Goals (th)at Work?

Goals, Monetary Incentives, and Workers' Performance*

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Abstract

In a randomized field experiment, we investigate the interplay between work goals, monetary incentives, and work performance. Employees are observed in a natural work environment where they have to do a simple, effort-intense task. Output is perfectly observable and workers are paid for performance. While a regular piece-rate contract serves as a benchmark, in some treatments workers are paid a bonus conditional on reaching a pre-specified goal. We observe that the use of personal work goals leads to a significant output increase. This is found if goals are self-chosen by the workers, as well as if goals are set exogenously by the principal – although in the latter case, the exact size of the goal plays a crucial role. Strikingly, the positive effect of self-chosen goals persists even if the goal is not backed up by monetary incentives. Our results suggest that work contracts where – through the choice of a personal work goal – workers themselves determine the risk and the size of their bonus payment at the same time can be a powerful incentive device.

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1 Introduction

> *"[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, p.1)

Goals are involved in many everyday situations. For example, people set a target weight when being on a diet; learning goals are formulated in schooling; savings plans are used to be able to buy expensive consumption goods; countries agree on emission targets to protect the environment; quota systems are introduced to promote gender equality; firms make use of management styles that involve milestones or target-based bonuses to improve upon production, sales or consumers' satisfaction; etc. These examples include instances i) where people set their own goals and ii) where goals are set by someone else, as well as situations iii) where not reaching the target yields no monetary consequences and iv) where goals are backed up by incentives. This paper particularly explores to what extent *self-chosen* goals affect workplace performance, as well as the interplay between monetary incentives and individuals' goal setting. Moreover, the effectiveness is compared to traditional work-contracts involving exogenously-chosen goals and bonus payments.

To shed light on these issues, we conducted a natural field experiment. We hired workers to help in the process of restructuring a large library. Their task was to search the library shelves for specific books from a given list. It was a one-time job and each worker was only employed for a single working day. Wage payments included a fixed wage and a performance-based component. Our treatment manipulations are on the latter: in the benchmark treatment PIECERATE, €.10 were paid for each book that was found by the worker. The same piece-rate was used in treatment BELIEF. 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. Missing the self-chosen work goal, however, yielded no monetary consequences. The difference in behavior between PIECERATE and BELIEF thus identifies the effect of a self-chosen goal, holding monetary incentives constant between treatments. This was different in treatment GOAL. Here, workers again had to state a work goal. If the goal was met by the actual output, workers received a bonus payment. The amount of the bonus payment was predetermined by the size of the self-chosen goal — the higher the goal, the higher the bonus (again €.10 for each book). Thus, workers faced a tradeoff between the difficulty of reaching the goal and the potential reward for it. They themselves could adjust the goal to tailor the work contract to their individual abilities.

Since the basic structure in GOAL resembles a regular work contract that stipulates a bonus payment conditional on reaching an *exogenously* fixed goal, we subsequently ran two additional treatments EXO100 and EXO50. The only difference between these treatments and treatment GOAL was that now the employer defined the work goal. The goal was set to 100 in EXO100 (an amount that the average worker should have been able to find, and which also was the average size of the self-chosen goal in treatment GOAL), respectively, to 50 in EXO50 (a conservative goal which each worker should have been able to reach).

We find that work goals significantly affect workers' output. The average productivity in treatment GOAL (116 books) is almost 14% higher than in PIECERATE (102 books); suggesting that the combination of monetary incentives and self-chosen goals increases performance. Average performance under the exogenously-set goal in EXO100 (112 books) is also significantly higher than in the benchmark treatment, and only slightly lower than in treatment GOAL. However, already in EXO100 the exogenously set goals can be detrimental for some workers' performance. We observe a strong compression of output, which seems to be caused by high-ability workers adjusting their output to the low goal (in treatment GOAL, they instead set themselves a higher goal and worked more). Supportive evidence

stems from EXO50, where the average output (92 books) is below the output in treatment PIECERATE. Strikingly, we observe that also monetarily non-binding work goals can increase performance. The average number of books found in treatment BELIEF (117) is about the same size as in GOAL, and thus about 15% higher than in PIECERATE – even though the monetary incentives are exactly identical in BELIEF and in PIECERATE. Taken together, this suggests that the use of personal goals can increase performance and that self-chosen work goals might be preferable over exogenously set goals; in particular if (as in our case) workers' abilities are sufficiently heterogeneous and ability is private information of the worker.

One could picture goals to affect economic behavior not only at the workplace, but in other domains as well (cp. our opening examples, e.g., private saving plans, environmental protection, public-goods provision, etc.). However, the study of goals in Economics is still in its infancy. In particular when it comes to self-chosen goals, there are only very few contributions and all of them are very recent. For example, Falk & Knell (2007) discuss goals in the context of a social comparison model, in which agents chose their own "Joneses" they want to compare to. There, a tradeoff between motives of self-enhancement (downward comparisons with others that make one feel better) and self-improvement (upward comparisons with others that help to improve own performances) emerges. Self-chosen and non-binding goals can also serve as a source of internal motivation to attenuate the self-control problem of hyperbolic discounters. Hsiaw (2010) 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, the goal-setting attenuates the tendency to undervalue the option and to stop too early. A similar approach is presented in Koch & Nafziger (2011) who study self-control problems, too. 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. Corresponding empirical

evidence is provided by Kaur et al. (2010, 2012), 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. We complement this literature by providing clean empirical evidence that *self-imposed* goals can work in the absence as well as in the presence of corresponding monetary incentives. Moreover, we show that goals can, but must not, increase effort when the goal-size is specified by the principal rather than by the agent himself. Furthermore, we present an incentive contract that combines self-chosen goals and monetary incentives in such a way that all workers prefer to set themselves a non-trivial goal (which, for example, is not the case in Kaur et al., 2010); and which can be adapted to other economic contexts as well.

Our findings are also of interest to the recent work on labor supply and income targets, which implicitly deals with self-chosen goals as well (e.g., Camerer et al., 1997; Fehr & Götte, 2007; Huffman & Götte, 2007; Farber, 2008; and Crawford & 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 (which could potentially be present in all of our treatments) can be replaced with an explicit production goal.[1] 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 piece-rate or the production technology is varied to provide conclusive answers.

Finally, in particular the mechanism in treatment Goal might appeal to scholars and practitioners in the area of management. There is a large literature on the optimal design

[1]As such, on a broader level our research relates to the more general research on reference-dependent preferences (e.g. Köszegi & Rabin, 2006 and 2007, Abeler et al., 2011), because explicitly choosing a goal might be interpreted as setting a reference point against which gains and losses are evaluated.

of work contracts (e.g., see Gibbons, 2005, for an overview), mostly dealing with simple linear compensation schemes (e.g., Lazear, 2000) and tournaments (starting with Lazear & Rosen, 1981). Besides, there is related literature on bonus contracts where bonus payments are made conditional on relative performance, and such incentive schemes are widely used in practice (see, e.g., Murphy, 2000, and references therein). However, the targets used to evaluate performance are usually not self-chosen by the worker, but externally determined by the principal. Workers might start to gamble the system as they have incentives to choose their work effort strategically in order to affect future goals (e.g., Frank & Obloj, 2009, and Delfgaauw et al., 2010). By contrast – although our current field experiment does not provide data on the dynamics of goal settings over time – one might speculate that such dysfunctional behavioral responses are mitigated by using a work contract as in treatment Goal. There, downward adjustments of one's goal automatically lead to a bonus reduction because the size of the goal and the corresponding monetary consequences are perfectly aligned.[2]

Outside of Economics, research on goals has a long tradition and is still flourishing (for a comprehensive overview, see Locke & Latham, 2002, 2006, and Moskowitz and Grant, 2009). In particular literature in Psychology is studying 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. Our paper ties nicely with this literature by exploring the interaction between motivation, self-chosen goals, and

[2]A potential drawback could arise if for some reason one prefers to fix the total amount of money that is being spent on bonuses beforehand (e.g., to ensure a high level of planning reliability). This is not possible when using an incentive scheme as in Goal, because there, total payments depend on the goals that are actually chosen by the workers and are not fixed ex ante.

specific forms of *incentive contracts*.[3]

The rest of this paper is organized as follows: we describe the experimental design of our field study in Section 2. In Section 3, we present detailed results on the effect of goals and work contracts on work behavior, as well as on the interaction between goal-setting and monetary incentives. Section 4 concludes the paper.

2 Experimental Design

We conducted a field experiment to study the impact of self-chosen and exogenously-set goals on work behavior. The experiment took place at a large library of a German research institute that had to be restructured.[4] Restructuring implied that each single book had to be located in the library shelves and then had to be relocated to its new place in a different shelf. We advertised this job opportunity online and via posters. In order to get a large number of independent observations, as well as to rule out reputational concerns, job offers were only made for half a day (3.5h) and workers could only apply once. We received a large number of online applications, out of which we randomly selected subjects for our study. They were invited via email and asked to confirm the timeslot that we had 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.[5] After having

[3]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 et al. (1997) or Gómez-Miñambres et al. (2012), or the influence of the general goal "to make money" on behavior, e.g., Aarts et al. (2004).

[4]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.

[5]We always had only a single subject working at a time, because the library uses mobile aisle shelving. Having subjects work in isolation allows us to abstract from potential peer effects and at the same time

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. 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.[6] 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 the mobile shelves and walking around in the library.[7] 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 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 time difference between the first and the second trial can be used to approximate subjects' general ability for this kind of task; allowing us to control for potential heterogeneity among individuals.[8] 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

ensures statistical independence of our observations.

[6]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.

[7]Other field experiments use similar work tasks as well, e.g., data-entry tasks (Hennig-Schmidt et al. 2010; Gneezy & List, 2006; and Kube et al., forthcoming a,b), information search (Kosfeld & Neckermann, 2011) or fruit-picking (Bandiera et al., 2007, 2010).

[8]Throughout this paper, ability is defined as (-1)×(search time for the second test-book). Because of some subjects engaging in "mechanizing" (see below) when searching for the two test-books, we are missing clean ability measures for 8 subjects.

two books.[9]

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. The goal was noted on a post-it that was attached to the display of the workstation. The librarian then started a countdown before leaving the workplace, and the subject started working for three hours. The workstation always displayed 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, calculated the total payoff accordingly and paid the subject. In the end, the subject had to complete a short employee questionnaire and left.

Our treatments manipulated the arrangement of the work contracts. In every treatment, subjects received a fixed payment of €22. Additionally, they received a performance-related payment. In treatment **Piecerate**, this was a regular piece-rate as it is frequently used in employment relations. For each book that was scanned at the workstation, subjects' payoff increased by €.10; and no goal whatsoever was mentioned in Piecerate. By contrast, in treatment **Belief**, we asked subjects for their belief about how many books they could find within the 3 hours. We referred to their estimate as "personal goal". It was clear, however, that falling short of the personal goal yielded no monetary consequences. They again received a piece-rate of €.10 per book. This was slightly different in treatment **Goal**. Here, workers

[9]This was done to make the measure better comparable between subjects. Moreover, it allows us to check whether the work task becomes easier over time. This could happen because 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 neither find a general time trend in the number of books found over the course of our study, nor do we find such a trend in the ability measure ($r = 0.1063$ and $p = 0.3$, Spearman rank correlation between date of session and ability).

had to state a "personal goal" g. If the goal was met by the actual output x, workers received a bonus payment of $.10g$ (and of 0 if $x < g$). The amount of the bonus payment was thus predetermined by the size of the self-chosen goal — the higher the goal, the higher the potential bonus. The monetary structure was also the same in treatments **Exo50** and **Exo100**. However, in these two treatments, the goal of 50 (100), was exogenously fixed, but again bonus payments were made conditional on reaching the goal.[10] Workers who were exogenously assigned a "personal goal" of $g = 50$ ($g = 100$) received a bonus of $50 \times .10 =$€ 5 ($100 \times .10 =$ € 10) if $x \geq 50$ ($x \geq 100$).

In Appendix A, we provide a stylized model of the work situation under the different treatments, using a traditional approach with rational, payoff-maximizing employees. The results from the theoretical model provide the basis for the interpretation of observed differences in behavior between treatments. Treatment Piecerate serves as a benchmark for subjects' performance in the absence of explicit work goals. Comparing this benchmark to the outputs observed in Goal and Belief, we can check if the presence of a self-chosen work goal affects performance. More precisely, the comparison between Piecerate and Belief tells us about the effect of adding a self-chosen, monetarily non-binding work goal to a regular piece-rate contract; as the monetary incentives in Piecerate and Belief are exactly the same. Comparing Goal and Belief allows to disentangle the effects of having a self-chosen goal *per se* and a self-chosen goal that is backed up by monetary incentives. In addition, the comparison between Piecerate and Goal indicates how work behavior is affected if performance-related payments of comparable sizes are given in form of bonus payments contingent on reaching a self-chosen goal rather than in form of a piece-rate. Note that a worker's final payment will be exactly the same in Goal as in Piecerate if the subject perfectly anticipates the number of books he will find and sets his personal work goal

[10] The goal sizes of Exo50 and Exo100, were fixed after the data for Piecerate, Goal and Belief had been gathered. The goal sizes were adjusted to the outputs in Piecerate. Exo100 corresponds to the median book number (101 books) and Exo50 to the 1% percentile (52 books).

accordingly. One might argue that risk aversion in combination with an uncertainty about the expected output might induce subjects to set lower goals, so that the final payments in Goal are below the payments in Piecerate. However, this should only make it harder to observe an increase in performance in Goal. If we still find an increase, it should be considered a lower bound for the effectiveness of using such bonuses in this environment.

Along these lines, also the comparison of Piecerate with Exo100 (Exo50) sheds light on performance differences between piece-rates and goal-contingent bonuses. Behavior in treatment Exo50 indicates the effect of facing a very conservative goal that is achievable by the entire workforce (52 was the minimum output in the experiment and observed in Piecerate). On the other hand, studying treatment Exo100 tells us how workers behave under an average goal (101 was the median output in Piecerate). At the same time, contrasting behavior in Exo100 with Goal yields interesting insights on the differences between self-chosen and exogenously-imposed work goals, because Exo100 corresponds to the average goal size chosen in Goal (102 books).

In total 105 subjects participated in this study: 25 each in treatments Piecerate, Goal, and Belief, and 15 each in treatments Exo50 and Exo100 (see Table 4 in Appendix C for details on subjects' characteristics). The allocation of workers to the various treatment groups was randomized. Moreover, treatments were randomized over time slots and weekdays to avoid treatment effects being confounded by general productivity shocks occurring at different times of the day or weekdays. 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 all sessions of the field experiment were completed, subjects were debriefed via email and invited to participate in an online questionnaire. In this questionnaire, we elicited risk preferences (Holt & Laury, 2007) and personality traits (Rammstedt & John, 2007). Subjects received additional €10 for completing the questionnaire and additional payments from the Holt & Laury task. Of the 105 subjects that participated in the field experiment, 99 subjects

completed the online questionnaire.

3 Results

The barcode scans of the books provide us with two different measurements: the total number of books per subject and the time needed to find a single book. In the following, we will first investigate the influence of goals on the overall output of subjects. Afterwards, we will take a closer look at subjects' performance over time and relate this to the goal setting. Table 1 gives summary statistics for the outputs per treatment and Figure 1 gives the corresponding distributions.

Table 1: Summary Statistics for Outputs per Treatments

Treatment	Mean	Median	SD	Min.	Max.	25th Perc.	75th Perc.
Piecerate	102	101	20.56	52	146	90	114
Goal	116	124	25.19	72	164	98	130
Belief	117	115	27.51	68	173	100	136
Exo100	112.27	114	15.26	81	131	109	126
Exo50	92	91	12.37	73	120	83	103

Table gives the (rounded) mean, median, and standard deviation of outputs per treatment, minimum and maximum outputs, and the 25th and 75th percentiles.

In the Piecerate treatment, subjects accumulated on average 102 books; in the Goal treatment, 116 books; and in the Belief treatment, 117 books. Compared to the Piecerate treatment, the higher outputs in Goal and Belief equate to an increase in performance of more than 14%. These increases in output are significant for both comparisons (Piecerate vs. Goal $p = 0.0243$ and Piecerate vs. Belief $p = 0.0547$, both two-sided Wilcoxon

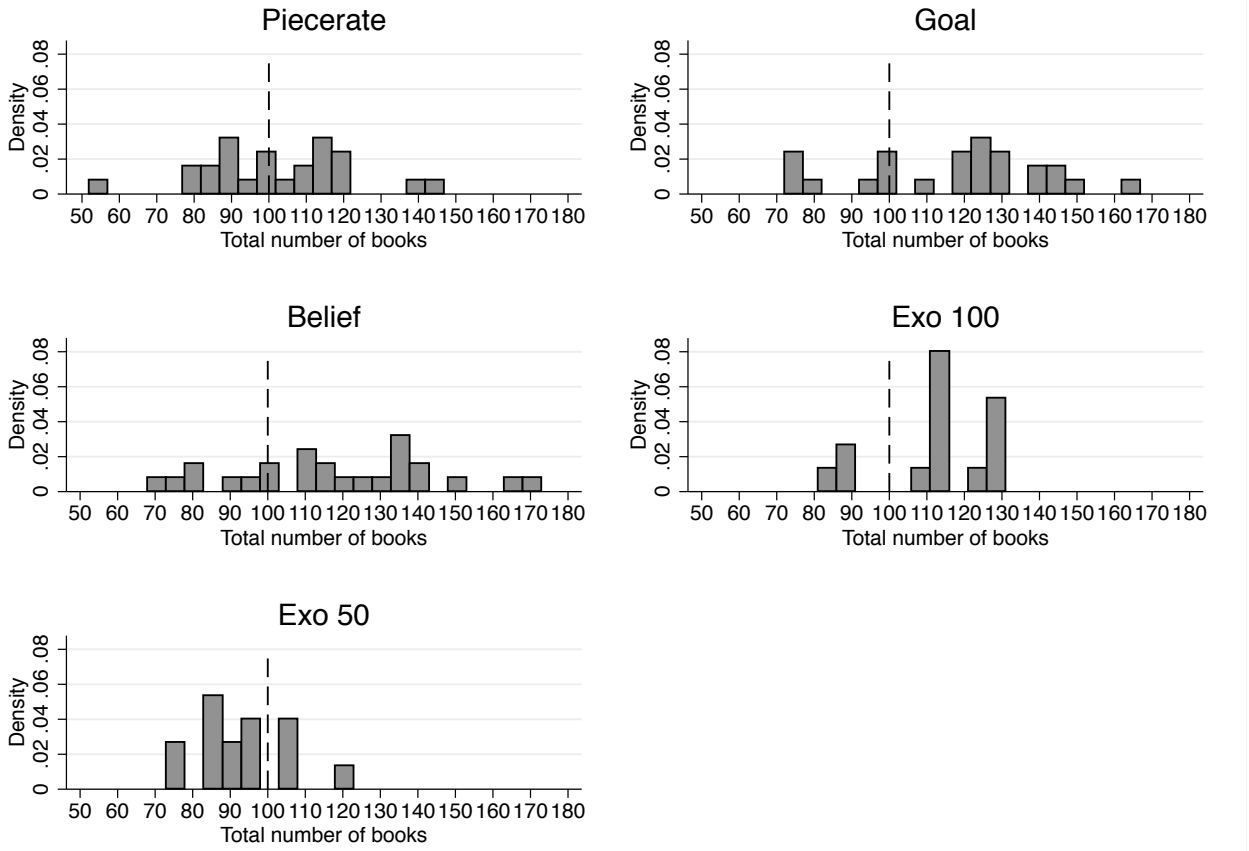

Figure 1: Distribution of total book numbers

rank sum tests). The average outputs in Goal and Belief are very similar and neither the median outputs nor the average outputs differ significantly between these two treatments (median test: $p = 0.571$; two-sided Wilcoxon rank sum test: $p = 0.9613$). Result 1 summarizes the positive effect of self-chosen goals on output:

Result 1: *Compared to the* Piecerate *treatment, subjects' average productivity increased significantly by more than* 14% *in the treatments* Goal *and* Belief. *The outputs in the two treatments with self-chosen goals do not differ significantly.*

Result 1 demonstrates that, in our setting, self-chosen goals have a positive effect on subjects' productivity. The actual net costs per book are also in favor of self-chosen goals:

considering the payoffs (including the fixed payment of €22) and the amount achieved per subject the costs per book in GOAL (25 Cent), and BELIEF (30 Cent) are below the one in PIECERATE (33 Cent).[11] From a principal's point of view, the question arises whether the same increase in output can be induced by exogenously imposed goals. To elaborate this question, we compare the treatments EXO100 and EXO50 with the PIECERATE treatment.

Comparing the EXO100 treatment with PIECERATE reveals a significant difference in outputs ($p = 0.0781$, two-sided Wilcoxon rank sum test). On average, the output in EXO100 is 10% higher than the one in PIECERATE. Comparing EXO100 with the two treatments with self-chosen goals shows no significant difference in outputs ($p = 0.3563$ for the comparison with GOAL, respectively $p = 0.5293$ for BELIEF). This suggests that the positive effect of goals on output can be exogenously imposed on the subjects.

However, the comparisons of EXO50 with PIECERATE and EXO100 demonstrate that the positive effect of exogenously imposed goals might depend on the size of the goal and not on the presence of goals per se. The output in EXO50 is on average 10% lower than in PIECERATE and 18% lower than in EXO100. Thus, a significantly lower output is observed in EXO50 than in PIECERATE and EXO100 ($p = 0.0856$ and $p = 0.0018$, both two-sided Wilcoxon rank sum test). In addition, comparing the output in EXO50 with the output in GOAL and BELIEF shows that imposing a conservative goal leads to significantly lower output than letting subjects chose their own goals ($p = 0.0021$ and $p = 0.0038$, two-sided Wilcoxon rank sum test).

The distribution of outputs reveals additional influences of exogenously set goals (refer to Table 1, Figure 1, and Figure 7 in the appendix). The dispersion of outputs in EXO50 and EXO100 is much smaller than the ones in the other three treatments. While average outputs did not differ significantly between GOAL and EXO100, the standard deviation does

[11] The lower costs in GOAL are a result of subjects not achieving their goal (thus receiving no additional bonus payment) as well as working beyond their goal.

and is significantly higher in GOAL ($p = 0.055$, two-sided sd-test).[12] This can be a desirable effect, as it decreases the unsteadiness of individual outputs. Hence, the minimal output in EXO100 is higher than the ones in GOAL and BELIEF. The drawback is that subjects seem not to be encouraged to provide outstanding performances. For example, the highest output in EXO100 is 33 books below the one in GOAL and 42 books below the one in BELIEF.[13]

Before we take a closer look at the chosen goals, we complement our non-parametric analysis with a regression analysis, adding controls for other potential influences, in particular individuals' ability. Table 2 gives the results of the estimated models using ordinary least squares (OLS). Model 1 compares the outputs in GOAL, BELIEF, EXO100, and EXO50, with PIECERATE functioning as the baseline for comparisons. The results are in line with our non-parametric analysis: significantly higher outputs in GOAL, BELIEF, and EXO100 than in PIECERATE; and a lower output in EXO50. Model 2 includes the initial ability measured during the briefing. The main qualitative results of model 1 are confirmed. In addition, the regression demonstrates that higher ability leads to significantly higher output, but it does not explain why GOAL, BELIEF, and EXO100 perform better than the classical PIECERATE. Model 3 confirms the previous results, while including additional controls for age, daytime, gender, and a dummy variable identifying subjects that "mechanize"[14].

Result 2: *The positive effects of goals can persist even if goals are set exogenously, but the result seems to depend on the fixed goal size. We observe a significantly higher output*

[12] The standard deviation is also significantly higher in GOAL than in EXO100 ($p = 0.008$, two-sided sd-test) and in BELIEF than in EXO100 and EXO50 ($p = 0.0255$ and $p = 0.0032$, both two-sided sd-tests).

[13] Table 5 in the appendix shows that the differences in minimal and maximal outputs are not driven by single subjects, but by the low and top performers in general. The subjects with a low performance in EXO100 have, on average, a higher output than the ones in PIECERATE, GOAL, and BELIEF, while the ones with a high performance in EXO100 have, on average, a lower output than the ones in GOAL and BELIEF.

[14] A subject exhibits mechanizing if it first searches a couple of books and afterwards scans them all at once; a subject that does not mechanize searches for each book separately and scans the book before searching the next one. Subjects were categorized as mechanizers by three student helpers. We coded a subject as a mechanizer if at least two student helpers categorized a subject accordingly. Refer to Figures 5 and 6 in the appendix for examples of subjects mechanizing and not mechanizing. In our experiment, mechanizing improves the performance significantly; however, it does not affect the previous results.

Table 2: OLS Total Number Books

Total Books	(1)	(2)	(3)
Goal	14.44**	11.61*	11.60**
	(6.530)	(6.282)	(5.662)
Belief	15.24**	11.60*	12.88*
	(6.897)	(6.489)	(6.728)
Exo100	10.27*	14.28**	12.46**
	(5.680)	(6.002)	(6.190)
Exo50	-9.667*	-6.755	-5.775
	(5.200)	(5.409)	(5.152)
Ability		0.104***	0.101***
		(0.0237)	(0.0240)
Constant	102***	120.8***	82.65***
	(4.129)	(5.738)	(21.14)
Controls:	-	-	age, daytime, gender, mechanizing
Observations	105	97	97
R-squared	0.150	0.297	0.385
Prob > F	0.0000	0.0000	0.0000

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

in Exo100 *than in* Exo50. *The variances in both treatments with exogenous goals are significantly lower than the ones in* Goal *and* Belief.

We have demonstrated that self-chosen goals can increase productivity and that average outputs in Goal and Belief do not differ significantly. However, the incentive mechanisms of Goal, and Belief differ: in Goal, monetary incentives are combined with the chosen goal and a bonus is only paid conditional upon reaching the goal, while in Belief, a regular,

unconditional piece-rate is paid. In view of Result 1, the question arises if it makes any difference for behavior whether the goal is backed up by monetary incentives or not.

Our data reveal that in the presence of goals, the size of the chosen goal seems to be affected by the underlying incentive scheme. Goals tend to be more conservative if they are combined with monetary consequences. The average goal of 144 books in BELIEF is significantly higher than the 102 books in GOAL ($p = 0.0016$, two-sided Wilcoxon rank sum test). Besides, the standard deviation of goals is significantly higher in BELIEF than in GOAL (49.83 vs. 32.82, $p = 0.0459$ two-sided sd-test).

An additional influence on the goal size is the initial ability. In the treatments with self-chosen goals, the goal size and the initial ability are significantly correlated. Subjects use the information from the two initial trials to subsequently set their personal goals: the higher the measured ability, the higher the personal goal ($r = 0.4538$ and $p = 0.0015$, Spearman rank correlation).

These results can be confirmed with OLS regressions (refer to Table 7 in the appendix for estimates). Even when controlling for a large number of covariates (e.g., initial ability, gender, age, risk-attitutes, etc.), the estimate for the goal size is roughly 45 books higher in BELIEF than in GOAL. To investigate how realistic subjects' goals are, we assume that subjects' ability does not improve over the course of time, and use the initial ability to calculate an expected amount of books at the end of the experiment. Comparing the actual goals with these simple estimates identifies a higher difference in the BELIEF treatment than in the GOAL treatment. On average, actual goals are 57 books above the estimates in BELIEF and 17 books above the ones in GOAL.

As a result of the different goal sizes, the number of subjects achieving their goals differs significantly between treatments. Only 32% of the subjects achieve their goal in BELIEF, while with 64% a significantly higher fraction of subjects do so in GOAL ($p = .046$, two-

sided Fisher exact test).[15] In the treatments with exogenously determined goals, even more subjects are successful; in EXO100, 80% attain their goals (100% in EXO50).[16] Obviously, reaching a goal is highly correlated with the size of the goal ($r = -0.7083$ with $p < 0.001$, point-biserial correlation) — the smaller the goal, the higher the likelihood to reach it. We summarize these results as follows:

Result 3: *Goals are more optimistic in the absence of monetary consequences. Significantly higher goals are chosen in* BELIEF *than in* GOAL *and thus significantly more subjects fail to reach their goals in* BELIEF.

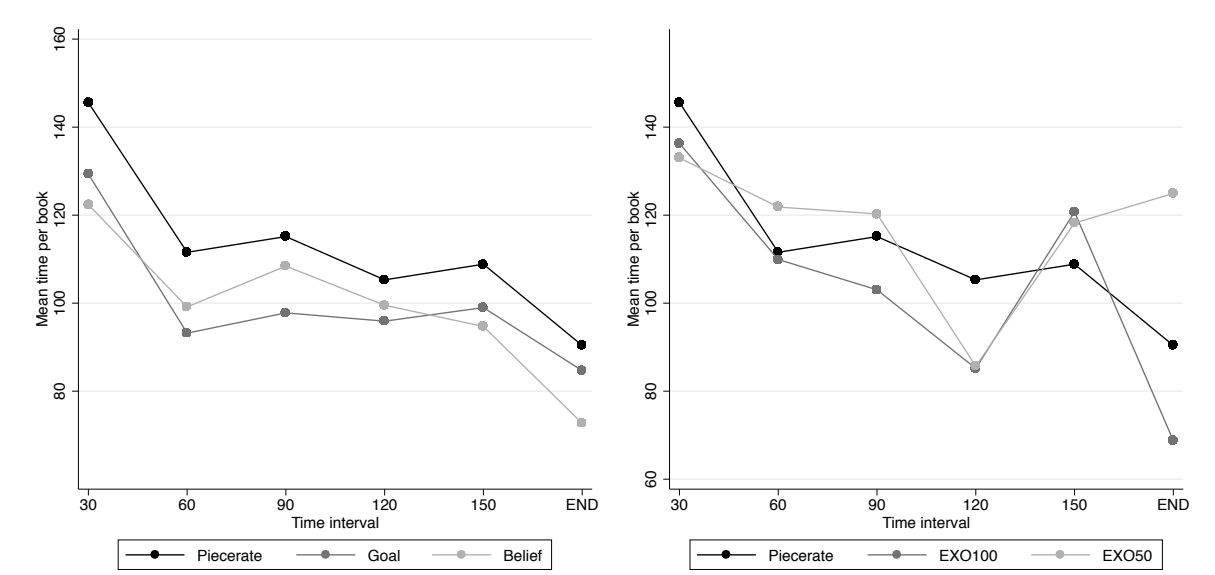

Figure 2: Mean time per book over the course of the experiment.

By scanning the books, subjects provide us with a time stamp for each book. This en-

[15]The employee questionnaire at the end of the session contained a question asking the subjects about their current mood. The monetary consequences of not reaching the goal in treatment GOAL clearly influence the answers to this question. Driven by the subjects who did not reach their goal, reported happiness is, on average, significantly lower in GOAL than in PIECERATE, BELIEF, and EXO100 ($p = 0.0375$, $p = 0.0086$, and $p = 0.0496$, all two-sided rank sum tests).

[16]No significant differences in attainment rates are observed between GOAL and EXO100 ($p = 0.477$), nor between EXO50 and EXO100 ($p = 0.224$). But significantly more subjects reach their goal in EXO50 than in GOAL ($p = 0.015$). As noted above, BELIEF has the lowest attainment rate and therefore significantly less subjects achive their goal than in EXO100 ($p = .008$) and EXO50 ($p < 0.001$).

Table 3: Random Effects Model – Time Per Book in Treatments with Goals

Time Per Book	(1)	(2)	(3)	(4)	(5)	(6)
Goal	-19.26***	-10.57**	3.857	5.066	7.976	10.72
	(5.776)	(5.356)	(10.40)	(8.381)	(9.792)	(7.498)
Belief	-22.08***	-12.25**	0.326	0.680	9.194	10.67
	(5.974)	(5.255)	(10.34)	(8.101)	(9.963)	(7.519)
Exo100	-18.56***	-17.00***	0.930	2.893	6.198	10.79
	(5.263)	(4.832)	(10.26)	(8.165)	(9.378)	(7.756)
Ability		-0.104***	-0.0987***	-0.0789***	-0.0825***	-0.0823***
		(0.0260)	(0.0293)	(0.0235)	(0.0247)	(0.0238)
Goal size			-0.994**	-0.846***	-0.615	-0.725**
			(0.406)	(0.328)	(0.393)	(0.317)
(Goal size)^2			0.00388**	0.00331***	0.00246*	0.00285**
			(0.00155)	(0.00125)	(0.00142)	(0.00117)
#Book				-2.091***	-2.217***	-2.219***
				(0.387)	(0.393)	(0.396)
(#Book)^2				0.0114***	0.0116***	0.0117***
				(0.00264)	(0.00252)	(0.00255)
Attained					23.17***	23.53***
					(6.147)	(6.154)
Attained x Belief					-34.01***	-30.41***
					(11.59)	(11.79)
Constant	116.3***	92.23***	136.0***	198.7***	183.2***	210.1***
	(3.977)	(5.487)	(19.73)	(18.89)	(20.18)	(23.68)
Controls:	-	-	-	-	-	age, daytime, gender, mechanizing
Observations	8911	8329	8329	8329	8329	8329
Subjects	80	76	76	76	76	76
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

ables us to investigate how treatments and the specific goals influence the time needed to find a book. Figure 2 gives the development of the mean time needed to find a book throughout the experiment. As the figure reveals, subjects' times improve during the experiment.

Furthermore, for each time interval, subjects find books faster in GOAL and BELIEF than in PIECERATE and the same holds true for all but one time interval in EXO100.

Obviously, the significantly higher outputs in these three treatments are a result of subjects working faster. Thus, comparing the mean times needed to find a book between treatments leads to results in line with our previous ones: i) Subjects need on average significantly less time to find books in GOAL, BELIEF, and EXO100 compared to PIECERATE ($p = 0.0370$, $p = 0.0512$, and $p = 0.0428$, all two-sided Wilcoxon rank sum test). ii) The average time in EXO50 does not differ significantly from the one in PIECERATE ($p = 0.1667$), but it is significantly higher than in GOAL, BELIEF, and EXO100 ($p = 0.0106$, $p = 0.0054$, and $p = 0.0051$, all two-sided Wilcoxon rank sum test). iii) No significant differences between GOAL, BELIEF, and EXO100 are observed (all pairwise comparisons with $p > 0.56$, two-sided Wilcoxon rank sum test). iv) The positive influence of goal sizes on outputs results in a correlation between goal sizes and time per book ($r = -0.4592$ and $p < 0.0001$, Spearman rank correlation).

Further insights can be obtained with parametric analyses. Table 3 gives the results of random effects regressions for the times needed to find a book over all subjects. Result 1 has demonstrated that goals can increase subjects' performance in comparison to a setting without goals. To analyze the process through which goals increase output, the results in Table 3 are restricted to the treatments with goals, with EXO50 serving as the baseline for comparisons.

Results of models 1 and 2 in Table 3 are analogous to our previous analyses on output quantity. In treatments GOAL, BELIEF, and EXO100, subjects need significantly less time to find a book than in EXO50, resulting in the higher output as reported above. Again, this effect is robust to adding subjects' initial ability. Obviously, subjects with a higher ability need less time to find a book and this accumulates to higher outputs over the duration of the experimental session.

As soon as we include the goal sizes into the regression, the three treatment dummies become insignificant. Model 3 demonstrates that the size of the goal influences the time needed to find a book. Thus, the better performance of the three treatments is driven by the higher goal sizes in comparison to Exo 50. The higher the goal, the faster subjects tend to find books; however, the marginal effect of the goal size is decreasing. Given the estimates from model 3, goals up to 128 books lead to faster book searches, and for goals above 128, the positive effect decreases.[17] This finding is in line with goal commitment, which decreases if self-efficacy drops as a result of subjects realizing that they cannot achieve their goal (Locke & Latham 2002). The median goal in Belief is 150 books, while it is 110 books in Goal. Given our estimates, this means that the positive effects of goals are present in both treatments, but more pronounced in Goal, as it has more easily attainable goals.

In model 4, we control whether the effect of the goals is robust to controlling for potential "learning" of the task over time. The coefficients in this model show that the learning curve is initially steep and becomes flat over time. This means that subjects learn fast at the beginning, with subsequent improvements being smaller. Although our data exhibits evidence for learning, it does not superpose the functioning of goals. Therefore, we conclude our fourth result:

Result 4: *Higher goals cause the subjects to work faster, decreasing the average time needed to find a book and thereby increasing the output per session. This positive effect decreases as goals become higher and thus unattainable.*

However, in treatments Goal, Exo100, and Exo50 two types of incentives disappear as soon as a goal is reached. The first incentive is the intrinsic motivation to reach the goal. The second one depends on the payoff structure. Since in these treatments a bonus is paid contingent on reaching the goal, outputs above the goal do not yield additional payments. By

[17] The estimated effect of goal size would become negative after 256 books, though the highest chosen goal in our experiment was only 220. In model 6, including all controls, the estimates are only slightly different. The effect of goals increases up to 127 books and becomes negative at 254 books.

contrast, in BELIEF only the first incentive vanishes, while the piece-rate ensures monetary incentives also beyond the goal.

Model 5 investigates exactly these effects by controlling for book searches that took place after the goal had been reached. As soon as the goal is reached, subjects reduce their effort significantly and need more time for the subsequent books. After the goal is reached, a subject needs more than 30 additional seconds to find a book. However, the interaction with treatment BELIEF shows that subjects in this treatment are not prone to this effect and do not reduce their effort. Only 32% of the subjects in BELIEF reach their goal and these subjects tend to have lower goals. The mean goal of these subjects is only 87 books, which is much lower than the average output of 117 books in this treatment. Thus, the piece-rate benefits subjects that underestimate their ability and improve their performance.

Model 6 verifies the previous results and adds controls for age, daytime, gender, and mechanizing.[18] Our results are robust to these controls and we conclude with our last result:

Result 5: *As soon as a goal is reached, subjects reduce their effort and need more time to find a book. After a goal has been reached, monetary incentives in form of a piece-rate become important for the individual performance as they provide incentives to keep on working.*

4 Discussion

In this paper, we explored how work behavior is affected by self-chosen goals when the goal is backed up by monetary incentives, or when not attaining the goal yields no monetary consequences, and contrasted this with a situation where the production goal had been set by the employer. Our benchmark was a regular piece-rate contract without any goal. Compared to the benchmark, we observed significantly higher outputs in the presence of self-

[18] Table 8 in the appendix gives the coefficients of the controls.

chosen goals with monetary incentives. Also, goals chosen by the principal were potentially able to increase performance as long as the goal was chosen carefully. If the goal was too low, workers' output eventually decreased slightly in comparison to the benchmark. Strikingly, and surprisingly from a traditional economic perspective, even self-chosen goals that were not tied to monetary incentives were able to boost performance significantly.

Taken together, our results suggest that the combination of work goals and incentive contracts might be a very promising means to motivate employees. Whether the goals should be set by workers themselves or by the employer might depend i) on the amount of information available to the principal about workers' ability or past performance, and ii) on the degree of heterogeneity within the workforce. Workers in our field experiment differed significantly in their ability to carry out the specific work task, and thus a common goal was, at the same time, challenging to achieve for some and very easy to meet for others. This led to a compression in workers' output, motivating low performers but hampering high performers. In such a situation, letting each worker choose his own goal might be preferable, because they could set appropriate goals for themselves. Of course, if an employer has sufficient information, he could discriminate goals between workers, rather than using the same goal for all of them. The more information is available to him about individuals' abilities, the less difficult it will be to set the right goal for each person. But even then, self-chosen goals might still have a benefit, namely if workers dislike the unequal treatment by the employer and reciprocate to this unkind treatment by withdrawing effort. If workers set their own goals, the resulting inequality is self-imposed and arguably more likely to be accepted.

To shed more light on the differences in effectiveness of self-chosen and employer-imposed goals, future studies should try to gain data from repeated interactions of employers who work side by side. This would not only allow exploring how workers' goals and efforts are adjusted over time (e.g., see Gómez-Miñambres et al. (2012) for repeated exogenous, non-binding goals). It could also yield insights into workforce dynamics and sorting, revealing what type

of employees select into (or out of) work contracts with (non-)incentivized goals (e.g., see Larkin & Leider (2012), for a recent study on sorting decisions). In these contexts, it might also be interesting to study how joint team goals affect performance, in particular because firms often define goals for an entire team or division. Speaking of extensions, one could also look at the impact of goals under different incentive schemes (e.g., in tournaments), or in richer work environments where effort is multi-dimensional and goals might induce dysfunctional behavioral responses. Another modification of our study would be to analyze how behavior changes as the strength of the monetary incentives to achieve the goal is varied: do self-chosen goals become more optimistic or more conservative as the corresponding bonus payments increase, and what are the implications for performance?

Having data from these extensions would also allow to study in more detail the channels through which the goals increase work performances. The identification of such channels is not a classical question in Economics, arguably due to the strong focus on output-oriented models. Still, there is a growing interest in economic models that incorporate concepts and insights from Psychology. With respect to goals in general, there already exists extensive psychological research that might inform us on potential channels (see Moskowitz & Grant, 2009, for a recent overview). Out of these, there are some that we find particularly appealing to explain why work goals might have affected output, because they could easily be modeled in an utility-maximizing framework. For example, it could be that cognitive dissonance is at work here. Workers might have initially thought that the job is dull and does not require much effort, but a challenging goal might make the job look much more exciting and valuable. To resolve the dissonance between the prior and the new information, workers increase their effort (effort-justification paradigm). Another possibility is that individuals have a preference for consistency (e.g., Cialdini et al., 1995, Falk & Zimmermann, 2011). If you have publicly set yourself a goal or have accepted a given goal, you strive for that goal so others can see that your thoughts about your performance are consistent with your action as

measured by your output. Goals might also create an intrinsic motivation for an otherwise extrinsically motivated work task (e.g., Deci 1975), resulting in higher effort levels. It could also be that missing a work goal induces negative emotions that pose psychological costs, and effort is increased to prevent them.[19]

In essence, we are convinced that goals do play an important role for workplace behavior. In particular, self-chosen goals that are attached to a dedicated incentive contract might be a promising means to shape behavior not only in the workplace, but also in many other economically relevant domains (e.g., Beckenkamp & Maier-Rigaud, 2006; Morell et al., 2009). Even in the absence of monetary incentives, given the tremendous amount of corresponding studies in the psychological literature, it might still be worthwhile to think about the use of goals (e.g., as a "tool" in policy interventions). Yet for a proper use there are still open questions, some of which we have pointed out above and need to be addressed first.

[19] Along these lines, it might also be informative to study the neural correlates involved in the goal-setting and goal-pursuit process (e.g., Berkman & Liberman, 2009), or to look at character traits or non-cognitive skills that potentially determine an individuals' intensity to pursue goals (e.g., Almlund et al., 2011, Burks et al., 2009).

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Appendix

A Stylized Model

In this section we investigate the effects of goals on output in a setting with heterogeneous agents that are rational payoff-maximizers. Agents' payoff is given by

$$\pi(e_i) = ve_i - C_i(e_i),$$

where $v > 0$ is the size of the piece-rate, e_i is effort and $C_i(e_i)$ are agent's costs of effort provision, which are increasing in effort and convex ($C_i' > 0, C_i'' > 0$). Since the transformation of effort into output is likely to be orthogonal to treatment, and thus should not matter for the qualitative comparisons of theoretical predictions between treatments, we simplify matters and equate effort and output; i.e., e_i measures the number of books. For the sake of convenience, we assume a quadratic cost function and only two types of agents $i \in \{H, L\}$ with either high costs for effort provision or low costs:

$$C_i(e_i) = a_i e_i^2, \text{ with } i \in \{H, L\} \text{ and } a_H > a_L > 0.$$

We assume that agents know their cost functions and thus their corresponding $a_i \in \{a_L, a_H\}$.

A.1 Effort provision in treatments Piecerate and Belief

The difference between treatments Piecerate and Belief is that in Belief subjects state their personal work goals before providing effort. However, these goals have no monetary consequences in Belief and behavior of rational money-maximizing agents is not affected by the presence of such goals. Agents set arbitrary goals and simply maximize their income

via their effort decision. The corresponding optimization problem is the same in treatments PIECERATE and BELIEF and yields the following condition:

$$\frac{\partial \pi}{\partial e_i} = v - 2a_i e_i \stackrel{!}{=} 0 \Rightarrow e_i^* = \frac{v}{2a_i}$$

The corresponding payoff is given by:

$$\pi(e_i^*) = v\frac{v}{2a_i} - a(\frac{v}{2a_i})^2 = \frac{v^2}{4a_i}$$

Note that, given our specification, the unique existence of optimal effort e_i^* is guaranteed as the condition $\frac{\partial^2 \pi}{\partial^2 e_i} = -2a_i < 0$ is always true. Moreover, agents with lower costs for effort provision would provide higher effort than agents with higher costs, $e_L^* > e_H^*$, and as a result they would also obtain higher payoffs (see also Figure 3 for an illustration).

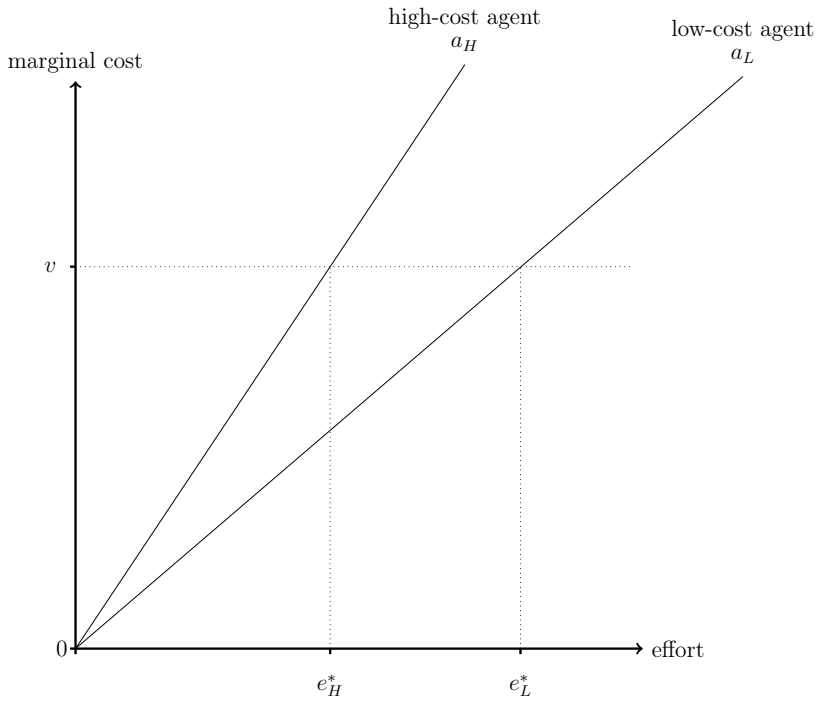

FIGURE 3: OPTIMAL EFFORT

A.2 Effort provision under self-chosen goals

In the GOAL treatment, the goal choice $g_i > 0$ and attaining the goal, respectively, yield monetary consequences. Agents' payoffs are now given by:

$$\pi(e_i, g_i) = \begin{cases} vg_i - a_i e_i^2 & \text{if } e_i \geq g_i \\ 0 - a_i e_i^2 & \text{if } e_i < g_i \end{cases}$$

Given that agents know their own type, they would want to provide the same effort as in PIECERATE and BELIEF and set the goal accordingly. To see why, note that agents' optimal effort for a given goal $g_i > 0$ is given by

$$e_i^* = \begin{cases} 0 & \text{if } \pi(g_i) < 0 \\ g_i & \text{if } \pi(g_i) \geq 0, \end{cases}$$

that is, depending on the goal size, the agent either provides exactly the amount of effort such that the goal is met (if the payoff is positive) or zero effort (if $C(g_i) > vg_i$, i.e., the payoff from providing effort to meet the goal is negative). This implies that the agent can choose positive effort levels via the size of the goal as long as the goal size is above a threshold level $\bar{g}_i$, from which on the payoff becomes negative:

$$\pi(g_i) = vg_i - a_i g_i^2 \leq 0 \Rightarrow \bar{g}_i \geq \frac{v}{a_i}$$

Clearly, the optimal self-chosen goal in treatment GOAL is below this threshold. Moreover, it is straightforward that, since the agent chooses his effort level via his goal, he will set the goal as to induce the same effort that is optimal in PIECERATE and BELIEF – because once the goal is met, the payoff is the same in PIECERATE and BELIEF:

$$\frac{\partial \pi}{\partial g_i} = v - 2a_i g_i = 0 \Rightarrow g_i^* = \frac{v}{2a_i}$$

$$g_i^* < \bar{g}_i$$

A.3 Effort provision under exogenous goals

As pointed out in the previous section, agents would provide effort as long as e_i (resp. g_i) is below $\bar{g}_i = \frac{v}{a_i}$; and the optimal effort level will be below this threshold value, implying positive payoffs for the agents. Contrarily, the principal is interested in the highest possible output for the given piece-rate v and will set the goals in the EXO treatments as high as possible. If the principal knows the type of each agent, he would implement the highest goal for each agent that still induces the agent to provide effort, i.e., he will set the corresponding threshold level $\bar{g}_i$:

$$\bar{g}_H = \frac{v}{a_H}, \; \bar{g}_L = \frac{v}{a_L}$$

One might argue that, while agents are well aware of their own type, the principal does not know the agents' type when setting the goal; or alternatively that he must assign a common goal g because, for some reasons, he is not allowed to assign individual goals to the agents. In these cases, with two types of agents only two potential goals are relevant. Risk-neutral principals will either implement the threshold goal of a high-cost type ($\bar{g}_H$) or of a low-cost type ($\bar{g}_L$), and nothing else. To see why, consider the following: i) Choosing a goal above $\bar{g}_L$ is clearly not optimal, because both types would provide zero effort under this goal. ii) Also a goal below $\bar{g}_H$ cannot be optimal. It is achievable and yields non-negative payoffs

to both types, but the same is true for $\bar{g}_H$ and in that case, both high- and low-cost types would provide higher efforts than under $g < \bar{g}_H$. iii) Setting a goal above $\bar{g}_H$ would induce high-cost agents to provide zero effort, but this could be optimal if the fraction of low-cost agents is sufficiently large. However, since high-cost agents will not work anyway as soon as $g > \bar{g}_H$, it is optimal to move all the way up and implement $\bar{g}_L$ to extract the highest possible efforts from the low-cost types.

Whether the principal sets $g = \bar{g}_H$ or $g = \bar{g}_L$ thus depends on the composition of the population. Let p denote the probability of facing a high-cost agent, and $(1-p)$ of facing a low-cost agent. The principal chooses the lower goal $\bar{g}_H$ only if the expected output for $g = \bar{g}_H$ is higher then the one for $g = \bar{g}_L$:

$$pe_H(\bar{g}_H) + (1-p)e_L(\bar{g}_H) > pe_H(\bar{g}_L) + (1-p)e_L(\bar{g}_L)$$

$$\Leftrightarrow p\frac{v}{a_H} + (1-p)\frac{v}{a_H} > p0 + (1-p)\frac{v}{a_L}$$

$$\Leftrightarrow \frac{v}{a_H} > (1-p)\frac{v}{a_L} \Leftrightarrow \frac{v}{a_H} > \frac{v}{a_L} - p\frac{v}{a_L} \Leftrightarrow p\frac{v}{a_L} > \frac{v}{a_L} - \frac{v}{a_H}$$

$$\Leftrightarrow p > (\frac{v}{a_L} - \frac{v}{a_H})\frac{a_L}{v} \Leftrightarrow p > \frac{va_L}{va_L} - \frac{va_L}{va_H}$$

$$\Rightarrow p > 1 - \frac{a_L}{a_H}$$

If a_L increases with respect to a_H, the output of the low-cost agent becomes more similar to the output of the high-cost agent, and the principal will select the lower goal $\bar{g_H}$ for a smaller fraction of high-cost agents in the population. If a_L decreases with respect to a_H, the output of the low-cost agent increases and the higher output of the low-cost agents with the higher goal $\bar{g_L}$ justifies a higher fraction of zero output by the high-cost agents. Therefore, the principal will select the lower goal only for an increased fraction of high-cost agents.

A.4 Summary of Expected Treatment Differences

In the absence of goals (treatment BASELINE), as well as when goals yield no monetary consequences (treatment BELIEF), agents with lower costs of effort provision would provide higher efforts than agents with higher costs, $e_L^* > e_H^*$. The same effort levels should be observed in treatment GOAL, because agents know their type and simply choose the goal that corresponds to their optimal effort level in BASELINE.[20] Under exogenous goals, efforts can be higher if the principal is able to assign individual goals to the two types, because he will then be able to extract agents' positive payoffs by setting higher goals than the agents would choose. If he can only set a common goal for all agents (as in our treatments EXO), expected efforts can also be lower; in particular in populations where the fraction of both types of agents and costs are substantial.[21] The reason is that principals will set the goal such that either the low-cost agents provide less effort than in BASELINE (in which case we should observe effort compression between types), or that the high-cost agents provide less (zero) effort.

[20] If agents are uncertain about their type when setting the goal, *expected* effort levels will be lower than in BASELINE or BELIEF. The size of this difference depends on the actual parameter values and probabilities of being the high- or low-cost type. Goals will either be set to g_L^*, in particular when the probability of being a low-cost type is sufficiently large, and/or when the differences between effort costs of low and high types is sufficiently small; or will be between g_H^* and $\bar{g}_H$. In the latter case, expected efforts are lower because low-cost agents will provide less effort than in BASELINE. In the former case, they will be lower because high-cost agents will provide less (zero) effort.

[21] If instead there is a prevalent type, the degree of uncertainty is very small and principals will simply select the threshold goal for that type – thus inducing higher effort levels than in the other treatments.

B 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 4). 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 4: 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.

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 F 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.[22] 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. 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

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

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.

We ran two wave of experiments. First, treatments PIECERATE, GOAL, and BELIEF were run simultaneously. In the second wave, treatments EXO50 and EXO100 were run simultaneously. Goal sizes in EXO50 and EXO100 were adjusted to outputs and self-chosen goals that were observed in the first wave. EXO100 corresponds to the average goal size that was chosen in GOAL (102 books), which can also be considered a feasible goal because the median book number in PIECERATE was 101 books. EXO50 featured a very conservative goal, as it was chosen by us because of the minimum output observed in the first wave (52 books).

In total 105, subjects participated in this study: 25 each in treatments PIECERATE, GOAL, and BELIEF, and 15 each in treatments EXO50 and EXO100. Table 4 summarizes observations and student characteristics.

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.[23]

[23]We tested for a correlation between date and initial ability, which turned out to be not significant

After all sessions of the field experiment had been completed, subjects were debriefed and invited via email to participate in an online questionnaire. In this questionnaire, we elicited risk preferences (Holt & Laury, 2007) and personality traits (Rammstedt & John, 2007). In addition to the €10 that subjects received for completing the questionnaire, they also got additional payments of the Holt & Laury task. Of the 105 subjects that participated in the field experiment, 99 subjects completed the online questionnaire. When picking up their payment for the online survey, subjects signed a data privacy statement allowing us to merge the survey data with their individual working data. The evaluation of the data was done anonymously.

($r = 0.1063$ and $p = 0.3$, 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.

C Tables

Table 4: Summary of Treatments and Subjects Characteristics

Treatment	# Subjects	# Questionnaires	Mean age	Male Subjects	Mean Payoff
Piecerate	25	24	23.0	52%	€32.2
Goal	25	22	23.2	60%	€27.6
Belief	25	24	23.7	56%	€33.7
Exo100	15	15	24.3	40%	€30.0
Exo50	15	14	22.7	47%	€27.0
Total	105	99	23.4	52%	€30.4

The table gives the number of subjects, the number of completed online questionnaires, the mean age, and the percentage of male subjects. The mean payoff excludes the additional payments for the online questionnaires.

Table 5: Performances in Treatments

Output	Piecerate	Belief	Goal	Exo100	Exo50	Average
Low Performer	81.2	88.56	88	95.8	79.8	86.79
Medium Performer	102.43	117.43	122.71	113.67	90.25	111.6
Top Performer	122.44	145.78	140	123.43	104.17	130.81

Subjects are categorized as low/medium/high performer if their total output was among the lowest/medium/top 33% of the subjects in the corresponding treatment.

D Figures

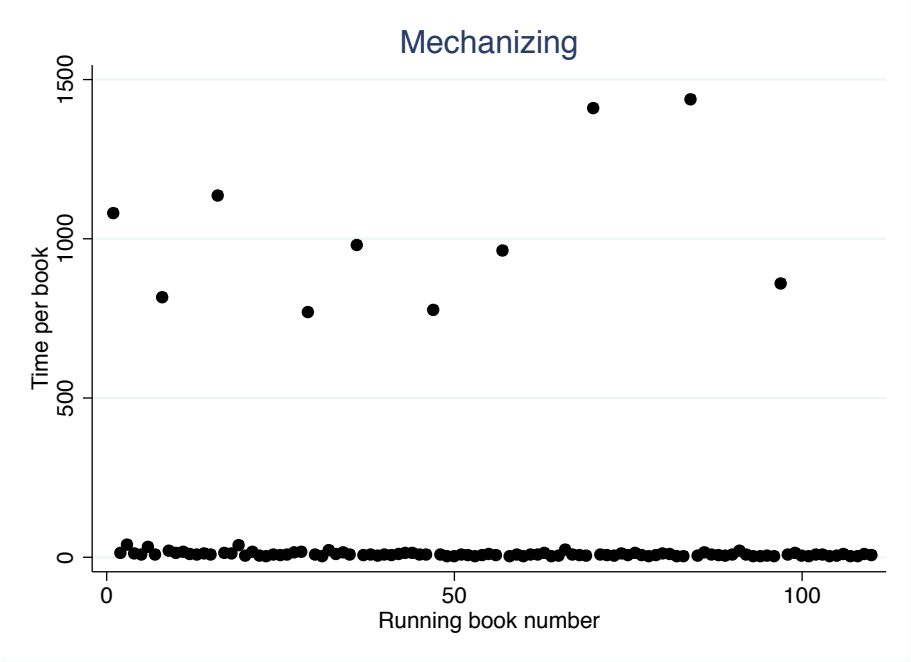

Figure 5: Subject that does mechanize

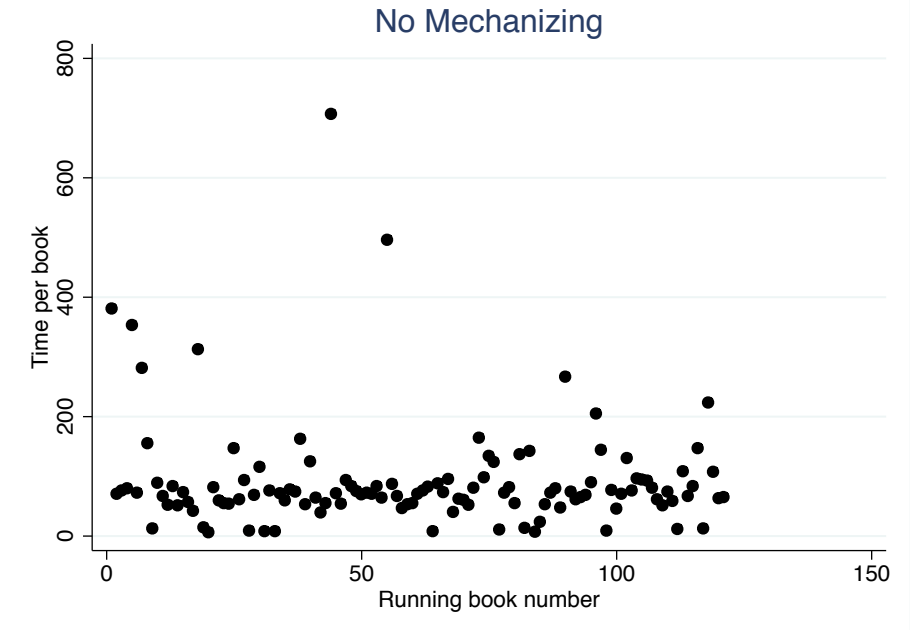

Figure 6: Subject that does not mechanize

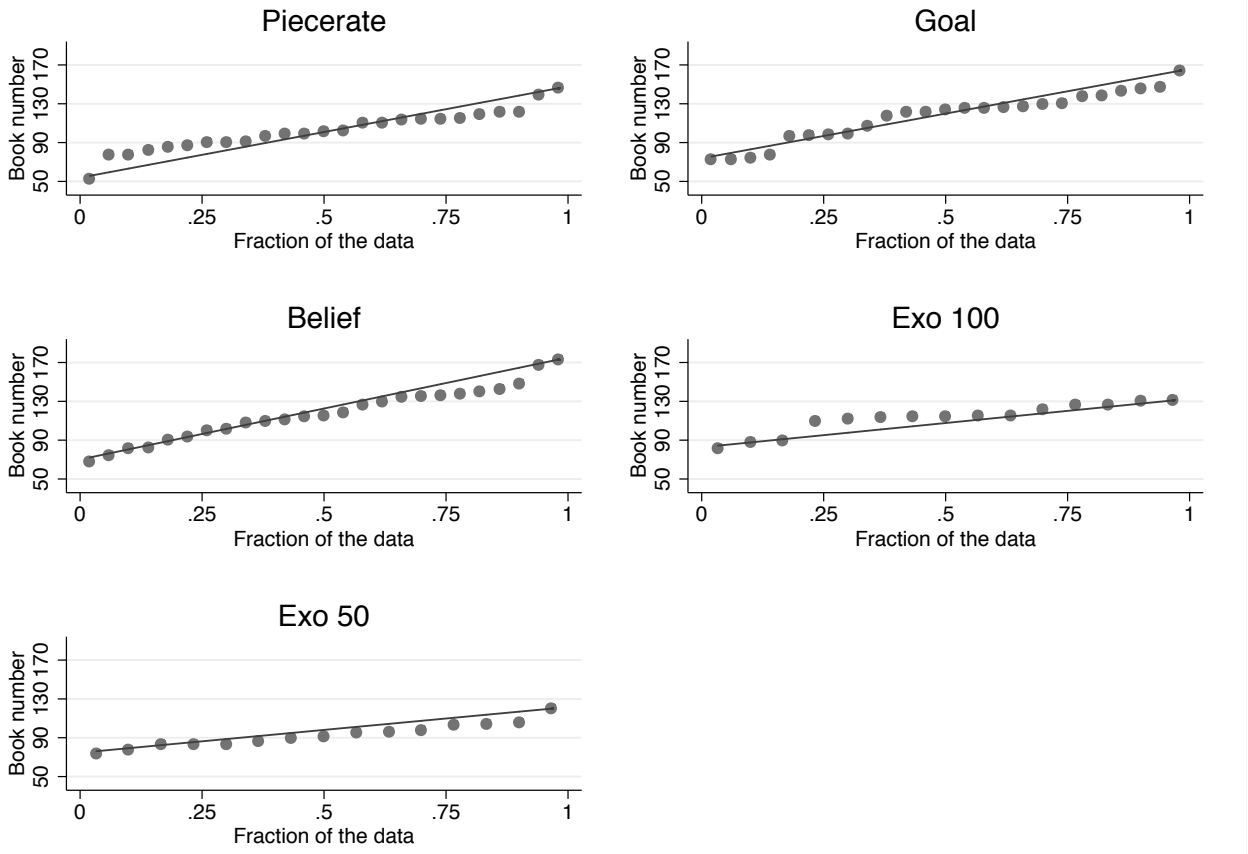

FIGURE 7: QUANTILES OF OUTPUTS PER TREATMENTS

E Regressions

Table 6: OLS Total Number Books

Total Books	(1)	(2)	(3)
Goal	14.44**	11.61*	11.60**
	(6.530)	(6.282)	(5.662)
Belief	15.24**	11.60*	12.88*
	(6.897)	(6.489)	(6.728)
Exo100	10.27*	14.28**	12.46**
	(5.680)	(6.002)	(6.190)
Exo50	-9.667*	-6.755	-5.775
	(5.200)	(5.409)	(5.152)
Ability		0.104***	0.101***
		(0.0237)	(0.0240)
Male			-7.404*
			(4.088)
Age			1.426*
			(0.768)
Morning			-5.464
			(3.743)
Mechanizing			12.35**
			(5.574)
Constant	102***	120.8***	82.65***
	(4.129)	(5.738)	(21.14)
Observations	105	97	97
R-squared	0.150	0.297	0.385
Prob > F	0.0000	0.0000	0.0000

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

Table 7: OLS Size of Goals

Goal	(1)	(2)	(3)	(4)	(5)
Belief	41.60***	38.26***	38.82***	42.51***	44.87***
	(11.93)	(11.18)	(11.02)	(11.63)	(11.55)
Ability		0.192**	0.183**	0.167**	0.155**
		(0.0714)	(0.0708)	(0.0614)	(0.0640)
Holt&Laury			-2.287	-6.009**	-6.275*
			(1.837)	(2.708)	(3.405)
Neuroticism				19.09	21.19*
				(11.33)	(10.97)
Extraversion				9.278	12.57
				(13.95)	(11.14)
Openness				-2.585	-2.950
				(12.96)	(11.96)
Agreeableness				-1.337	-0.212
				(11.50)	(10.89)
Conscientiousness				8.384	5.789
				(9.839)	(9.803)
Male					14.73
					(11.85)
Age					-2.251
					(1.836)
Morning					-8.870
					(12.93)
Constant	102.4***	132.9***	146.1***	67.62	104.0
	(6.565)	(14.43)	(17.12)	(87.75)	(89.42)
Observations	50	46	46	43	43
R-squared	0.202	0.384	0.399	0.476	0.530
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
We use the first switching point of a subject in the Holt & Laury task as the measurement of risk aversion.

TABLE 8: RANDOM EFFECTS MODEL – TIME PER BOOK IN TREATMENTS WITH GOALS

Time Per Book	(1)	(2)	(3)	(4)	(5)	(6)
GOAL	-19.26***	-10.57**	3.857	5.066	7.976	10.72
	(5.776)	(5.356)	(10.40)	(8.381)	(9.792)	(7.498)
BELIEF	-22.08***	-12.25**	0.326	0.680	9.194	10.67
	(5.974)	(5.255)	(10.34)	(8.101)	(9.963)	(7.519)
EXO100	-18.56***	-17.00***	0.930	2.893	6.198	10.79
	(5.263)	(4.832)	(10.26)	(8.165)	(9.378)	(7.756)
Ability		-0.104***	-0.0987***	-0.0789***	-0.0825***	-0.0823***
		(0.0260)	(0.0293)	(0.0235)	(0.0247)	(0.0238)
Goal size			-0.994**	-0.846***	-0.615	-0.725**
			(0.406)	(0.328)	(0.393)	(0.317)
(Goal size)^2			0.00388**	0.00331***	0.00246*	0.00285**
			(0.00155)	(0.00125)	(0.00142)	(0.00117)
#Book				-2.091***	-2.217***	-2.219***
				(0.387)	(0.393)	(0.396)
(#Book)^2				0.0114***	0.0116***	0.0117***
				(0.00264)	(0.00252)	(0.00255)
Attained					23.17***	23.53***
					(6.147)	(6.154)
Attained x BELIEF					-34.01***	-30.41***
					(11.59)	(11.79)
Male						9.165***
						(3.234)
Age						-0.980
						(0.753)
Mechanizing						-7.300**
						(3.430)
Morning						3.745
						(3.119)
Constant	116.3***	92.23***	136.0***	198.7***	183.2***	210.1***
	(3.977)	(5.487)	(19.73)	(18.89)	(20.18)	(23.68)
Observations	8911	8329	8329	8329	8329	8329
Subjects	80	76	76	76	76	76
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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

F Instructions

F.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.

F.2 Instructions - Piecerate

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.

F.3 Instructions - Belief

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.

F.4 Instructions - Goal

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 have the opportunity to earn a bonus payment. In order to determine the amount of the bonus payment, you have set a personal goal for yourself, stating the amount of books you think you will 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.

Should you not reach your goal after the 3 hours, you will not receive the bonus payment. If you reach your goal, you will receive the bonus payment. The amount of the bonus payment depends on the personal goal that you have previously set for yourself, as you will receive an extra 10 cents for every additional book that you add to this goal.

- Example 1: if you set your personal goal at 20 books, you will receive a bonus payment of (20×0.10) as soon as you have found 20 books or more (this also applies if you have found, for example, 40 books). Should you not meet your goal of 20 books, you will not receive a bonus payment.
- Example 2: if you had instead set your personal goal to 40 books, you would have received (40×0.10) as soon as you had found 40 books or more. If not, you will not receive a bonus payment.