of implicit effort costs." *Working Paper*.

Gómez-Miñambres, Joaquín. 2012. "Motivation through goal setting." *Journal of Economic Psychology*, 33(6): 1223–1239.

Harding, Matthew, and Alice Hsiaw. 2014. "Goal setting and energy conservation." *Journal of Economic Behavior & Organization*, 107: 209–227.

Heath, Chip, Richard P Larrick, and George Wu. 1999. "Goals as reference points." *Cognitive Psychology*, 38(1): 79–109.

Herweg, Fabian, Daniel Muller, and Philipp Weinschenk. 2010. "Binary payment schemes: Moral hazard and loss aversion." *American Economic Review*, 100(5): 2451–77.

Hsiaw, Alice. 2010. "Goal-setting, social comparison, and self-control." *mimeo, Harvard University*.

Hsiaw, Alice. 2013. "Goal-setting and self-control." *Journal of Economic Theory*, 148(2): 601–626.

Huffman, D., and L. G. Götte. 2007. "Affect as a source of motivation in the workplace." In *Emotion and Decision-Making*. , ed. Roy Baumeister and George Loewenstein. New York:Russell Sage.

Kahneman, Daniel, and Amos Tversky. 1979. "Prospect theory: An analysis of decision under risk." *Econometrica*, 47(2): 263–291.

Kaiser, Johannes. 2009. "An exact and a Monte Carlo proposal to the Fisher–Pitman permutation tests for paired replicates and for independent samples." *The Stata Journal*, 7(3): 402–412.

Kaur, Supreet, Michael Kremer, and Sendhil Mullainathan. 2010. "Self-control and the development of work arrangements." *American Economic Review*, 100(2): 624–628.

Kaur, Supreet, Michael Kremer, and Sendhil Mullainathan. 2015. "Self-control at work." *Journal of Political Economy*, 123(6): 1227–1277.

Koch, Alexander K, and Julia Nafziger. 2011. "Self-regulation through Goal Setting." *Scandinavian Journal of Economics*, 113(1): 212–227.

Koch, Alexander K, and Julia Nafziger. 2016. "Goals and bracketing under mental accounting." *Journal of Economic Theory*, 162: 305–351.

Kőszegi, Botond, and Matthew Rabin. 2006. "A model of reference-dependent preferences." *Quarterly Journal of Economics*, 121(4): 1133–1165.

Lee, Thomas W, Edwin A Locke, and Soo H Phan. 1997. "Explaining the assigned goal-incentive interaction: The role of self-efficacy and personal goals." *Journal of Management*, 23(4): 541–559.

Locke, Edwin A, and Gary P Latham. 2002. "Building a practically useful theory of goal setting and task motivation: A 35-year odyssey." *American psychologist*, 57(9): 705–717.

Locke, Edwin A, and Gary P Latham. 2006. "New directions in goal-setting theory." *Current Directions in Psychological Science*, 15(5): 265–268.

Locke, Edwin A, and Gary P Latham. 2013. *New developments in goal setting and task performance.* Routledge.

Moskowitz, Gordon B, and Heidi Grant. 2009. *The psychology of goals.* Guilford Press.

Ordóñez, Lisa D., Maurice E. Schweitzer, Adam D. Galinsky, and Max H. Bazerman. 2009. "Goals gone wild: The systematic side effects of overprescribing goal setting." *Academy of Management Perspectives*, 23(1): 6–16.

van Lent, Max, and Michiel Souverijnz. 2016. "Goal setting and raising the bar: A field experiment." *Working Paper*.

Wu, George, Chip Heath, and Richard Larrick. 2008. "A prospect theory model of goal behavior." *mimeo, University of Chicago*.

A Figures

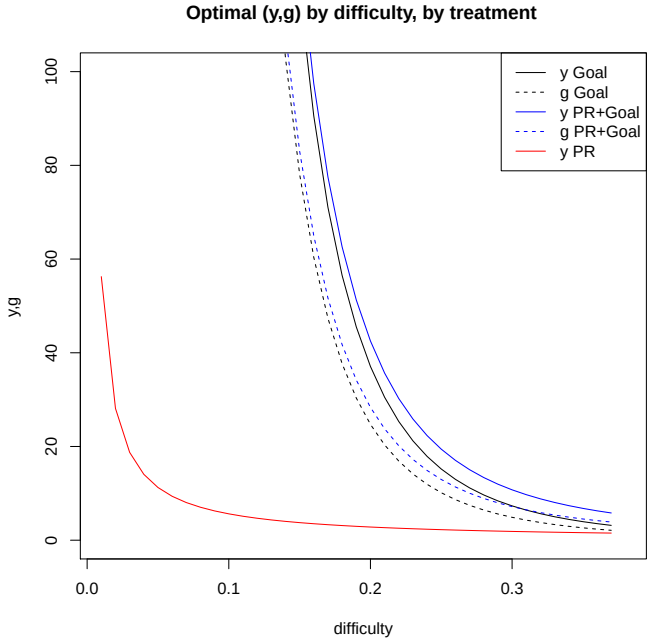


Figure A.1: Optimal output y and goal g (if present) as a function of difficulty, by treatment.

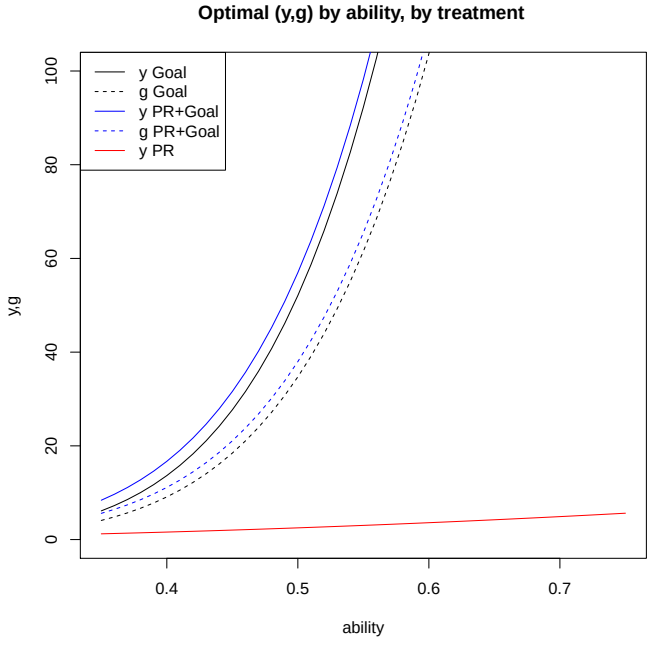


Figure A.2: Optimal output y and goal g (if present) as a function of ability, by treatment.

B Tables

Table B.1: OLS explaining Time per Output and Total Output

	High Difficulty				Low Difficulty			
	Time Per Output		Total Output		Time Per Output		Total Output	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Goal	-17.72**	-12.15***	16.70**	16.07**	-2.646	-2.769	2.950	1.506
	(8.744)	(4.038)	(6.464)	(6.516)	(4.583)	(3.532)	(8.984)	(8.781)
Piecerate+Goal	-14.29**	-9.465**	15.24**	13.09*	-10.10**	-11.34***	28.80***	29.60***
	(7.085)	(4.531)	(6.880)	(7.276)	(4.418)	(3.677)	(8.390)	(9.321)
Time Ability		0.0576**		-0.0931**		0.0476**		-0.159***
		(0.0239)		(0.0376)		(0.0224)		(0.0408)
Age		0.192		-0.208		0.0838		-0.563
		(0.779)		(1.259)		(0.704)		(1.486)
Male		1.396		-5.027		-1.243		7.927
		(3.748)		(6.391)		(4.080)		(8.435)
BookNumber		-2.190***				-0.722***		
		(0.423)				(0.156)		
BookNumber2		0.0106***				0.00304***		
		(0.00272)				(0.000946)		
Tuesday		-8.586		12.56		1.790		15.21
		(5.681)		(8.372)		(5.111)		(12.32)
Wednesday		-7.998		10.76		-4.524		28.93**
		(5.476)		(8.459)		(4.709)		(12.25)
Thursday		-7.050		10.96		-3.231		19.33*
		(6.208)		(9.484)		(3.753)		(10.22)
Friday		-8.118		12.33		3.325		4.196
		(5.502)		(9.122)		(5.020)		(11.69)
Constant	108.5***	175.5***	102***	116.6***	69.51***	94.37***	164.0***	181.3***
	(4.348)	(23.44)	(4.119)	(33.20)	(3.433)	(19.72)	(6.080)	(39.26)
Controls	-	age, gender, #book, #book^2 day of week	-	age, gender day of week	-	age, gender, #book, #book^2 day of week	-	age, gender, day of week
Observations	7,853	7,147	70	64	10,479	9,867	60	56
Subjects	70	64	70	64	60	56	60	56
R-squared	0.001	0.014	0.097	0.234	0.001	0.005	0.188	0.453

Robust standard errors in parentheses, Clustering on subject level for time per output

$***p < 0.01$, $**p < 0.05$, $*p < 0.1$

Table B.2: OLS explaining Time per Output and Total Output

	High Difficulty				Low Difficulty			
	Goal		Piecerate+Goal		Goal		Piecerate+Goal	
	Total Output	Time p. Output	Total Output	Time p. Output	Total Output	Time p. Output	Total Output	Time p. Output
Goal Size	0.216**	-0.153**	0.00937	-0.0364	0.263**	-0.0975**	0.336***	-0.0982**
	(0.0855)	(0.0677)	(0.132)	(0.138)	(0.119)	(0.0405)	(0.111)	(0.0355)
Ability Time	-0.158*	0.122	-0.0957	0.0720	-0.223	0.123**	-0.172**	0.00944
	(0.0846)	(0.0706)	(0.0929)	(0.0717)	(0.137)	(0.0568)	(0.0705)	(0.0655)
Male	-16.36**	10.28*	-7.846	5.787	4.590	-6.100	-4.819	5.731
	(6.938)	(5.620)	(11.28)	(9.587)	(13.47)	(5.658)	(6.892)	(4.890)
Age	0.324	0.230	-2.427	1.824	-4.038	2.345	-1.301	-0.497
	(2.141)	(1.981)	(2.317)	(1.965)	(5.341)	(1.918)	(3.815)	(2.148)
Constant	121.3*	79.72	192.7***	42.43	263.4*	8.751	199.2*	81.70
	(63.43)	(58.89)	(58.48)	(52.83)	(125.7)	(46.79)	(97.33)	(56.18)
Observations	19	2,255	24	2,783	19	3,185	19	3,710
Subjects	19	19	24	24	19	19	19	19
R-squared	0.469	0.001	0.115	0.001	0.448	0.003	0.534	0.001

Robust standard errors in parentheses, Clustering on subject level for time per output
$***p < 0.01$, $**p < 0.05$, $*p < 0.1$

C Procedural Details

In 2010, the library of the Max Planck Institute for Research on Collective Goods in Bonn had to be restructured from an alphabetical order to an order by topic. Each single book out of roughly 35,000 books had to be searched and found in the library shelves and had then to be relocated to a different shelf. The library uses mobile aisle shelving allowing only one subject at a time to work in this area (see also Figure C.1). Consequently, there was always only a single worker in the library at a time; usually one in the morning and one in the afternoon (allocation of treatments to the day of the week and the time of the day was randomized).

Figure C.1: Picture of the library showing the mobile aisle shelving

Job offers were advertised at the University of Bonn. The announcement read that it was an one-time job opportunity lasting for 3.5 hours and paying a minimum amount of €22. The announcement contained information about the background (re-organizing a library), as well as a short description of the work task. Everyone who saw the poster was allowed to apply for the job. The only restriction was that, given the height of the bookshelves, participants needed to be taller than 1.70 meters. Job candidates had to apply online, stating their preferred working times. Among all applicants, a student research assistant randomly selected participants for our study and offered them an open slot. The time slots (and thus also the subjects) were randomly assigned to the different treatments. Subjects were informed via email about their time slot. Two days before

the actual day of work, each subject received an email reminding him or her again of the time slot, location, duration, and minimum wage payment. Workers were not aware that they were participating in a field experiment. Indeed, due to the authenticity of the work task and work environment, we had no report of any subject asking whether their job was part of an experiment. For the second wave with low difficulty the whole procedure was repeated in 2014.

Upon arrival, the subject received a short written manual for the work task and was additionally instructed by one of the librarians who strictly followed a fixed protocol (see Appendix D for an English translation of the German instructions). Then the subject received a list of books to be searched. While the books in the shelves were alphabetically ordered, the books on the list were ordered by topic. This implied that the probability of two successive books on the list being close to each other in the shelves was rather low. The list was so long that it was obvious to the subject that he or she would not have been able to find all the books on list within three hours, which is important because otherwise finishing the entire list might have served as a goal as well – potentially overriding our treatment manipulation.

The exact task for the subject consisted of the following steps:

1. Pick the book from the top of the list and search for it in the library shelves.
2. Scan the book's ID at a computer workstation and mark the book on the list. If the book is borrowed, instead of the book a placeholder will be at that position in the shelf. In that case, a barcode label for borrowed books should be scanned and the book should be marked in the list correspondingly.
3. Place the book (or the book's placeholder) in a book trolley. Stick to the exact order as it is given on the list of books.
4. Pick the next book from the list and start over.

The librarian emphasized that the subject should work sequentially through the list, keeping the same order on the book trolley as on the list since the books would later be re-labeled and placed into the shelves in this order.[29] After the work task had been explained, each subject had to search for two test books, scan them at the workstation and place them on a book trolley. This procedure served three purposes. First, it ensured that each worker had understood the work task. Second, it provided workers with a rough estimate of their own ability – i.e., how long they approximately need to find a single book - which is important information for workers when they have to set themselves a goal.

[29] According to the librarians who applied the new labels, the order was always kept but for a few exceptions.

Third, because scanning a book provides us with a timestamp for each book, we can approximate subjects' initial ability by using the time difference between the test-books' first and second timestamp.

The treatment manipulation, i.e., the exact payment scheme, was introduced only after the subject had found the two test books and scanned them at the workstation. Like the task description, the payment scheme was also handed out in written form and was additionally explained by a librarian. Subjects then could pose clarifying questions. Afterwards, if the treatment featured a self-chosen goal, subjects had to announce their personal goal. The goal was noted on a post-it that was attached to the display of the workstation. The librarian started a timer and left the workplace. The subject started working for three hours. The workstation always showed the current number of scanned books. Thus subjects were informed about their current earnings and their distance to the goal at any time. Subjects were allowed to take a break whenever necessary. After exactly three hours, the librarian returned, checked the total amount of scanned books and calculated the total payoff accordingly. In case the subject was found to be in the process of scanning books at the computer terminal, he or she was allowed to finish the scanning and stop working afterwards. In the end, a short questionnaire was handed out, eliciting the difficulty of the task, subjects' satisfaction with the personal performance, and their general well-being.

In the first run under high difficulty, subjects searched for a total of 11,461 books during the course of the present study, which is roughly one third of the library's holding of books. After approximately 5,000 books had been handled, the shelves were compressed and filled up with books from other parts of the library. This ensured that the amount of books in the shelves was similar for each subject; and in fact, we do not observe that subjects become faster as the holding of books declines over the course of the experiment.[30] In the second run, books were direclty put back after the experiment. Thus, the inventory of the shelves is identical for all subjects and again no significant correlation between date and initial ability can be found ($r = 0.004$ and $p = 0.974$ Spearman rank correlation). After all sessions of the field experiment had been completed, subjects were debriefed via email.

[30]We tested for a correlation between date and initial ability, which turned out to be not significant ($r = 0.09$ and $p = 0.475$, Spearman rank correlation). This means that the initial ability test which is (by design) not influenced by the treatments does not become easier or more difficult over time.

D Experimental instructions

D.1 Instructions for book search

Your task is to find the books on the list you have just been handed out. Please work your way from the top of the list to the bottom. Once you have found a book, scan it on your PC and place it in the designated book trolley.
In a next step, our librarians will provide the books with new labels and place them in a different location. Because the sorting of the labels corresponds to the order of the books on your list, it is extremely important to us that you locate, scan, and place the books on the book trolley in the same order.
It might happen that you are not able to find a book. If the book has been borrowed, there should be a plastic tab in its place instead. This tab should contain this information and the corresponding book details. In this case, please mark the corresponding book on your list with an "A" and place the plastic tab in the designated storage container as a substitute for the missing book. Also, make sure to scan the barcode found on the green card ("LOAN").
Another possibility might be that you cannot find a book because it has been misplaced by a previous user. In this case, please mark the corresponding book on your list with a "00" and place a white sheet of paper in the designated book trolley instead. If you are not sure whether the book you found in the shelf is the same book as on your list, please point this out by putting a white sheet of paper inside the book and placing it in the designated book trolley.
It might also happen that you find more than one copy of a given book. In this case, please mark the corresponding book on your list with a "2" (or "3", "4",...) and then scan all of the copies.
Please approach us if there is a problem, which you are not able to solve on your own.

D.2 PIECERATE instructions

We ask you to execute your task carefully. However, try to find as many books as possible during the next 3 hours. The more books you find, the higher the cash payment will be which you will get from us immediately after the time has expired. The following applies:

- You will receive a base salary of €22. This means that you will get at least €22 for the 3 hours you are here.
- In addition to your base salary, you will receive a bonus payment. The amount of the bonus payment will depend on the amount of books that you have successfully searched for and found, as you will get an extra 10 cents for every book you find.
- A book counts as "found" only if you have either scanned the book (also the extra copies if there are any) or if you have scanned the plastic tab that belongs to a borrowed book. Missing books (barcode on the red card "MISSING") do NOT count as found.

D.3 PIECERATE + GOAL instructions

We ask you to execute your task carefully. However, try to find as many books as possible during the next 3 hours. The more books you find, the higher the cash payment will be which you will get from us immediately after the time has expired. The following applies:

- You will receive a base salary of €22. This means that you will get at least €22 for the 3 hours you are here.
- In addition to your base salary, you will receive a bonus payment. The amount of the bonus payment will depend on the amount of books that you have successfully searched for and found, as you will get an extra 10 cents for every book you find.
- A book counts as "found" only if you have either scanned the book (also the extra copies if there are any) or if you have scanned the plastic tab that belongs to a borrowed book. Missing books (barcode on the red card "MISSING") do NOT count as found.

Apart from that, you have to estimate the amount of books that you believe you will find. This estimate represents your personal goal.

D.4 GOAL instructions

We ask you to execute your task carefully. However, try to find as many books as possible during the next 3 hours. The following applies:

- You will receive a base salary of €22. This means that you will get €22 for the 3 hours you are here.
- A book counts as "found" only if you have either scanned the book (also the extra copies if there are any) or if you have scanned the plastic tab that belongs to a borrowed book. Missing books (barcode on the red card "MISSING") do NOT count as found.

Apart from that, you have to estimate the amount of books that you believe you will find. This estimate represents your personal goal.