Performance Pay and Multi-dimensional Sorting – Productivity, Preferences and Gender

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Abstract

This paper studies the impact of incentives on worker self-selection in a controlled laboratory experiment. In a first step we elicit subjects' productivity levels. Subjects then face the choice between a fixed and a variable payment scheme. Depending on the treatment, the variable payment is a piece rate, a tournament or a revenue-sharing scheme. We elicit additional individual characteristics such as subjects' risk attitudes, measures of self-assessment, social preferences, gender and personality. We also elicit self-reported measures of work effort, stress and exhaustion. Our main findings are as follows. First, output is much higher in the variable pay schemes (piece rate, tournament, and revenue sharing) compared to the fixed payment scheme. This difference is largely driven by productivity sorting. Second, personal attitudes such as relative self-assessment, willingness to take risks, social preferences and personality indicators affect the sorting decision in a systematic way. Third, variable pay schemes attract men more than women, a difference that is partly explained by gender-specific risk attitudes. Finally, reported effort is significantly higher in all variable pay conditions than in the fixed wage condition. In sum, our findings underline the importance of multi-dimensional sorting, i.e., the tendency for different incentive schemes to systematically attract people with different abilities, preferences, self-assessments, gender and personalities. Our lab findings are supported by and additional analysis using data from a large and representative sample. We show that the likelihood of working in a variable payment scheme depends positively on willingness to take risks and negatively on being female and endowed with preferences for reciprocity.

Keywords: Sorting, Incentives, Piece Rates, Tournament, Revenue-Sharing, Risk Preferences, Social Preferences, Gender Experiment, Field Evidence

JEL codes: J3, M52, C91, D81, J16

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1 Introduction

Typically the rationale for providing incentive schemes is to align the interests of principals and agents in the presence of a contract enforcement problem. This view underestimates the importance of worker self-selection, i.e., the possibility that agents with different individual characteristics feel attracted by different pay schemes and therefore systematically self-select into particular firms and organizations. In the presence of self-selection the overall performance of an organization is likely to depend not only on the output effects that stem from the incentive effect of its payment system *per se* but also on the endogenous composition of its workforce. A few studies (e.g., Lazear, 2000) indicate that productivity sorting contributes to output differences between different incentive systems. Little is known empirically, however, about the nature of this selection process along other dimensions that are crucial to an organization's success. Recent theoretical models suggest, for example, that social preferences could play a decisive role in the selection process, with important consequences for worker performance in teams (Kosfeld and von Siemens, 2007).

Field data often lack important information on workers' preferences and motives and confounding factors impede causal inference. This paper therefore explores the driving forces of self-selection in a controlled laboratory environment. We address the following questions: Which personal characteristics beyond individual productivity differences provoke workers to self-select into variable instead of fixed pay contracts? In particular, how do relevant characteristics like risk aversion, relative self-assessment, social preferences, gender or personality shape the selection process? How does the composition of the workforce differ when firms offer either fixed wages or variable payments in the form of piece rates, tournaments or revenue sharing?

The idea of the experiment is to first elicit subjects' individual productivity levels. Subjects then face the choice between a variable and a fixed payment scheme. We observe which payment mode they prefer and how much they work. Finally, we elicit further individual characteristics that may be relevant for the sorting decision. Among them are subjects' risk attitudes, relative self-assessment, social preferences, gender and personality. In addition we elicit self-reported measures of work effort, stress and exhaustion. The work task consists of multiplying one-digit numbers by two-digit numbers and is characterized by a substantial degree of heterogeneity in productivity. We study three treatment conditions, which are characterized by different variable pay schemes. This allows us to study the sorting patterns when the choice is between a fixed payment and either a piece rate, a tournament, or a revenue-sharing scheme. These three forms of variable pay constitute the most important forms of explicit performance incentives. Since the treatments are exactly identical except for the alternative variable pay scheme, our design allows us to study different sorting patterns as a response to these different pay schemes in a uniform and comprehensive framework.

Our main results reveal the importance of multi-dimensional sorting. We first establish that output in all variable payment schemes is higher than output under the fixed wage regime. Our second result shows that this output difference is mainly attributable to productivity sorting, which is strong and present in all three treatments. When facing the alternative between variable and fixed payments, more productive workers systematically prefer the variable pay. This holds regardless of whether the latter is offered as a piece rate, a tournament or a revenue-sharing scheme. Our third result shows that relative self-assessment plays an important role for sorting into tournaments, which is sensible as payments in tournaments depend on relative performance. The better subjects think they perform relative to others and the more they overestimate their relative performance, the more likely they are to enter tournament competition. Fourth, controlling for individual productivity, risk attitudes play an important role in the sorting decision: the likelihood that subjects prefer the variable payment is higher the less risk averse they are. This finding reflects the fact that the fixed payment yields a safe payoff whereas earnings in the variable pay are uncertain and therefore risky. Our fifth result concerns social preferences. We find that tournaments attract relatively selfish individuals. This may be driven by the fact that providing effort in tournaments imposes a negative externality on the competitors and that final payoffs in the tournament are quite unequal. These features are not present under piece rates or revenue sharing, and we observe no sorting based on social preferences in these schemes. In our sixth result we show that women are less likely to select into variable pay schemes than men. This is partly explained by differences in risk attitudes between men and women. We also show that personality is relevant for self-selection. Interestingly, different personality traits are relevant for men and women. On top of the observed sorting patterns our seventh result shows that self-reported effort varies significantly with different work incentives. In comparison to those working under fixed wages, subjects working under variable pay schemes report significantly higher effort levels as well as higher levels of stress and exhaustion.

Laboratory experiments are sometimes criticized in terms of a lack of generalizability. In other words, one may wonder whether our results on multi dimensional sorting carry over to workplace decisions in the field. In a final step of our analysis we address this concern and check the generalizability of our results with the help of a large and representative panel survey. Using information on individual risk attitudes and social preferences we estimate Probit models where we regress the probability of working under variable pay on gender, risk attitudes and social preferences controlling for productivity proxied by years of education, experience and tenure. All results of our laboratory experiments are supported: women and reciprocally motivated workers are less likely, and more risk tolerant workers are more likely to work under variable payment schemes. We think that this result in combination with our controlled lab evidence provides a particular powerful confirmation of the importance of multi-dimensional sorting.

The literature on optimal incentives has shown that characteristics of the production processes and the information structure affect optimal employment contracts.[1] Our results indicate that organizations should, in addition, take into account the interaction of incentives and multi-dimensional sorting when deciding on the design of the incentive system. This follows from the fact that worker characteristics and preferences affect the success of firms. This is quite obvious for productivity. But also risk preferences, overconfidence or social preferences may have an important influence on a firm's success. For example, if an investment company attracts relatively risk loving and overconfident fund managers, this will most likely affect the company's portfolio strategy. As another example, social preferences can be relevant for reducing free-riding in teams and may therefore positively affect output (see, e.g., Fehr and Gächter, 2000). Of course, many of the discussed worker attributes are typically unobservable during the hiring process. In this sense our results suggest that firms may use incentive schemes as screening devices to attract particular types of workers (Salop and Salop, 1976). To the extent that firms, even when operating in similar environments, have different preferences regarding the composition of their workforce, our results offer an explanation for why firms install different remuneration schemes. Our results also imply that changing the pay system sets off sorting processes beyond productivity sorting. This change in the workforce composition might affect several procedures inside the firm and change the entire work environment or firm culture (see, e.g, Kosfeld and von Siemens, 2006). It is also important to realize that introducing

[1] Early work (e.g., Stiglitz, 1975) focused on the role of monitoring costs and imperfect information about individuals' abilities. Implications for the choice between piece-rate contracts and time-rate contracts in the presence of monitoring costs have also been amply studied (see, e.g., Brown, 1990, 1992, 1994; Goldin, 1986; Parent, 1999; Pencavel, 1977). Lazear and Rosen (1981) have proposed rank order tournament as optimal incentive contracts when reliable monitors of effort are too costly. Optimal multiperiod incentive schemes have been considered in another strand of the literature, e.g., Laffont and Tirole, 1988, which also highlights the role of future commitment (see Baron and Besanko, 1984; Gibbons, 1987; Kanemoto and MacLeod, 1992). For evidence on the interplay between job characteristics and the incidence of particular compensation contracts see also MacLeod and Parent (1999).

variable pay in certain jobs that are predominantly characterized by fixed wage schemes, such as the public sector, are likely to reduce job satisfaction among incumbent workers who prefer the previous wage system, as revealed by their past choice.

Showing the relevance of sorting also underlines the methodological difficulties associated with testing contract theory with field data (Prendergast, 1999; Chiappori and Salanié, 2003). Comparing output under performance pay schemes to output when remuneration is independent of effort, it is often hard to determine whether higher output under the former is due to incentives or sorting. This point has been made in the theoretical analysis by Lazear (1986) and empirically shown in a well-known case study of a firm that changed from fixed wages to piece rates (Lazear, 2000). Ignoring this selection effect would imply a dramatic overestimation of the incentive effect. Our results confirm this conclusion about productivity sorting for piece rates, but also for tournaments and revenue sharing. Moreover, our results point to another potential confounding factor in testing contract theory: Preference and self-assessment sorting. It is well known that optimal contracts depend on risk preferences. More recently it has also been argued that optimal contracting depends on social preferences, i.e., on the composition and interaction of selfish and reciprocal agents (see, e.g., Fehr, Klein and Schmidt, 2007; Englmaier and Wambach, 2005; Grund and Sliwka, 2005; Bartling and von Siemens 2006). In light of our findings, the composition of both risk and social preferences in a given pool of agents is likely to be endogenous.

Ruling out this kind of endogeneity is an important rationale for conducting laboratory experiments. In the lab it is easy to implement random treatment assignment in order to rule out sorting and to get unbiased estimates of the incentive effects of different incentive schemes. In this way, experiments have produced valuable and indispensable knowledge about the incentive effects of different incentive schemes.[2] Our experiment shows that experiments can be used not only to rule out selection effects with random assignment but also to study sorting in a controlled way. In a similar vein sorting has been studied, e.g., in a market entry game (Camerer and Lovallo, 1999), in simple bargaining games (Oberholzer-Gee and Eichenberger, 2004; and Lazear, Malmendier and Weber, 2005), the

[2] Using random treatment assignment, tournament incentives have been studied, e.g., by Bull, Schotter and Weigelt (1987), Schotter and Weigelt (1992), Falk and Fehr (2002) and Harbring and Irlenbusch (2003). The lab evidence on tournaments is complemented by field studies on corporate tournaments (Bognanno, 2001), tournaments in agricultural production (Knoeber and Thurman, 1994) and sports tournaments (e.g., Ehrenberg and Bognanno, 1990; Fernie and Metcalf, 1999; and Sunde, 2003). The incentive effects of piece rates have been experimentally investigated, e.g., by Bull, Schotter and Weigelt (1987) and van Dijk, Sonnemans and van Winden (2001), while team incentives have been studied, e.g., by Nalbantian and Schotter (1997). The impact of incentives has also been studied in field experiments, e.g., Bandiera et al. (2005) and Nagin et al. (2002).

gift-exchange game (Eriksson and Villeval, 2004) or the prisoner's dilemma game (Bohnet and Kübler, 2004). More related to our paper is Cadsby et al. (2005) and Eriksson, Teyssier and Villeval (2005) who show that effort variability in tournaments is lower when agents can decide whether to work under piece rates or under tournament incentives. This is also the choice that subjects face in the experiment by Niederle and Vesterlund (2007). Based on the finding that women perform worse in the presence of men in competitive environments (Gneezy and Rustichini, 2004) they study whether women shy away from competition. They find that women are less willing to compete in tournaments compared to men when the alternative is to work under piece rates. As mentioned above, this is similar to our finding that women are less likely to select into variable pay than men when the alternative is a fixed payment. In this sense sorting offers a possible channel for gender differences in occupational choice, career choice and ultimately for the existence of the gender wage gap.

The paper is organized as follows. The next section describes the experiment. Section 3 presents the results. We first discuss the output effects of different incentive schemes. Then we present evidence on the importance of sorting with respect to productivity, relative self-assessment, risk preferences, social preferences, gender and personality. Finally, we discuss the effect of incentives on the provision of effort. In section 4 we check the generalizability of our findings, using data from the German Socio-Economic Panel (SOEP), a large and representative panel survey. Section 5 concludes.

2 An Experimental Approach to the Study of Incentives and Multi-Dimensional Sorting

The ideal data set for studying how individual characteristics affect the sorting decision into different incentive schemes combines knowledge of individual productivity and personal characteristics along with direct observation of the selection decision in a well defined environment. Such data are difficult to obtain in the field. First, individuals' characteristics and preferences are typically not observed. This holds for productivity measures, but even more so for personal attributes like risk aversion, social preferences or relative self-assessment. Second, workers are typically exposed to a mix of explicit and implicit incentives, which complicates an accurate characterization of the incentives that actually prevail in the work environment. Suppose, for example, that the researcher observes that a firm has established piece-rate contracts. This does not preclude the possibility that workers are also motivated by the threat to be dismissed or the chance of being promoted, or are confronted with additional incentives that directly affect remuneration, for example, bonus payments or team incentives like profit sharing. Moreover, implicit contracts and repeated game effects may create work incentives even in the absence of explicit performance incentives (MacLeod and Malcomson, 1989, 1998). Third, individual output measures are often not available or are fraught with measurement error. Fourth, it is only appropriate to interpret policy changes in firms as natural experiments if these changes are exogenous, which is always debatable. Finally, policy changes need time to affect the endogenous composition of the workforce and it is not obvious what time frame the researcher should consider. Allowing too little time for sorting to take place, will lead to an underestimation of the sorting effect. Waiting too long, however, increases the likelihood that other factors besides the change in the incentive scheme will affect the sorting process.

We think that experiments offer a valuable tool for studying incentives and sorting in a controlled environment, complementing the evidence generated by observational field studies in an informative way (see section 4). In the lab, it is possible to precisely define the material incentives upon which subjects can base their sorting decision. It is further possible to elicit measures of individual productivity with little measurement error as well as individual characteristics and preferences. Furthermore we rule out any mix of different implicit or explicit incentives. Finally, since the sorting decision takes place immediately, timing is not an issue.

2.1 The Work Task

The work task implemented in our experiment consists of multiplying one-digit numbers by two-digit numbers. This "real effort" task implies that subjects have to actually work[3] and are to some extent uncertain about their productivity and the productivity of others. This is a realistic feature of most work tasks and leaves room for sorting according to (relative) self-assessment. As a task, multiplying numbers is also well suited for our purposes because it requires no previous knowledge, is easy to explain, and guarantees a sufficient degree of heterogeneity in productivity. Moreover, this task is a relatively good proxy for general cognitive ability, and in light of recent neuroscience evidence, learning effects during the experiment are expected to be small (Roth, 2001). Depending on the chosen numbers, the difficulty level of multiplying one-digit numbers by two-digit numbers varies quite a bit.

[3] This is in contrast to most economic labor market experiments that mimic effort costs by requiring subjects to choose a number, with higher numbers costing more money. Other real effort experiments include, e.g., Fahr and Irlenbusch (2000) who have subjects crack walnuts, van Dijk, Sonnemans and van Winden (2001) who asked subjects to perform cognitively demanding tasks on the computer, Gneezy et al. (2003) who had subjects solve mazes at the computer and Falk and Ichino (2006) who asked subjects to stuff letters into envelopes.

This has to do with the fact that different problems require different usages of working memory. In particular, we distinguish between five different degrees of difficulty.[4] As we will see below, solving more difficult problems is more time-consuming.

All problems were presented to subjects on computer screens (see Appendix). They could type their answer in a box and confirm it by clicking an "OK"-button with their mouse. Having entered the answer, a subject was informed whether or not the solution was correct. If it was correct, a new problem appeared instantaneously on the screen (except in steps 1 and 2 of the experiment where only one problem had to be solved, see below). If the answer was wrong, subjects had to tackle the same problem again until the correct solution was entered. We forced subjects to solve a problem before a new question appeared on the screen in order to prevent subjects from guessing and searching for "easy" problems. A subject was always informed about the cumulative number of problems he or she had answered correctly.

2.2 Design and Treatments of the Experiment

In order to study how individual characteristics affect the sorting decision into different incentive schemes, we implemented an experiment that includes 12 steps (see Figure A.1 in the Appendix). Subjects were informed at the beginning that they would go through different steps, but they did not know what these steps would look like. The first three steps are designed to elicit three different measures of individual productivity. In the first step, all subjects were asked to calculate one multiplication problem as fast as possible. The problem that they were confronted with on the computer screen had a degree of difficulty 4. No payment was involved. The time that elapsed before the correct answer was entered is our first productivity indicator (Productivity Indicator 1).

The second productivity measure (Productivity Indicator 2) is basically the same as the first, except that this time subjects were paid for being fast. Again they were asked to calculate one problem with degree of difficulty 4 as fast as possible. This time, they were endowed with 150 points. Subjects were told that 5 points would be subtracted from this endowment for each second they needed for solving the problem. This means, e.g., that a subject who answered the question after 15 seconds earned 75 points while someone who needed 22 seconds received only 40 points, etc. Earnings for subjects who did not come up with the correct answer in 30 seconds were zero. A clock on the screen informed about how many of the 30 seconds had elapsed.

[4] Examples for the five levels of difficulty are: Level 1: $11 \cdot 9$; Level 2: $3 \cdot 32$; Level 3: $6 \cdot 43$; Level 4: $4 \cdot 68$; Level 5: $7 \cdot 89$.

Our third measure of an individual's productivity (Productivity Indicator 3) is the number of problems that a subject solved when working for five minutes for a piece rate of 10 points per correct answer. Each subject went through the exact same sequence of problems. We implemented a stratified sampling design of questions, i.e., each block of 10 problems had the following structure in terms of difficulty: One problem of degree 1, one problem of degree 2, two problems of degree 3, four problems of degree 4, and two problems of degree 5. The sequence of questions within a block of ten questions was random.

The three productivity indicators measure different aspects of individual productivity. Productivity Indicator 1 measures willingness and ability to answer a problem quickly. Since no stakes are involved, it is also informative about some form of intrinsic motivation. Productivity Indicator 2 measures how fast subjects answer questions when they are under some pressure, which resulted because they were paid for being fast and because they saw the time that remained for answering the question on the screen. Productivity Indicator 3 measures output under a different incentive scheme and allows much more time. It is therefore a good proxy for subjects' productivity and perseverance. The latter is relevant since the work task after the sorting decision involves 10 minutes of problem solving. In section 3 we will therefore predominantly use Productivity Indicator 3.

In step 4 we asked subjects to subjectively assess how hard they had worked in the five minute working time in step 3. In particular, we asked the following three questions: How much effort did you exert? How stressed did you feel? How exhausted did you get? Answers to these questions were given on a seven point scale, where the value 1 means 'not at all' and the value 7 means 'very much'. Then, in step 5, we asked subjects to assess their performance in step 3 relative to the performance of the other 19 participants in their session. We are interested in this assessment to find out whether it affects the sorting decision (in particular into tournaments) and whether selection into variable pay schemes is associated with relative overassessment. The question subjects had to answer reads as follows: How many of the other 19 participants solved more question than you did? Subjects had an incentive to answer the question as accurate as possible. For a correct estimate they received 100 points, for a deviation of plus or minus one from the correct number they received 50 points, and otherwise they received zero points. Subjects were informed about their true rank in the distribution not until the very end of the experiment.

Step 6 is the actual sorting decision. Subjects were informed that they were to work for ten minutes on the same work task as before, i.e., multiplying one-digit and two-digit numbers, with a similar degree of difficulty. Before they started to work, they were offered the choice between a variable pay contract and a fixed-payment contract. The chosen contract determined how they were paid for the output they produced later in the 10-minute work period. In each of our three treatments, the fixed-payment contract, w^F, guarantees the payment of 400 points independent of output x, the number of correctly answered problems, i.e.,

$$w_i^F = 400. \tag{1}$$

It was made clear to subjects that they would receive 400 points independent of whether they solved a few, many, or no problems at all. The only requirement for receiving the 400 points was that they had to stay in the lab.

The type of variable pay scheme offered as an alternative to the fixed wage defines each of our three treatments. We study piece-rate, tournament or revenue-sharing contracts. These three forms of variable pay constitute the most important prototypical forms of explicit performance incentives. In the piece-rate treatment, the alternative contract paid a piece rate of ten points per correct answer, just as in step 3. Remuneration of subject i according to the piece-rate contract, w^{PR}, is given by

$$w_i^{PR} = 10 \cdot x_i. \tag{2}$$

In the tournament treatment, a subject i could choose to compete in a two-person tournament, in which the opponent j was randomly chosen among all subjects who had also opted for the tournament. Among the two competitors, the subject who had solved more problems at the end of the 10-minute work period won the tournament and received the winner prize of 1,300 points. The loser received zero points. If both competitors had solved the same number of problems, the winner was determined by a random draw. The tournament contract w^T for player i is given by

$$w_i^T = \begin{cases} 1300 & \text{if } x_i > x_j, \quad i \neq j, \\ 1300 \text{ with probability 0.5 and 0 with probability 0.5} & \text{if } x_i = x_j, \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

Subject i was informed about opponent j's output only after the working time of ten minutes was over. If an odd number of subjects had selected into the tournament, one randomly chosen subject's output was used a second time to determine the score of the unmatched subject's opponent. If only one subject opted for the tournament (which did not happen), no tournament was implemented and the subject was informed that he or she would be compensated according to the fixed-payment contract w^F. Subjects were informed about these details prior to their sorting decision.

In the revenue-sharing treatment, subjects could choose to work for a revenue sharing contract as an alternative to the fixed wage contract w^F. Two subjects who opted for this compensation were randomly matched and formed a team. The team received a piece rate of ten points for each correctly answered problem. A team's revenue was then divided equally among the two team members. The compensation for player i in the revenue-sharing condition w^{RS} is hence given by

$$w_i^{RS} = 10 \cdot \frac{x_i + x_j}{2}. \tag{4}$$

Again, the output of the other team member j was disclosed only after the end of the 10-minute working time. If only one subject or an odd number of subjects decided to work under revenue-sharing incentives, the same rules as under the tournament treatment applied.

Right after the sorting decision but before the actual working time began, we asked all subjects in step 7 how they would have decided if the fixed payment had been different. In particular, subjects had to indicate whether they would prefer the treatment-specific variable pay or the fixed payments of {50, 100, 150, ..., 800} points. These hypothetical choices reveal valuable information about sorting patterns at more or less attractive fixed payment alternatives.

Step 8 is the 10-minutes working time, during which subjects worked under their preferred contractual terms, i.e., either for a fixed payment of 400 points or for the respective variable pay. At the end of the working time, we notified subjects about their earnings, and we disclosed the competitor's output to tournament participants and the partner's output to team members. In step 9 we asked subjects to inform us on a seven point scale about effort, stress and exhaustion in exactly the same way as in step 4.

In the remaining three steps, we collected data on additional personal characteristics. In step 10 we elicited subjects' social preferences with the help of a simple trust game (similar to Berg et al., 1995). Each subject played a 2-player, sequential trust game. Both players received an endowment of 120 points. The first mover could transfer any amount {0, 20, 40, 60, 80, 100, 120} to the second mover. Any transfer was tripled. The second mover could then send back any amount between zero and 480. To elicit information about player types we used the contingent response method, i.e., second movers had to indicate for each of the seven possible transfer levels how much they wanted to transfer back to the first mover, before they knew the actual transfer. This is an incentive compatible way to elicit social preferences since any decision is potentially payoff-relevant. In order to be able to classify each subject, everybody had to play both roles, first and second mover. After all choices had been made, pairs of subjects were formed by random matching and the roles of first and second movers within a pair were assigned by a random draw. The players' choices were then implemented, and subjects were paid accordingly.

Step 11 elicits subjects' risk preferences using simple lottery choices, similar to Holt and Laury (2002). Participants in our experiment were shown a table with 15 rows. In each row they had to decide whether they preferred a safe option or playing a lottery. In the lottery they could win either 400 points or 0 points with 50 percent probability. The lottery was exactly the same in each row, but the safe option increased from row to row. In the first row, the safe option was 25 points; in the second it was 50 points, and so on up to 375 points in row 15. After a subject had made a decision for each row, it was randomly determined which row became relevant for payment. This procedure guarantees that each decision was incentive compatible. If subjects have monotonous preferences, they prefer the lottery up to a certain level of the safe option, and then switch to preferring the safe option in all subsequent rows of the choice table. The switching point informs us about a subject's risk attitude.

In the final step 12, we elicited subjects' risk attitudes in an alternative way, namely by asking individuals to indicate their willingness to take risks in general on an eleven-point scale, with zero indicating complete unwillingness to take risks, and ten indicating complete willingness to take risks. We use the same wording of the question as in the 2004 wave of the German SocioEconomic Panel (SOEP), a representative panel survey of the resident population of Germany (see also section 4).[5] Dohmen et al. (2005) have validated the behavioral relevance of this general risk question in a field experiment with a representative subject pool of 450 individuals. They conclude that the survey risk measure is a good predictor of risky choices with real money at stake.

We also gathered questionnaire data on socioeconomic characteristics (including gender, age, nationality, marital status, and parents' education), on educational achievement (grades and major fields of study on university-entrance examination (Abitur), high-school graduation year, and last mathematics grade in high-school). Subjects also completed a verbal IQ-test, the so called *Mehrfach-Wortschatz-Intelligenztest* (MWT-A) (Lehrl et al.,

[5] The exact wording of the question (translated from German) is as follows: How do you see yourself: "Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please tick a box on the scale, where the value 0 means: 'unwilling to take risks' and the value 10 means: 'fully prepared to take risk'."

1991), and a personal attitudes test developed by Hermann Brandstätter (see Brandstätter, 1988).

2.3 Procedural Details

The experiment was computerized using the software z-Tree (Fischbacher, 1999). All of the interaction was anonymous. Most of the instructions were presented on the computer screen. At the very beginning, however, subjects were handed out a written overview that informed them about the work task and presented the basic structure of the experiment. Subjects were told that no aid was allowed for answering the problems (calculator, paper and pencil etc.) and that we would check this throughout the experiment. We ran twelve sessions, four sessions in each of the three treatments. A total of 240 subjects participated. We invited the same number of females and males in each session and ended up with 121 female and 119 male participants.[6] A session lasted, on average about 90 minutes. Subjects were students from the University of Bonn. Ten points in the experiment were exchanged for 0.17 Euro (1 Euro $\sim$ 1.30 US Dollar at that time). Average earnings were 20.80 Euro.

3 Results

In this section we present the main results. In section 3.1, we start by investigating whether subjects who opt for a variable pay contract produce more than subjects who prefer to work for a fixed payment. In section 3.2 we focus on the role of sorting. First, we assess the role of productivity as an influencing factor for the selection into an incentive system. We then explore how other worker attributes — including risk preferences, relative self-assessment and overconfidence, social preferences, gender, and personality — determine the sorting decision. Finally, in section 3.3, we study how effort choices respond to the different incentive schemes.

3.1 Output

Our first result concerns output differences between variable and fixed payment schemes. We expect a positive output effect of variable pay schemes for two reasons. First, more productive subjects are likely to self-select into variable pay schemes, as we will address in more detail in the next section. Second, incentive theory predicts that subjects should

[6] We invited 12 men and 12 women to each session. The first 20 subjects who showed up at the lab participated in the experiment. The other subjects received a show-up fee and were asked to leave the laboratory.

work at least as hard in the variable pay schemes as in the fixed payment. Our first result verifies this expectation.

Result 1. *Output in all variable pay schemes is higher than output under the fixed wage regime.*

Figures 1 and 2 provide evidence for Result 1. Charts (a), (b) and (c) of Figure 1 depict realized output during the 10-minute work period (step 8 of the experiment) in the three different treatments. The upper histogram of each chart reflects the number of correctly solved problems for subjects who have self-selected into the fixed payment scheme while the lower shows the output distribution for subjects who opted for variable pay.

The figure clearly confirms that subjects on variable pay produce much more than those who work for a fixed payment. In all treatments the output distribution in the variable pay condition is shifted to the right compared to the respective output distribution in the fixed payment condition. The hypothesis that the fixed and variable output distributions are the same is rejected by a Wilcoxon rank-sum test at any conventional level (p-value < 0.0001) in each treatment. Subjects with a piece-rate contract solved on average 59.17 problems compared to 31.50 problems solved by subjects who worked for the fixed payment in the same treatment. The respective numbers in the tournament treatment are 61.03 versus 32.92 and in the revenue-sharing treatment 55.47 versus 34.48. OLS regressions (not reported here) of individual output on an indicator variable for variable pay and a constant substantiate that these output differences between the two self-selected groups of subjects are statistically significant at any conventional level in every treatment.

Figure 2 restates this result in a different way, which is also informative on another dimension. The horizontal bars in the figure represent how much time (in seconds) subjects with a particular remuneration contract need on average to enter the correct solution to a problem with a certain degree of difficulty. The brighter the bars the more difficult is the respective problem. For example, in the piece-rate treatment subjects who work under the fixed payment scheme need on average about 25 seconds to correctly answer a problem of difficulty level 5. Those who work on a piece-rate contract, however, need only about 13 seconds. The figure illustrates that regardless of the treatment, the time needed to solve a problem increases in the level of difficulty (level 1 to 5). Moreover, subjects in the variable pay schemes solve problems much faster than those working for a fixed payment. This holds for problems of all difficulty levels but is most pronounced for relatively tough problems. This pattern is partly explained by the fact that the error rate, which generally rises with the degree of difficulty, is higher for subjects in the fixed payment schemes.[7]

3.2 Sorting

The output differences observed in the previous section are most likely the result of sorting and different effort responses. In order to explain the output differences and to understand the nature of the sorting process, we start this section by studying the role of individual productivity for the sorting decision. In a second step we investigate how sorting is affected by other personal attributes.

3.2.1 Productivity

If subjects choose between the fixed-payment contract w^F (equation (1)) and the piece-rate contract w^{PR} (equation (2)), it is straightforward to show that subjects whose productivity exceeds a certain threshold value optimally opt for the piece-rate contract, while subjects with lower productivity prefer the fixed-payment contract. This productivity threshold increases in the level of the fixed payment, and it decreases in the attractiveness of the piece rate.[8] If the difference between optimal effort costs under piece rates and fixed wages is sufficiently small, risk-neutral subjects, who expect to solve more than 40 problems in 10 minutes, optimally choose the piece rate. This is the case for subjects who produced more than 20 correct answers during the 5-minute work period and who reckon that they can solve twice as many problems in 10 minutes than in 5 minutes.

In the tournament, a similar productivity sorting pattern is plausible but not as obvious as in the piece-rate treatment. The reason is the strategic nature of tournaments. A

[7] Subjects solved 95 percent of problems on their first attempt when the degree of difficulty was equal to 1, 92 percent when the degree of difficulty was 2, 88 percent when it was 3, 82 percent when the degree of difficulty was 4 and 78 percent when it was 5. Holding constant the degree of difficulty a probit analysis shows that subjects who selected the fixed-payment contract are 3 percent more likely on average to enter a wrong answer.

[8] More formally, this can be shown as follows: Assume that an individual's output, x_i, depends on his ability, θ_i, and effort, $e_i \geq 0$, according to the production function $x_i = \pi(\theta_i, e_i) + \varepsilon_i$, where $\varepsilon_i \sim N(0, \sigma_\varepsilon^2)$, π^θ, $\pi^e > 0$ and $\pi^{e\theta} \geq 0$. Subjects' ability is continuously distributed on the interval $[\underline{\theta}, \overline{\theta}]$ according to the cumulative distribution function $F(\theta)$. Assume that a subject's utility depends positively on the wage w and negatively on effort e according to the utility function $u(w, e) = w - c(e)$ with $u^w > 0$, and $u^c < 0$ since $c^e > 0$. Expected utility in the fixed wage regime with $w^F = \alpha > 0$ is maximized if the minimum required level of effort denoted by e^{min} is exerted, because remuneration is independent of effort in the fixed payment regime and $c^e > 0$. In our experiment, e^{min} captures the cost of remaining in the lab, sitting silently in front of the computer during the 10-minute work period. Expected utility under piece rates is maximized when the optimal effort level e^*, which satisfies $\frac{\delta c(e)}{\delta e} = \beta \frac{\delta \pi}{\delta e}$. Risk-neutral subjects opt for the contract that results in higher utility, so that the piece-rate contract is preferred when productivity exceeds the productivity threshold, $\hat{\pi}$, which is given by $\hat{\pi} = \frac{\alpha + c(e^*) - c(e^{min})}{\beta}$. The term $c(e^*) - c(e^{min})$ captures the disutility that results when effort is raised from e^{min} to e^*. Note that $\hat{\pi}$ increases in α and decreases in β.

risk-neutral subject optimally participates in the tournament if the winning prize of 1300 points multiplied by the probability of winning exceeds 400 points plus the value of the disutility that results from providing higher effort in the tournament than in the fixed payment.[9] Thus the sorting decision does not only depend on own productivity but also on the expected productivity of the other player who has sorted into the tournament. Therefore the existence of a unique sorting threshold depends on various distributional assumptions and is not guaranteed. Productivity sorting is also more likely the less important luck is relative to differences in ability.[10] In our experiment, productivity differences are likely to dominate luck in determining output and thus the likelihood of winning. Therefore, it is quite reasonable to expect an outcome in which more productive workers are more likely to participate in the tournament than less productive workers.

As in the tournament treatment, the prediction for productivity sorting in the revenue-sharing treatment depends on the assumed distributions. It is possible in theory to fix parameters such that either all subjects are expected to join the team, or no one is expected to join the team, or some are, either with or without a unique threshold. Note, however, that highly productive types, who can attain higher utility than under fixed wages even if their team partner does not produce anything, should always sort into the revenue-sharing scheme. Abstracting from effort costs, the corresponding critical output is 80 correct answers during the 10-minute working time.[11] We therefore expect average productivity to be higher among team participants than among subjects in the fixed wage scheme. Taken together, productivity sorting is likely to occur in all treatments, and especially in the piece-rate treatment. Our second result confirms these conjectures.

Result 2. *In all treatments there is systematic productivity sorting. On average, the more productive a worker, the more likely he self-selects into the variable pay scheme.*

Support for Result 2 comes from Figures 3 and 4 as well as from Tables 1 and 2.

[9] In the framework introduced in footnote 8, a risk-neutral subject optimally participates in the tournament if $\gamma \cdot Prob\{\pi_i(\theta_i, e_i^*) - \pi_j(\theta_j, e_j^*) > \epsilon_j - \epsilon_i\} \geq \alpha - c(e^{min}) + c(e_i^*)$.

[10] For example, if luck is absent, i.e., $\sigma_\epsilon = 0$ in the production function, and ability is continuously distributed on a closed interval $[\underline{\theta}, \overline{\theta}]$, a more able contestant has an optimal effort response function that ensures winning the tournament against a less able competitor. Since the most able subject always wins — and consequently enters the tournament — it is not optimal for a less productive person to compete. Entering the tournament is a weakly dominant strategy for the most able subject as he receives the outside option when no tournament takes place. In this setting no tournament takes place, as only the most productive individual optimally opts for tournament incentives. On the other hand, everybody will participate in the tournament if luck is sufficiently important relative to productivity differences. Finally, a sorting equilibrium, in which subjects whose ability exceeds a threshold $\hat{\theta}$ with $\underline{\theta} < \hat{\theta} < \overline{\theta}$ sort into the tournament and less able subjects select into the fixed payment scheme, may exist for intermediate cases.

[11] Along the lines of footnote 8 it can be shown that subjects whose team partner does not produce any output optimally opt for the revenue-sharing contract if their own productivity exceeds $\frac{2(\alpha - c(e^{min}) + c(e^*))}{\beta}$.

Figure 3 contains three charts, each of which compares the distributions of productivity (measured by Productivity Indicator 3) of subjects who sorted into the fixed payment scheme (upper histogram) and of subjects who sorted into the variable payment scheme (lower histogram) in a particular treatment. The fractions of subjects who self-select into the variable pay are 60.0 percent in the piece-rate, 48.75 in the tournament and 58.75 percent in the revenue-sharing treatment. Chart (a) of Figure 3 clearly confirms that those workers who self-select into the piece rate are more productive. Charts (b) and (c) show the same finding for the tournament and the revenue-sharing treatments, respectively. In line with our discussion above, the productivity histograms for subjects in the revenue-sharing treatment also reveal that all subjects whose productivity exceeds 40 answers in 5 minutes, and who are probably expecting to produce more than 80 correct answers in the 10-minute work period, sort into the revenue-sharing scheme.

Wilcoxon rank-sum tests verify that the differences shown in Figure 3 are statistically significant in all treatments (p-values < 0.0001). Moreover, the differences in mean productivity are quite sizeable. In the piece-rate treatment subjects who later opt for the piece-rate contract have an average productivity (measured by Productivity Indicator 3) of 26.7 correct answers compared to an average productivity of 14.2 of subjects who sort into a fixed-payment contract. Corresponding numbers are 25.8 versus 14.8 for the tournament treatment, and 24.5 versus 14.6 for the revenue-sharing treatment.

The result that more productive workers are more likely to sort into the variable payment holds regardless of the productivity indicator used.[12] In the upper part of Table 1 we report medians of all three productivity indicators, elicited in steps 1 to 3 of the experiment. The table shows, for example, that the median time needed to solve a problem amounts to 8 seconds for subjects who opt for the piece-rate contract and to 28.5 seconds for those who opted for the fixed payment in the piece-rate treatment. When paid for speed, subjects get faster in general (see Productivity Indicator 2), but the substantial productivity differences between the groups remain (7 seconds vs. 20.5 seconds). A similar pattern is observed in the tournament treatment and in the revenue-sharing treatment.

[12] All three productivity measures are highly significantly correlated (p-values< 0.0001). The correlation between Indicators 3 and 1 is -0.438, i.e., individuals who are faster in entering the correct answer in step 1 also solve more problems during the 5 minutes in step 3. The correlation between Indicators 3 and 2 is -0.616 among the 184 individuals with uncensored observations, while the correlation between indicators 1 and 2 is 0.336. The productivity indicators are also significantly correlated with the final math grade in high school — a measure that ranges from 1, the worst grade, to 15, the best grade — and with the Abitur grade — a measure that ranges from 4.0, the worst grade, to 1.0, the best grade. The Spearman rank correlations and corresponding p-values of math grades and Productivity Indicators 1 to 3 are respectively: -0.28 (p-value < 0.001), -0.20 (p-value < 0.008), and 0.28 (p-value < 0.001). The Spearman rank correlations and corresponding p-values of Abitur grades and Productivity Indicators 1 to 3 are respectively: 0.29 (p-value < 0.001), 0.21 (p-value < 0.006), and -0.20 (p-value < 0.003).

Overall the productivity differences are highly significant in all three treatments as shown by p-values of median tests reported in Table 1, one exception being the median difference for Productivity Indicator 1 in the revenue-sharing treatment.[13]

The significance of productivity sorting is further substantiated by estimation results of Probit models, in which the latent variable is the propensity to opt for the variable pay alternative (i.e., depending on the treatment, piece rate, tournament, or revenue sharing). Not surprisingly, the coefficient estimates reported in Table 2 show unequivocally that more productive subjects are significantly more likely to sort into the variable pay schemes than into the fixed payment scheme. In Table 2 (as well as in all other regression tables in this paper) we display the coefficients, the standard deviations and the marginal effects. The negative signs of the coefficient estimates for Productivity Indicators 1 and 2 indicate that the faster a subject solves the respective problems in steps 1 and 2 of our experiment, the more likely he is to opt for the variable pay contract. The estimated marginal effect of -0.031 for Productivity Indicator 2 in the piece-rate treatment indicates that taking one second longer to correctly answer the question reduces the probability to choose the piece rate by 3.1 percent. For subjects whose observations are censored, we construct a dummy variable, which takes a value of one if a subject did not answer the question within 30 seconds. The resulting estimate in the piece-rate treatment reveals that theses subjects have a 57.5 percent lower probability to enter the piece rate.

The positive coefficients for Productivity Indicator 3 reveal that subjects in all treatments are more likely to select into a variable compensation system the more problems they solved in step 3 of the experiment. The estimated marginal effect (reported in parenthesis) of Productivity Indicator 3 in the piece-rate treatment (Column (3)) implies that answering one additional question in the 5-minute work period makes a subject 3.9 percent more likely to sort into the piece-rate scheme. It turns out that the marginal effect is strongest and the fit of the model is best in the piece-rate treatment, indicating that sorting leads to the most clear-cut partition of the productivity distribution in the piece-rate treatment. This is plausible given that sorting in the piece-rate treatment does not depend on strategic considerations and beliefs and is therefore considerably less complex than sorting in the tournament and revenue-sharing treatments.

An important implication of productivity sorting is that the average productivity of a selected group depends on the relative attractiveness of the contract alternatives. Recall from our discussion above that the theoretical productivity threshold in the piece-rate treatment increases in the level of the fixed payment α. Consequently, we would expect

[13] The p-values correspond to continuity corrected Pearson $\chi^2(1)$ statistics.

fewer and more productive workers to select into the piece-rate scheme when the fixed payment alternative becomes more attractive. Similarly, more productive workers should choose the tournament or the revenue-sharing scheme as the level of the fixed payment increases. These predictions are born out by our data on hypothetical sorting decisions elicited in step 7 of the experiment. The correlation between individual productivity and the lowest fixed wage a subject just prefers over the variable payment is positive and highly significant (p-values of Spearman rank correlations < 0.001 in all treatments).

Figure 4 shows the sorting pattern in all treatments for different (hypothetical) fixed payments according to Productivity Indicator 3. Panel (a) displays the results for the piece-rate treatment. The bars in the lower part of the panel reveal that the fraction of workers who self-select into the piece rate is higher the lower the fixed payment displayed in steps of 50 points on the horizontal axis. For example, when the fixed payment is 50 or 100 points, all workers prefer the piece rate, while 60 percent prefer the piece rate when the fixed payment is 400 points, the level actually implemented in the experiment. If the fixed payment is as high as 800 points, almost nobody selects into the piece-rate scheme anymore.

The consequences for average productivity of the selected groups are displayed in the top panel. Dark dots represent subjects sorting into the piece rate and grey diamonds represent subjects sorting into the fixed payment. The dashed grey horizontal line reflects average productivity of all subjects who participated in the piece-rate treatment. Since all workers prefer the piece rate to fixed payments for very low fixed wages, the average productivity in the piece-rate group coincides with the overall average productivity. As the fixed payment increases, typically the least productive workers from the piece-rate group start sorting into the fixed payment. This leads to an increase in the average productivity in the piece rate group and to a relatively low productivity level in the fixed wage group. As the level of the fixed payment increases, more productive workers select into the fixed payment group such that the average productivity in this group eventually approaches the overall average.

The sorting pattern is similar in all three treatments, as shown in Panel (b) for the tournament and in Panel (c) for the revenue-sharing treatment. As the fixed wage becomes more attractive, fewer and fewer subjects self-select into variable pay. Those workers who switch to the fixed payment as a response to an increased fixed payment are typically among the least productive of the subjects on the variable payment scheme. This leads to the increase in productivity of the variable payment group.

3.2.2 Relative Self-Assessment and Overconfidence

A fundamental difference between piece rates on the one hand and tournaments or revenue-sharing on the other hand is that, in the former scheme, payoffs depend only on one's own performance and are independent of other workers' outputs. As a consequence, beliefs about other workers' productivity are irrelevant for the sorting decision in the piece-rate treatment, but could affect the sorting decision in particular in the tournament treatment. We therefore expect that subjects' beliefs about their relative rank should affect the sorting decision in the tournament treatment while no such effect is expected in the piece-rate treatment.

Result 3. *Relative self-assessment affects the decision to select into a tournament.*

Result 3 is supported by the estimation results shown in Table 3. We estimate the effect of a subject's relative self-assessed rank, elicited in step 5 of the experiment, on the propensity to opt for the variable pay contract in each treatment. Relative self-assessment significantly predicts sorting into the variable pay condition in all three treatments (see Columns (1), (3) and (5) of Table 3). The significant negative coefficient estimate for the variable "relative self-assessment" means that subjects are more likely to select into the variable pay schemes the more productive they believe they are relative to other participants. Note, however, that this finding just reflects productivity sorting if self-assessed ranks and true ranks are highly correlated, which is in fact true: The correlation between a subject's self-assessed rank and his or her true rank based on Productivity Indicator 3 is 0.69.[14] The relevant question, therefore, is whether relative self-assessment predicts the sorting decision even after controlling for productivity. Once we control for productivity, relative self-assessment predicts sorting only in the tournament treatment, but not in the piece-rate and the revenue-sharing treatment (see Columns (2), (4) and (6) of Table 3).[15] The marginal effect estimate of relative self-assessment in the tournament treatment is sizable: A subject with a more positive self-assessment of only one rank is 3 percent more likely to enter the tournament than a less optimistic but equally productive subject.

The difference between a subject's self-assessed rank and true rank can be interpreted as a measure of overconfidence. According to this measure 48 percent of the subjects can be classified as overconfident, while 36 percent underestimate their actual rank. We find

[14] This correlation is somewhat stronger in the piece-rate treatment (0.74) and in the tournament treatment (0.72) than in the revenue-sharing treatment (0.63).

[15] Note that the standard errors of coefficient estimates in Table 3 are large due to the strong correlation of Productivity Indicator 3 and relative self-assessment.

that overconfident subjects are more likely to self-select into tournaments. There is no such effect for the piece-rate or revenue-sharing schemes. This result is based on Probit regressions where the choice to work for variable pay is regressed on the difference between a subject's self-assessed rank and true rank controlling for productivity.[16] We estimate a significant positive marginal effect for the decision to sort into a tournament implying that an overassessment of one rank increases the likelihood that a subject participates in the tournament by 4 percent.

3.2.3 Risk Preferences

A potentially very important personal characteristic that affects the sorting decision into different incentive schemes is an individual's attitude towards risk.[17] Risk is involved in all variable payment schemes simply because incomes are uncertain. In contrast no risk is involved in the fixed wage payment since payments are independent of output. As a consequence the expected utility from variable pay is lower for risk averse subjects than for risk neutral or risk loving subjects. Hence we expect that subjects are less likely to select into variable pay the more risk averse they are. This effect should be strongest in the tournament treatment since earnings uncertainty is most pronounced in this condition for two reasons: the spread of potential earnings is higher and there is an additional source of uncertainty since the contestant's ability is not known.

Result 4. *Risk preferences affect the sorting decision. Risk averse workers are less likely to self-select into tournaments and piece rates.*

Estimates of the impact of risk preferences on the decision to sort into the different incentive systems in Table 4 support this result. In the reported Probit regression models we measure risk preferences by subjects' responses to the risk question elicited in step 12. We prefer this risk measure over the lottery measure elicited in step 11 since several subjects did not have a unique switching point and it is not clear how these observations

[16] We weigh observations by the probability that a subject can overassess or underassess the true rank. In our preferred specification, subjects in median ranks, i.e., subjects in the 45th to 55th percentile of the productivity distribution receive a weight of one, subjects in the 40th to 45th percentile and subjects in the 55th to 60th percentile receive a relative weight of 8/9, subjects in the 35th to 40th percentile and subjects in the 60th to 65th percentile receive a relative weight of 7/9, and so forth. Observations of subjects in the lowest ranks of the productivity distribution or in the highest rank receive a weight of zero. Results are robust to various alternative weighting schemes that symmetrically trim the data, i.e., use only observations in the 5th to 95th percentile of the true productivity distribution, or the 15th to 85th percentile, 20th to 80th percentile, and so forth. Results are available on request.

[17] Principal-agent theory has emphasized that risk-averse workers dislike the income risk that is associated with variable pay when output depends upon factors beyond their control, which triggers a trade-off of risk and incentives (see Prendergast, 1999 and references therein).

should be treated. Moreover, Dohmen et al. (2005) have shown that answers to this question reliably predicted lottery choices in a paid field experiment. We also find a strong correlation between subjects' answers to the risk question and the lottery choices in our experiment.

The coefficient estimates in Table 4 imply that, controlling for productivity, risk preferences significantly affect the sorting decision in the piece-rate treatment and in the tournament treatment. In Column (1), for example, a one point higher indication of willingness to take risk on the eleven-point scale makes a subject 5.8 percent more likely to opt for the piece-rate contract for a given level of productivity. The estimates in Columns (1) to (3) also indicate that risk attitudes matter most in the tournament treatment, both in terms of quantitative importance and in terms of statistical significance. This is consistent with the fact that uncertainty is most pronounced in this condition.

In the piece-rate treatment, we would expect risk preferences to matter most for workers who are close to the productivity threshold that is relevant for a risk neutral agent. After all, very productive subjects who are far above this productivity threshold should always prefer the piece rate regardless of their risk preferences. Likewise, very unproductive subjects should always prefer the fixed payment. In order to test this implication, we estimated the model from Column (1) on the sample of 53 subjects who solved between 10 and 30 problems in step 3 of the experiment.[18] The estimated marginal effect of our risk measure is in fact larger in this sub-sample (equal to 9.4 percent) and statistically significant at the 5 percent level.

3.2.4 Social Preferences

Traditional contract theory is based on the assumption that principals and agents are solely interested in their own material payoffs. In contrast, there is by now considerable evidence indicating that a substantial fraction of people also care about reciprocal fairness (see the overviews by Camerer, 2003; Fehr and Gächter, 2006; and Fehr and Schmidt, 2000). The co-existence of selfish and reciprocally motivated agents changes the optimality conditions of different types of contracts. For example, Fehr, Klein and Schmidt (2007) find in their experiment that contracts, which are optimal when all actors are selfish, may be less efficient when there is a minority of people who care about fairness. Furthermore, contracts that are inefficient if all actors are selfish may achieve surprisingly high levels

[18] We chose these numbers because 20 problems would be a risk-neutral subject's productivity threshold in the piece-rate treatment if the following is true: the disutility that results when effort is raised from minimum effort level in the fixed payment to optimal effort in the piece treatment is negligibly small, and subjects expect to produce twice as much when the working time is twice as long.

of efficiency when there are some fair-minded people. Theoretical implications of social preferences for optimal contracting are derived in Grund and Sliwka (2005) and Englmaier and Wambach (2005), von Siemens (2006) and Kosfeld and von Siemens (2006). Given the relevance of social preferences for optimal contracting it is important to understand whether they also affect the sorting of agents. To shed light on this issue we report in this section how subjects with given reciprocal preferences select themselves into different pay schemes.

Remember from section 4 that all subjects participated in a trust game. Since we made use of the strategy method, we know for each agent and for each transfer how much he is willing to pay back. In order to classify the agents with respect to their reciprocal inclination, we first determined for each subject the relation between transfer and back transfer. We ran simple OLS regressions of the back transfers on received transfers, forcing the slope to go through the origin. In a second step we grouped all subjects according to their individual back transfer slope. Subjects with a slope equal to zero are called *selfish* because they send back nothing irrespective of the first mover's transfer. 12.5 percent of the subjects are selfish. Subjects with a slope larger than zero but smaller than one are classified as *weakly reciprocal*. They pay back something but on average they pay back less than the first mover has sent (22.9 percent). Finally, we call all subjects with a slope larger than or equal to one *reciprocal*. These subjects return at least as much as they have received from their first movers (64.6 percent).

In Columns (1) to (3) of Table 7 we show Probit estimates of how reciprocal preferences affect the willingness to work under the three different variable pay schemes. The indicator variables classify subjects as either selfish, reciprocal or weakly reciprocal, where the latter is the reference category.[19] Controlling for productivity, Column (1) shows that social preferences play no role for the sorting decision between fixed wages and piece rates. Neither the variable selfish nor the variable reciprocal are close to being significant. This is not surprising as both, fixed wages and piece rates are individual pay schemes that provide no sensible basis for any sort of social comparison or fairness judgement. After all, the decision to work under fixed wages or piece rates does not affect payoffs of anybody else.

In contrast, tournaments seem to attract significantly less reciprocal subjects than fixed wage contracts, as Column (2) of Table 7 shows. One potential explanation is that people endowed with reciprocal preferences dislike interacting in competitive and non-

[19] Note that the results are virtually the same if we use a binary measure, grouping selfish and weakly reciprocal workers in one group and reciprocal workers in the other group.

cooperative environments where incentives are such that higher work effort produces a negative externality on others. Moreover, tournaments lead to extremely unequal outcomes. While the winner earns a lot, the loser gets nothing. If reciprocal subjects are averse to unequal outcomes, they may be willing to trade off expected payments with less inequity (for formal models see, e.g., Fehr and Schmidt, 1999 and Falk and Fischbacher, 2006). No clear picture emerges from the revenue-sharing treatment. One reason may be that while payoffs are identical in the team, reciprocal workers may nevertheless be hesitant to join as they are afraid of being exploited. This would be the case if they cooperate and work hard, while the teammate free rides.

Recall that we also collected information about first movers' willingness to trust in the trust game. We can therefore also check whether different levels of trust affect worker self-selection. As a measure of trust we simply use the amount transferred in the trust game. The relative frequencies of sending 0, 20, 40, 60, 80, 100, and 120 points are 10.83 percent, 16.25 percent, 18.33 percent, 22.08 percent, 10.83 percent, 4.58 percent, and 17.08 percent, respectively. Columns (4) to (6) show whether willingness to trust predicts sorting decisions, controlling for productivity. It turns out that trust does not significantly explain any sorting decision. Our results on social preferences can therefore be summarized as follows:

Result 5. *Reciprocal subjects are less likely to enter tournaments than selfish subjects. Willingness to trust is no significant predictor of the sorting decision.*

3.2.5 Gender and Personality

In this section we are interested in gender and personality as factors that may affect the sorting decision into variable pay. We think that investigating the impact of gender and personality on contractual choice is particularly interesting since it offers a potential explanation for the gender wage gap. If women are more likely than men to prefer non-competitive and non-variable pay, this would translate directly into lower average wages for women than for men.

A first indication that women prefer fixed wages to a higher extent than men in our experiment is given by Table 6. It reports the relative numbers of female and male participants who self-select into variable pay or fixed wages. For example, while 74 percent of the male participants in the piece-rate treatment choose to work under the variable pay wage regime, only 45 percent of the female do so. Similar numbers prevail for the decision to work under tournament or revenue-sharing incentives. In Column (4) we pool the three treatments. 68 percent of the 119 male subjects prefer variable pay compared to only 44 percent of the 121 female subjects.

Results in Table 6 do not correct for potential productivity differences between male and female participants. As Figure 5 shows, however, the gender differences are strong and robust if we compare subjects with similar productivity levels. The figure shows for each treatment separately as well as for all treatments pooled the fraction of males and females in a given productivity cluster who sort into variable pay. We use the following clusters according to Productivity Indicator 3: less than 15, 15 to 19, 20 to 25, and above 25 problems solved. For example, in the piece-rate treatment, displayed in the upper left panel, about 60 percent of the male participants who solved 15 to 19 correct answers in the 5 minute work period choose the variable pay, while only about 40 percent of the female participants with the same productivity level do. If we pool all treatments, shown in the lower right panel of Figure 5, we find that men are more likely to choose variable pay than women in each of the four productivity brackets.

Table 7 reports Probit estimates for the choice of the variable pay contract vs. the fixed-payment contract. We pool observations from all three treatments. The dependent variable is 1 if a subject chooses the variable pay and 0 otherwise. In the first column, the only regressor is a gender dummy which takes the value 1 if the subject is female and zero otherwise. The negative coefficient shows that women are significantly less likely to sort into the variable pay schemes than men. The marginal effect indicates that, on average, female subjects are about 24 percent less likely to enter a variable pay scheme than male subjects. In the second column, we control for productivity. Not surprisingly, the respective coefficient is positive and highly significant. While the gender coefficient gets considerably smaller – with a marginal effect of about 15 percent – it still has the negative sign and remains significant at the 5-percent level. Thus differences in productivity cannot fully explain the different choices of women and men.

But what about differences in risk preferences? Many studies have shown that, on average, women tend to be more risk averse than men (see Croson and Gneezy, 2004 for an overview). These differences also hold true in our sample. Both behavior in the lottery experiment as well as responses to the risk question, reveal that women are more risk averse than men. Average responses to the general risk question are 4.83 for women and 5.96 for men (medians are 5 and 6, respectively).[20] This difference is highly significant (Wilcoxon rank-sum test $p<0.0001$). Given the importance of risk preferences for the sorting decision, shown above, the difference in risk preferences is a promising candidate for

[20] This is in line with the findings of Dohmen et al. (2005).

explaining gender differences. In fact, the third column in Table 7 shows that, as before, risk and productivity matter, but the gender coefficient becomes smaller and insignificant. The marginal effect is still negative but reduced to about 7 percent. Thus in our set-up at least some of the gender differences can be attributed to differences in productivity and risk preferences. These findings are in some contrast to a recent paper by Niederle and Vesterlund (2005). In their study gender differences in sorting cannot be explained by either productivity or risk preferences. Note, however, that in their set-up the decision is between piece rates and tournaments and not between fixed wages and variable pay as in our study. Since both options in their study are variable pay schemes, they are both associated with some risk and uncertainty. Therefore risk preferences may be less important to motivate the sorting decision than in our set-up. Regardless of why we observe the gender differences, however, both studies show an important interaction between gender and contractual choice, which is of relevance both from a general research as well as from a policy oriented perspective. We summarize our findings about the impact of gender on sorting into incentive schemes as follows:

Result 6. *Women are less likely to sort into variable payment schemes than men. This effect is at least in part driven by gender specific risk preferences.*

Personality has not received much attention in economics in general (Duckworth et al., 2007) and it is therefore not surprising that not much is known about the relation between personality and sorting into different payment schemes or firms. This is problematic insofar as personality may matter to firms as much as other more standard personal characteristics. In fact, employer surveys suggest that so-called "soft skills" such as reliability or positive work attitudes are rated by employers as more important than prior work experience or technical skills (Regenstein, Meyer, and Hicks, 1998; Becci et al., 2005; Atkinson and Williams, 2003). But if these soft skills are important and if people with particular soft skills and personalities feel systematically more or less attracted to work in particular organizations or under particular pay schemes, the firm's decision about pay schemes should take this sorting into account. This is exactly why firms make use of personality tests in their hiring process (see, e.g., Autor and Scarborough, 2005).

Using information about subjects' personalities from the questionnaires in step 12 of the experiment we find in fact that personality affects sorting into different payment schemes, and that the sorting patterns are different for different incentive schemes as well as for men and women. For example, while males with lower norm-orientation are more likely to join tournaments, this incentive scheme is preferred by women who are rather "tough".[21] Interestingly we find that women who are "businesslike", "headstrong", "adventurous", and "not warmhearted" are more likely to opt for the piece rate contract and that women who are "self-confident", "reckless" and who can "rather easily deal with defeat" prefer tournaments. Finally, women who indicate that they are "rather shy" instead of "self-confident", "mentally stable" and rather "unwilling to experiment" are more likely to sort into the revenue-sharing scheme. In terms of our general research question the data suggest that different incentive devices are quite likely to systematically attract people not only with different abilities, preferences and self-assessments but also with different personalities.

3.3 Effort Provision

In this section we briefly discuss how different incentive schemes affect effort provision. Intuitively, subjects in the variable pay schemes should provide at least as much effort as subjects with the fixed-payment contract, simply because all variable payment schemes add an explicit reward for providing effort. Consequently, we also expect that subjects in variable pay schemes feel more stressed and get more exhausted than subjects who work for the fixed payment. These expectations are all borne out by the data:

Result 7. *Subjects in variable pay schemes provide more effort than those who receive fixed payments. In addition they report more stress and exhaustion.*

Table 8 compares average self-reported effort levels, stress and exhaustion for two subgroups: subjects who sorted into the variable compensation scheme and subjects who opted for the fixed compensation scheme. Panel (a) shows the results for the piece-rate treatment, while Panels (b) and (c) show the outcomes for the tournament and revenue-sharing treatments, respectively. Columns (1) to (3) of the table refer to the 5-minute

[21] Estimation results are available on request. Our results rely on the outcomes of a personality test that was developed by Hermann Brandstätter and is described in Brandstätter (1988). This so called 16 PA test is a short form of the German-language version of Cattell's sixteen personality factor questionnaire (16 PF), an internationally well established personality assessment, that produces five dimensions of personality (the so-called "Big Five"). The German-language version of the 16 PF was developed by Schneewind, Schröder and Cattell (1983) and contains 192 items that compass sixteen primary scales of personality. These primary scales produce five independent secondary factors (the so-called "Big Five"), which are commonly labelled as conscientiousness, neuroticism, openness to experienceagreeablenessand extroversion. Our short test presents subjects with 32 conflictive adjective pairs, which describe traits. For each adjective pair, subjects indicate how they would assess themselves on a 9-point scale that is spanned by the conflictive adjectives. Linear combinations of these 32 ratings produce the five secondary factors $Q_I - Q_V$, following a procedure described by Brandstätter (1988). The coefficients of these linear combinations were determined in a regression analysis, in which each of the five secondary factors that were obtained from the 16 PF according to Schneewind, Schröder and Cattell (1983) was regressed on all 32 measures that the 16 PA test produced for a sample of 300 individuals who had completed both the 16 tests. The estimated coefficient vector provides the parameters for the linear combinations that map out the five secondary factors for men and women separately.

work period (step 3), in which all subjects worked under the exact same incentives. For example, mean effort in the piece rate treatment is 5.63 for those who later selected into the piece rate while it is 5.50 for those who later prefer the fixed pay. This difference is not statistically significant as the corresponding p-value in Column (3) reveals. In fact, for all treatments there are no statistically significant differences in effort, stress, and exhaustion between the two subgroups.

Things change a lot, however, when subjects work in their preferred incentive scheme during the 10-minute work task (see Columns (4) to (6)). In the piece-rate treatment, for example, mean effort is now 6.00 for workers receiving a piece rate, while it is only 4.25 for the fixed wage group. This difference is highly statistically significant as the p-value in Column (6) shows. Results in Table 8 reveal that in all treatments, subjects with a variable compensation contract provide significantly more effort and feel significantly more stressed than subjects in the fixed payment scheme. Regression estimates from an ordered Probit model with effort measured on the 7-point scale as dependent variable reinforces the result that subjects working for variable pay provide more effort, even when controlling for individual productivity.[22] A comparison of efforts in Columns (5) and (2) further shows that subjects who select into the fixed-payment contract put forth less effort than they previously did when they were working in the piece rate condition. Sign-rank tests, which are not reported in the table, confirm that this slacking off is statistically significant. Finally, Table 8 indicates that subjects who work for variable pay tend to get more exhausted, but differences in exhaustion levels are not significant in all treatments.

4 Generalizabilty: Predicting Sorting in Actual Employment Relations

We have reported systematic patterns of sorting depending on productivity, attitudes and preferences. Given the controls possible in the lab we have concluded that these determinants have a causal impact on individual's decisions to self-select in to variable payment schemes. A potential concern related to our lab evidence, however, concerns the generalizabilty of our findings. In other words, do the findings from the lab carry over to actual employment and workplace decisions?

We are able to address this issue using data from the German Socio-Economic Panel (SOEP). The SOEP is a representative panel survey of the adult population living in

[22] The results are available upon request.

Germany. All members over the age of 17 of a household in the sample are asked for a wide range of personal and household information, and for their attitudes on assorted topics.[23] Each wave records information on the respondents current labor market status and employment. The 2004 wave of the SOEP included an additional question on whether the performance of a respondent is regularly evaluated in a formal procedure, a requisite element of performance contingent remuneration schemes. Respondents in the 2004 wave also answered a survey question on their willingness to take risks (see section 4), which has been experimentally validated by Dohmen et al. (2005). In addition, we have survey measures on individuals' trust attitudes from the 2003 wave and measures of reciprocity from the 2005 wave.[24] In light of our experimental results we predict that women are less likely to work under variable pay and that this is in part driven by gender specific preferences. Moreover, we predict that being reciprocal has a negative and being willing to take risks has a positive impact on the probability to work under variable pay. Finally, productivity should enter positively.

We estimate Probit models in order to assess how the probability of working under a variable payment scheme is related to gender, willingness to take risks, reciprocity, trust, and productivity. Table 9 reports estimates of the marginal effects of determinants of the sorting decision. The dependent variable in all three specifications takes the value 1 if the respondent's performance is regularly assessed in a formal evaluation procedure. Column (1) reveals that women, not controlling for productivity and preferences, are on average 10 percent less likely to work for variable pay than men, consistent with the results in our experiment. Column (2) shows that this gender difference is partly explained by differences in preferences and attitudes. Importantly, the estimates show that individuals who are more willing to take risks and individuals who are less reciprocal are more likely to work for variable pay. Also as in our experiment, the impact of trust is less significant. In Column (3), we also control for productivity as proxied by years of education, experience, and tenure. The estimates show that the impact of gender, risk attitudes and reciprocity is robust, and that, in line with our findings in the experiment, more productive workers

[23] For more details on the SOEP, see www.diw.de/gsoep/.

[24] The trust measure we use is similar to the standard measures of trust used in other surveys, for example the General Social Survey. Subjects were asked to indicate on a four-point scale to what extent they agree or disagree with the following statement: In general, one can trust people. The reciprocity measure that we use averages respondents' agreement (on a 7-point scale) to the following six statements: (1) If someone does me a favor, I am prepared to return it; (2) If I suffer a serious wrong, I will take revenge as soon as possible, no matter what the cost; (3) If somebody puts me in a difficult position, I will do the same to him/her; (4) I go out of my way to help somebody who has been kind to me before; (5) If somebody insults me, I will insult him/her back; (6) I am ready to undergo personal costs to help somebody who helped me before. An answer of 1 on the scale means: "does not apply to me at all" and choosing 7 means: "applies to me perfectly". For further details, see Dohmen et al. (2008).

are more likely to work in variable payment schemes. Thus the results confirm our findings from the lab. The fact that we find the same sorting patterns with two complementary data sets, stresses the importance and systematics of multi-dimensional sorting.

5 Concluding Remarks

In this paper we have provided controlled laboratory evidence on the importance of multi-dimensional sorting. Productive workers are more likely to self-select into variable payment schemes when offered a fixed payment scheme as an alternative. This productivity sorting explains a substantial part of output differences observed in variable versus fixed payment schemes. Controlling for productivity, workers are more likely to prefer a fixed payment scheme the more risk averse they are, especially when the choice is between tournaments and fixed wages. Tournament schemes not only attract more risk tolerant individuals, but also more overconfident and more selfish workers. Variable payment schemes attract fewer women, an effect that is partly driven by an underlying gender difference in risk attitudes. Finally, personality systematically affects the sorting decision but differently for men and women. Besides their impact on sorting, incentives of course also affect effort provision. In our study workers provide more effort in pay for performance schemes than in to fixed payment schemes. Moreover, they report higher levels of stress and exhaustion.

Our findings on gender, preferences and attitudes are supported by evidence from survey data. Using data from the German Socio-Economic Panel it turns out that in Germany women are significantly less likely to work for variable pay. In addition, the survey evidence buttresses the finding that individuals are more likely to sort into variable payment schemes the more productive, the more willing to take risk and the more selfish they are. Additional complementary evidence is provided by Bonin et al. (2006), who use data from the SOEP and find that individuals who are more willing to take risks are more likely to work in occupations with higher earnings variability, and Dohmen *et al.* (2005), who observe that risk averse workers are more likely to be employed in the public sector. Interestingly, there is also evidence for Germany showing that women are more likely to work in the public sector compared to men. The public sector is characterized by fixed wages and low risks concerning income variability and unemployment, but also by relatively low wages compared to the private sector. Considering full-time employment, 32.96 percent of all women work in the public sector and 67.04 percent in the private sector. The respective numbers for men are 21.25 percent and 78.75 percent.

Multi-dimensional sorting has several important implications. When designing incentives, organizations should not only focus on effort effects but also consider the self-selection of different types of workers. Given that many of the discussed personal attributes, such as risk aversion or overconfidence are difficult to observe in the process of recruitment, an incentive scheme may also serve the purpose of a screening device. Of course, sorting is not only relevant between but also within firms. Firms can offer different career paths to get the right people on the right job. Our results also shed light on the question why firms use different incentive schemes even when operating in similar environments. A possible explanation is simply that they have different requirements regarding the composition of their workforce, which they manage to attract with different organizational features. Our findings on gender and risk attitudes point to a potential channel for gender differences in occupational choice, career choice, and ultimately for the existence of the gender wage gap.

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Table 1: Productivity Differences

	Piece rate treatment			Tournament treatment			Revenue-sharing treatment		
	Piece rate (Median)	Fixed pay (Median)	Median test (p-value)	Tournament (Median)	Fixed pay (Median)	Median test (p-value)	Revenue sharing (Median)	Fixed pay (Median)	Median test (p-value)
Productivity:									
Indicator 1 (time needed in seconds)	8.00	28.50	0.003	11.00	26.00	0.002	13.00	24.00	0.173
Indicator 2 (time needed in seconds)	7.00	20.50	0.000	6.00	18.00	0.000	9.00	22.00	0.002
Indicator 3 (correct answers)	26.00	13.50	0.000	25.00	12.00	0.000	24.00	16.00	0.001

Notes: The table shows the median of each productivity indicator for both subgroups in all three treatments. Productivity Indicators 1 and 2 are elicited in steps 1 and 2 respectively and measure the amount of time that a person needed to solve a question with degree of difficulty 4. No monetary incentives were offered in step 1, while subjects were paid for speed in step 2 (see text for details on payment mode). Productivity Indicator 2 is censored for subjects who failed to answer the question within 30 seconds. Indicator 3 is elicited in step 3 of the experiment and measures the number of correct answers that subjects produced during a 5-minute work period in a piece-rate scheme.

Table 2: Productivity Sorting

Dependent variable	Piece rate treatment 1 if piece rate chosen			Tournament treatment 1 if tournament chosen			Revenue-sharing treatment 1 if revenue sharing chosen		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Productivity indicator 1	-0.019***			-0.011**			-0.001		
	[0.006]			[0.004]			[0.002]		
	(-0.007)***			(-0.004)**			(-0.001)		
Productivity indicator 2		-0.083***			-0.062***			-0.112***	
		[0.024]			[0.022]			[0.033]	
		(-0.031)***			(-0.025)***			(-0.043)***	
1 if prod. ind. 2 censored		-1.625***			-1.794***			-1.719***	
		[0.448]			[0.449]			[0.488]	
		(-0.575)***			(-0.564)***			(-0.605)***	
Productivity indicator 3			0.107***			0.064***			0.057***
			[0.022]			[0.015]			[0.016]
			(0.039)***			(0.025)***			(0.022)***
Constant	0.712***	1.306***	-1.908***	0.276	0.826***	-1.316***	0.276*	1.605***	-0.884***
	[0.194]	[0.314]	[0.465]	[0.188]	[0.279]	[0.332]	[0.166]	[0.407]	[0.328]
Pseudo R-squared	0.148	0.162	0.323	0.058	0.167	0.192	0.004	0.157	0.149
Number of observations	80	80	80	80	80	80	80	80	80

Notes: The table shows estimates of Probit models for the propensity to sort into the variable payment scheme in the three different treatments. Standard errors are reported in brackets and the implied marginal effects, evaluated at the mean of observable characteristics, are shown in parentheses below the coefficient estimates. One asterisk denotes significance at the 10% level, two or three asterisks denote statistical significance at the 5% and at the 1% level respectively.

Table 3: Relative Self-Assessment and Sorting

	Piece rate treatment		Tournament treatment		Revenue-sharing treatment	
Dependent variable	1 if piece rate		1 if tournament		1 if revenue sharing	
	(1)	(2)	(3)	(4)	(5)	(6)
Relative self-assessment	-0.150***	-0.03	-0.142***	-0.081*	-0.099***	-0.044
	[0.036]	[0.051]	[0.034]	[0.046]	[0.032]	[0.039]
	(-0.057)***	(-0.011)	(-0.057)***	(-0.032)*	(-0.038)***	(-0.017)
Productivity indicator 3		0.096***		0.039**		0.047**
		[0.029]		[0.020]		[0.018]
		(0.035)***		(0.016)**		(0.018)**
Constant	1.616***	-1.413	1.170***	-0.131	1.229***	-0.232
	[0.363]	[0.945]	[0.320]	[0.729]	[0.359]	[0.661]
Pseudo R-squared	0.194	0.326	0.183	0.22	0.096	0.161
Number of observations	80	80	80	80	80	80

Notes: Probit estimates. Standard errors are reported in brackets below the coefficients. Marginal effects in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. The variable "relative self-assessment" takes values from 0 to 19 and measures a subject's estimate of the number of persons that were more productive in step 3 of the experiment. The smaller the value of the self-assessment variable is, the more productive a subject thinks he is relative to others.

Table 4: Risk Preferences and Sorting

Dependent variable	Piece rate	Tournament	Revenue sharing
	(1)	(2)	(3)
Risk attitude	0.160*	0.330***	0.038
	[0.088]	[0.092]	[0.084]
	(0.058)*	(0.132)***	(0.014)
Productivity indicator 3	0.105***	0.074***	0.058***
	[0.023]	[0.016]	[0.016]
	(0.038)***	(0.030)***	(0.022)***
Constant	-2.707***	-3.282***	-1.105*
	[0.663]	[0.678]	[0.595]
Pseudo R-squared	0.354	0.330	0.151
Number of observations	80	80	80

Notes: Probit estimates. Standard errors are reported in brackets and marginal effects in parentheses below coefficients; * significant at 10%; ** significant at 5%; *** significant at 1%. Coefficient estimates for models in columns labelled "trimmed" are based on observations of subjects who produced more than 9 but less than 31 answers in the 5-minute work period

Table 5: Social Preferences and Sorting

	Reciprocity			Trust		
Dependent variable	Piece rate	Tournament	Revenue sharing	Piece rate	Tournament	Revenue sharing
	(1)	(2)	(3)	(4)	(5)	(6)
1 if selfish	-0.534	-0.602	-0.999			
	[0.622]	[0.571]	[0.608]			
	(-0.206)	(-0.229)	(-0.380)			
1 if reciprocal	-0.100	-0.920**	-0.133			
	[0.458]	[0.387]	[0.352]			
	(-0.036)	(-0.353)**	(-0.051)			
Amount sent				0.007	0.002	0.003
				[0.005]	[0.004]	[0.004]
				(0.003)	(0.001)	(0.001)
Productivity indicator 3	0.110***	0.071***	0.060***	0.110***	0.064***	0.057***
	[0.024]	[0.016]	[0.016]	[0.024]	[0.015]	[0.016]
	(0.040)***	(0.028)***	(0.023)***	(0.040)***	(0.026)***	(0.022)***
Constant	-1.825***	-0.810**	-0.763*	-2.399***	-1.466***	-1.031**
	[0.532]	[0.396]	[0.395]	[0.603]	[0.420]	[0.409]
Pseudo R-squared	0.331	0.245	0.176	0.345	0.195	0.152
Number of observations	80	80	80	80	80	80

Notes: Probit estimates. Standard errors are reported in brackets and marginal effects in parentheses below coefficients; * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Proportions of Men and Women Sorting Into Variable Pay Schemes

	Piece rate	Tournament	Revenue sharing	All variable
Women	45	40	46	44
Men	74	58	72	68

Notes: The table shows the percentages and absolute numbers (in parentheses) of men and women who select into the variable pay schemes.

Table 7: Gender and Sorting

Dependent variable:	1 if variable pay chosen		
	(1)	(2)	(3)
1 if female	-0.626***	-0.382**	-0.181
	[0.166]	[0.183]	[0.196]
	(-0.243)***	(-0.148)**	(-0.071)
Productivity indicator 3		0.067***	0.072***
		[0.010]	[0.010]
		(0.026)***	(0.028)***
Risk attitude			0.166***
			[0.051]
			(0.065)***
Constant	0.470***	-0.994***	-2.072***
	[0.120]	[0.241]	[0.420]
Pseudo-R-squared	0.044	0.221	0.254
Number of observations	240	240	240

Notes: Probit estimates. Standard errors are reported in brackets and marginal effects in parentheses below coefficients; ** significant at 5%, *** significant at 1%.

Table 8: Effort, Stress, and Exhaustion

	Before sorting decision			After sorting decision		
	Piece rate (Mean)	Fixed (Mean)	M-W test (p-value)	Piece rate (Mean)	Fixed (Mean)	M-W test (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)
Effort	5.63	5.50	0.559	6.00	4.25	0.000
Stress	5.44	5.53	0.757	5.60	3.56	0.000
Exhaustion	2.96	2.59	0.448	4.00	2.59	0.001
Number of observations	48	32		48	32	

(a) Effort, Stress and Exhaustion in Piece-Rate Treatment

	Before sorting decision			After sorting decision		
	Tournament (Mean)	Fixed (Mean)	M-W test (p-value)	Tournament (Mean)	Fixed (Mean)	M-W test (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)
Effort	5.54	5.39	0.442	6.15	4.76	0.000
Stress	5.54	5.41	0.854	5.74	3.98	0.000
Exhaustion	2.90	2.85	0.749	3.36	3.29	0.773
Number of observations	39	41		39	41	

(b) Effort, Stress and Exhaustion in Tournament Treatment

	Before sorting decision			After sorting decision		
	Revenue sharing (Mean)	Fixed (Mean)	M-W test (p-value)	Revenue sharing (Mean)	Fixed (Mean)	M-W test (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)
Effort	5.43	5.30	0.703	5.43	4.45	0.001
Stress	5.36	5.45	0.500	5.40	3.79	0.000
Exhaustion	2.43	2.18	0.518	3.60	2.52	0.006
Number of observations	47	33		47	33	

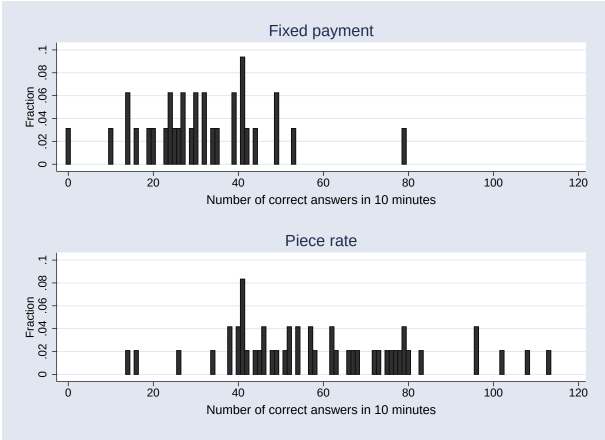
(c) Effort, Stress and Exhaustion in Revenue-Sharing Treatment

Table 9: Survey Evidence on Sorting into Performance Pay

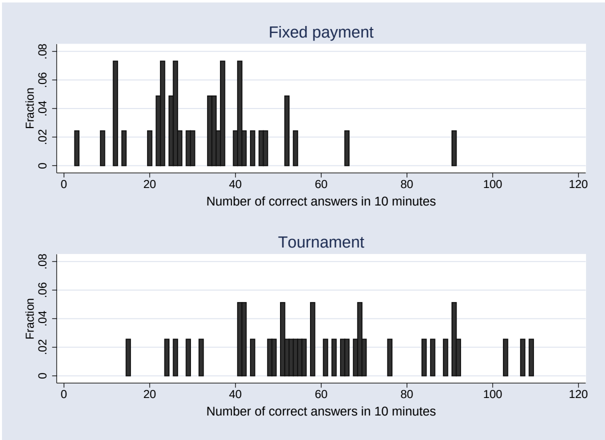
Dependent variable:	1 if performance evaluation		
	(1)	(2)	(3)
1 if female	-0.095***	-0.087***	-0.067***
	[0.010]	[0.010]	[0.011]
Risk attitude		0.013***	0.011***
		[0.002]	[0.002]
Reciprocity		-0.018***	-0.014**
		[0.006]	[0.006]
Trust		-0.014*	-0.003
		[0.008]	[0.008]
Years of schooling			0.023***
			[0.002]
Experience (in years)			0.013***
			[0.002]
Experience^2/100			-0.021***
			[0.005]
Tenure (in years)			0.005***
			[0.001]
Age (in years)			-0.008***
			[0.001]
Pseudo-R-squared	0.01	0.01	0.03
Number of observations	8948	8237	8092

Notes: Probit estimates. Marginal effects are reported. Robust standard errors are reported in brackets; ** significant at 5%, *** significant at 1%. The data are from the 2004 wave of the German Socio-Economic Panel (SOEP), except for the survey measures of trust and reciprocity which are taken from the 2003 and 2005 wave respectively. The dependent variable is a binary variable that takes the value 1 if the respondent's performance is regularly evaluated by a supervisor according to a formal procedure. The sample is restricted to respondents aged 65 and younger. We exclude respondents who are either self-employed, enrolled in school, not in regular employment or completing an apprenticeship.

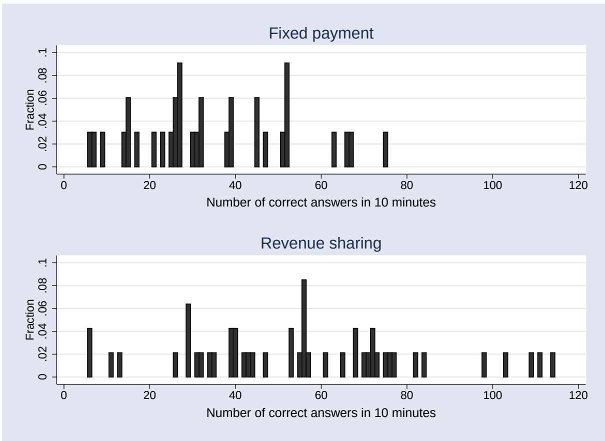
Figure 1: Output of Self-Selected Subjects in Different Compensation Schemes



(a) Piece-rate treatment



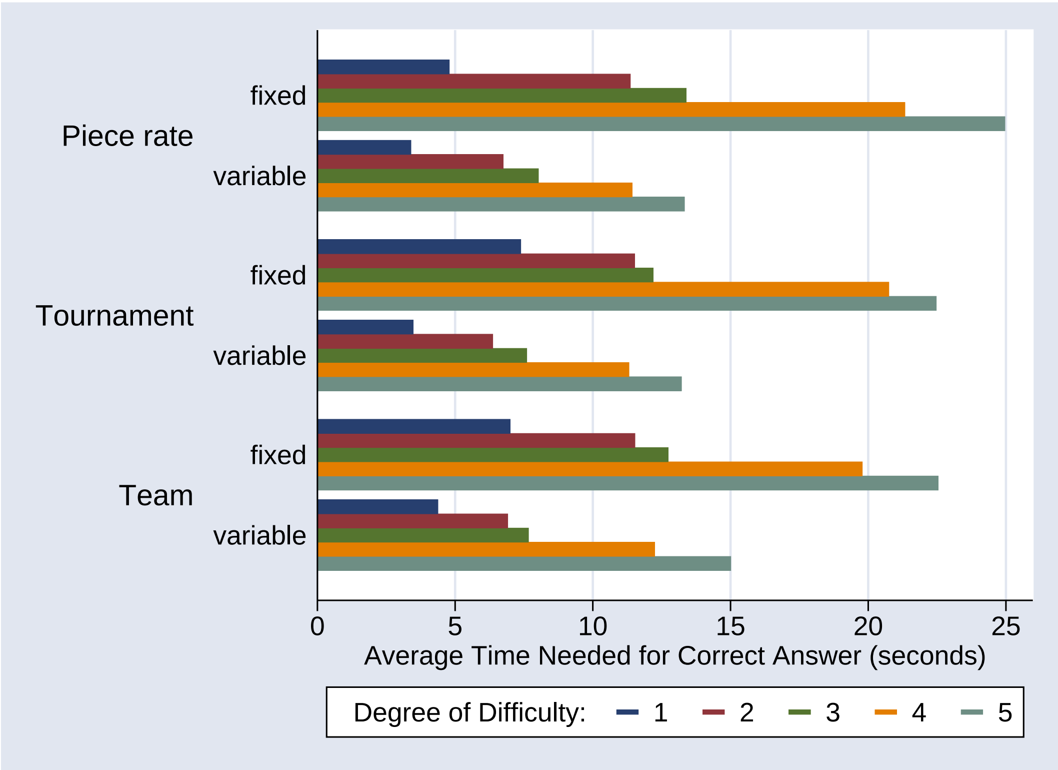
(b) Tournament treatment



(c) Revenue-sharing treatment

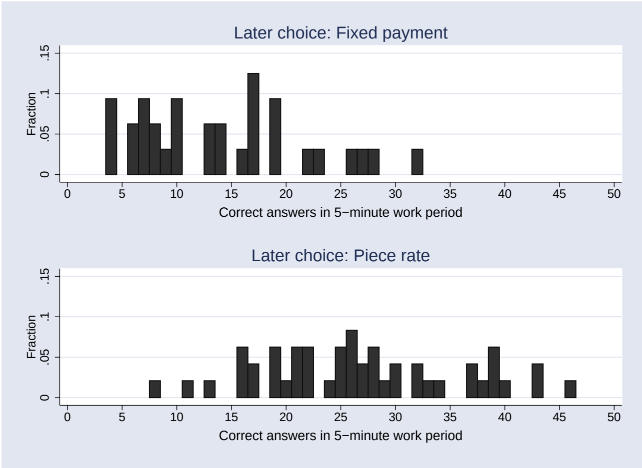
Notes: Each panel of the figure plots, for a particular treatment, two histograms of individual output (measured as the number of correct answers during the total working time of ten minutes), one for each of the self-selected groups of subjects: The upper histogram shows the output distribution of workers who selected into the fixed-payment contract, and the lower histogram of a panel shows the output distribution of workers who selected into the variable payment contract. Panel (a) shows output histograms for the piece-rate treatment, Panel (b) those that arose in the tournament treatment, and Panel (c) plots output histograms from the revenue-sharing treatment.

Figure 2: Performance and Task Difficulty

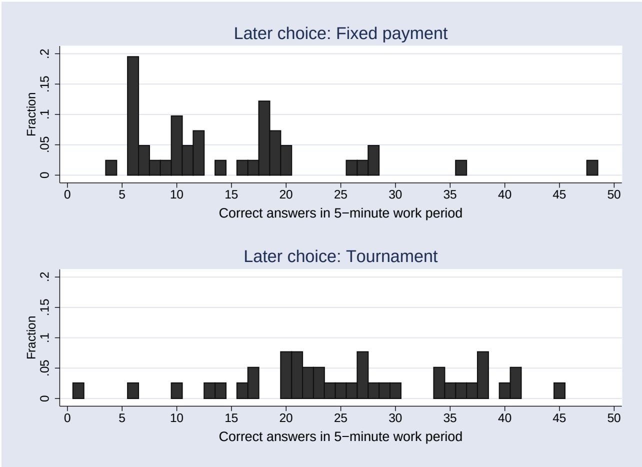


Notes: The figure shows, for each treatment, how much time (in seconds) subjects working in a particular self-selected regime need on average to solve a question of a given degree of difficulty.

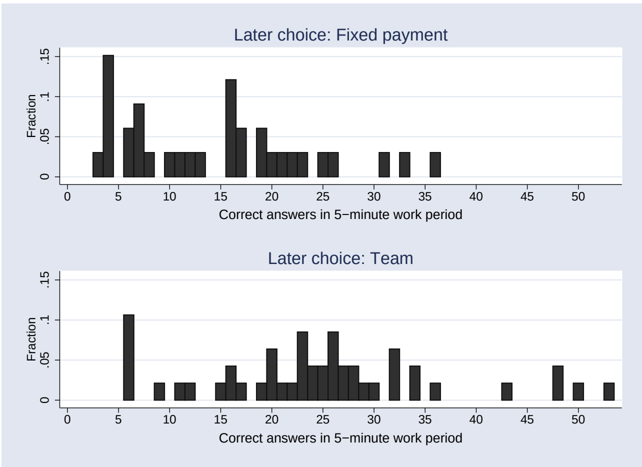
Figure 3: Productivity of Subjects before Self-Selection Into Incentive Contract



(a) Piece-rate treatment



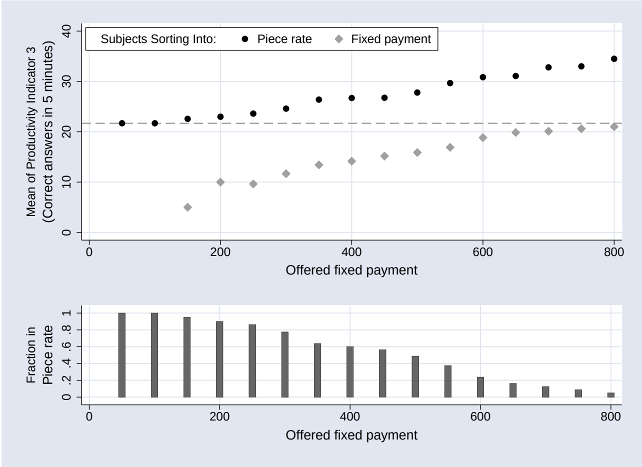
(b) Tournament treatment



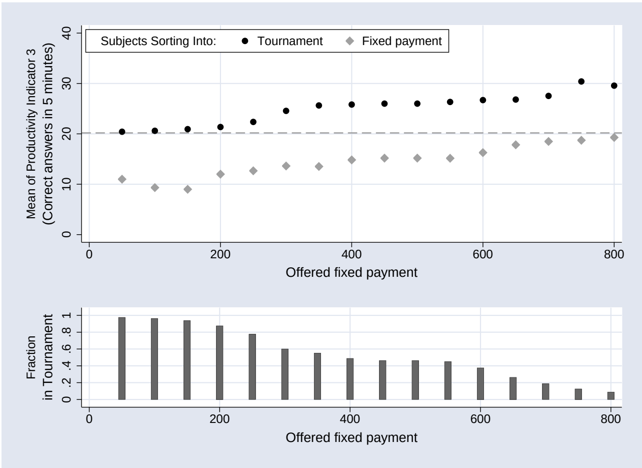
(c) Revenue-sharing treatment

Notes: Each panel of the figure plots histograms of Productivity Indicator 3, which was elicited in step 3 of the experiment and which measures the number of correct answers during a 5-minute work period. The upper histogram always shows the distribution of individual productivity for subjects who subsequently chose the fixed payment alternative, while the lower histogram of a panel always shows the productivity distribution among subjects who subsequently preferred the variable payment alternative. Panel (a) refers to the piece-rate treatment, and Panel (b) and Panel (c) to the tournament treatment and revenue-sharing treatment respectively.

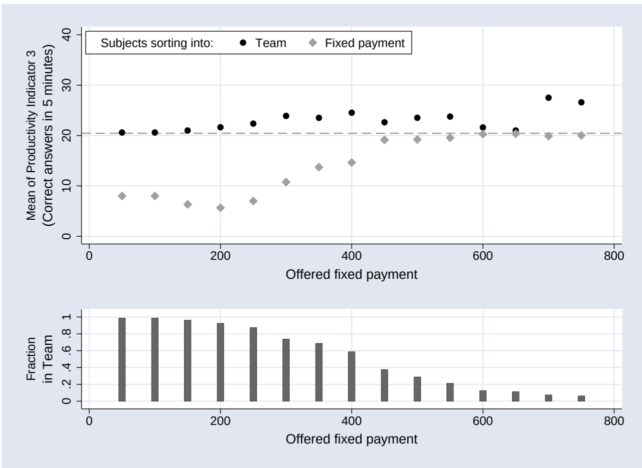
Figure 4: Fraction of Subjects Opting for Variable Pay and Average Productivity of Sorted Subjects



(a) Piece-rate treatment



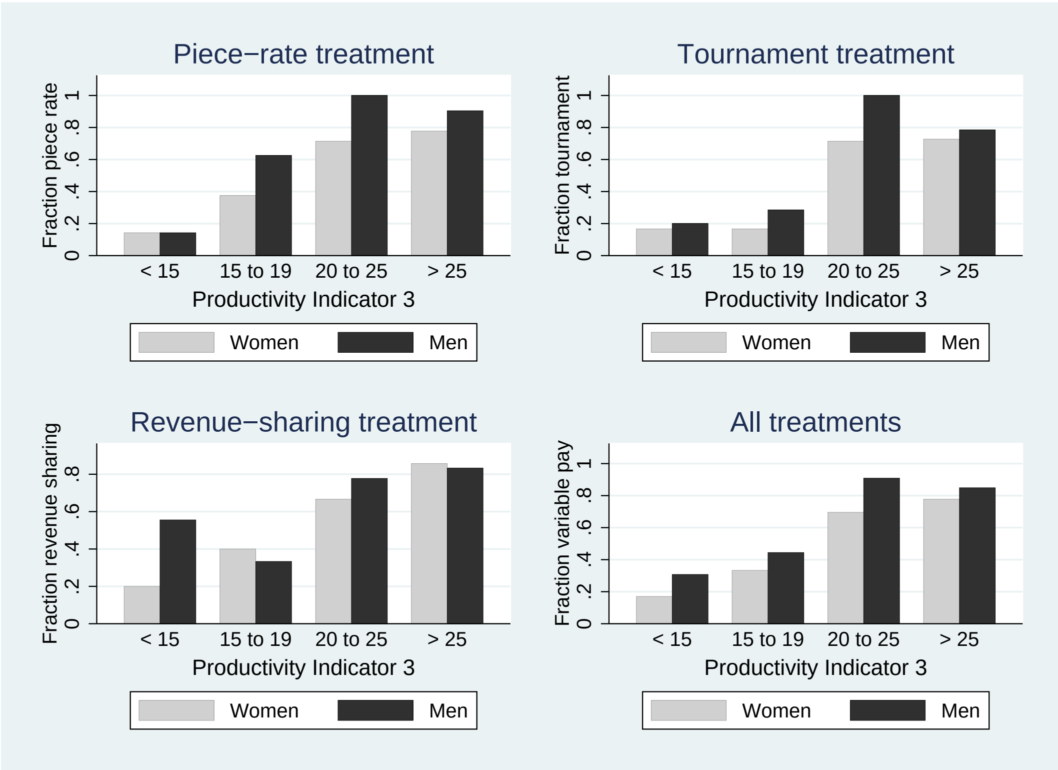
(b) Tournament treatment



(c) Revenue-sharing treatment

Notes: The upper graph of each panel shows average productivity, measure by Productivity Indicator 3, among subjects who would sort into the respective variable payment scheme at a particular fixed payment alternative. The lower graph of each panel displays the number of subjects who would opt for variable compensation at a given offered fixed payment alternative. Panel (a) refers to the piece-rate treatment, Panel (b) to the tournament treatment and Panel (c) to the revenue-sharing treatment.

Figure 5: Gender and Sorting



Notes: The figure shows what fraction of men and women with a particular productivity level selects into the variable payment scheme.

Appendix

Figure A.1: Design of the Experiment

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7	Step 8	Step 9	Step 10	Step 11	Step 12
Productivity Indicator 1	Productivity Indicator 2	Productivity Indicator 3	Effort questions	Relative self-assessment	Sorting decision	Sorting with different fixed payment alternatives	Working time	Effort questions	Social preferences	Risk preferences	Question-naires
Calculate one problem of difficulty level 4 as fast as possible	Calculate one problem of difficulty level 4 as fast as possible (paid)	Piece rate with 10 P per correct answer 5 minutes	How much effort have you exerted? How stressed did you feel? How exhausted did you get?	How many people (out of 20) solved more question better than you did? Paid correct: 100 P +/-1: 50 P	a) **Piece rate:** 10 P per correct answer b) **Tournament:** Winner is who has more correct answers Winner gets 1300P Loser gets 0P c) **Revenue sharing:** (Sum of output) *10 divided by 2 vs. **Fixed payment:** 400 P independent of output	Varying the fixed payment alternatives	10 minutes Piece rate, Tournament, Revenue sharing or Fixed payment	How much effort have you exerted? How stressed did you feel? How exhausted did you get?	2-player, sequential trust game Endowment of 120 Transfer of 1st mover tripled Contingent response method for 2nd mover Role reversal No information	Choice between L(400, 0; 0.5) and 15 safe options 25, 50, ..., 375 One alternative randomly chosen	Risk-preference questions Attitudes"Big Five" Socioeconomics Math and high-school grades

In the following we present the English translation of the German instructions. The following first page of the instructions was handed out on paper:

Instructions: Introduction

You are now taking part in an economic experiment. During the experiment you can earn money by receiving **points**. The number of points that you receive during the experiment depends on your decisions.

All points that you earn in the experiment will be exchanged into Euros at the end of the experiment. The exchange rate is:

10 Points = 17 Cent

At the end of the experiment you will receive the amount of money that you have earned during the experiment in cash.

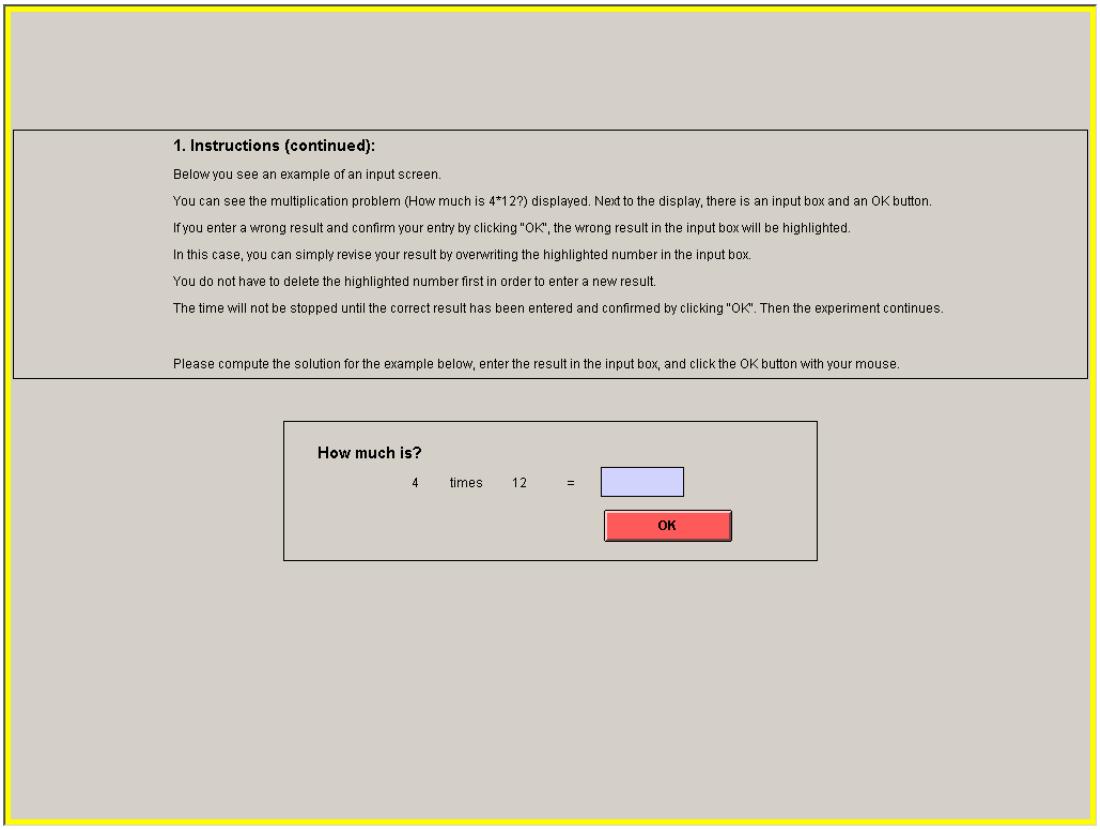
The experiment consists of six **parts** and a **questionnaire**. Each part will be introduced on a screen with the header „Instructions“. These instructions will explain in detail what the respective part of the experiment is about. Please follow the instructions carefully. If you have any questions please let us know by raising your hand. Your question will then be answered at your cubicle.

In this experiment you will often have to solve multiplication problems. You must solve the problems **without any helping device**, i.e., devices such as paper and pencil, pocket calculators or cell phones, are not allowed. **If you use any helping device, you will be immediately excluded from the experiment and from all payments**. The experiment does not begin before all helping devices are completely removed.

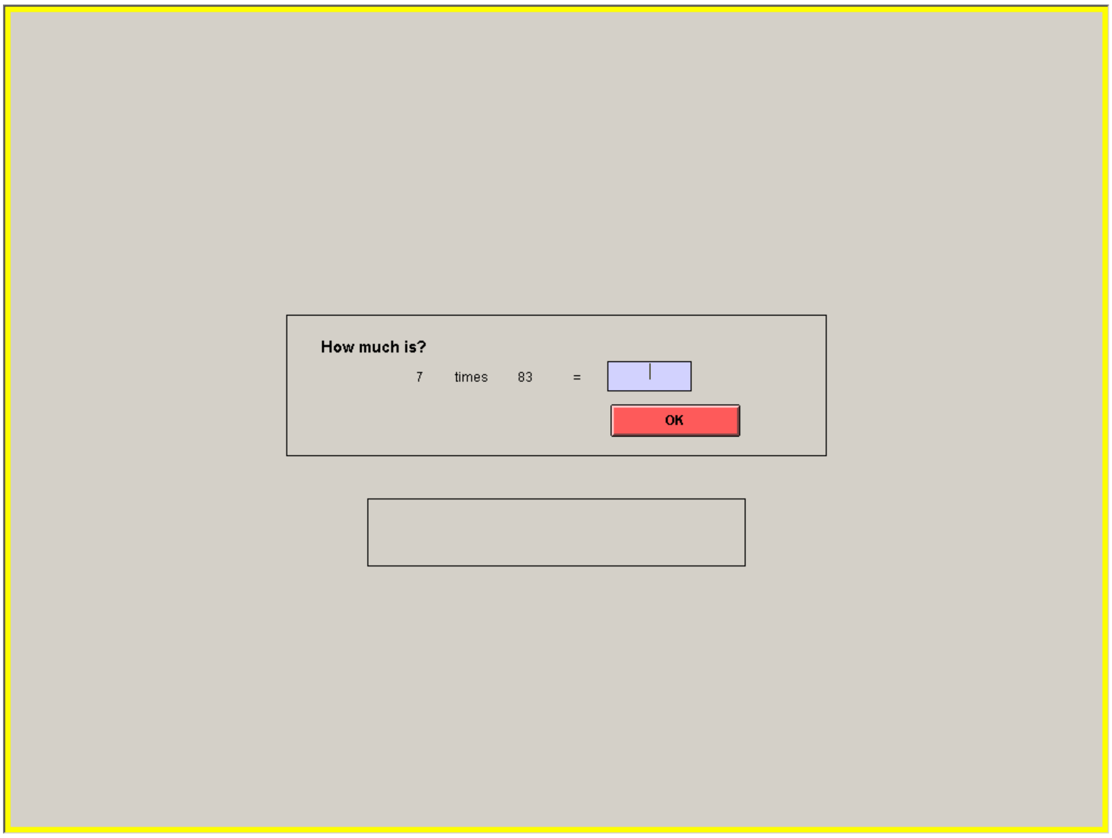
Please note that communication between participants is strictly prohibited during the experiment. In addition we would like to point out that you may only use the computer functions which are required for the experiment. Communication between participants and unnecessary interference with computers will lead to exclusion from the experiment.

Please raise your hand once you have read these instructions.

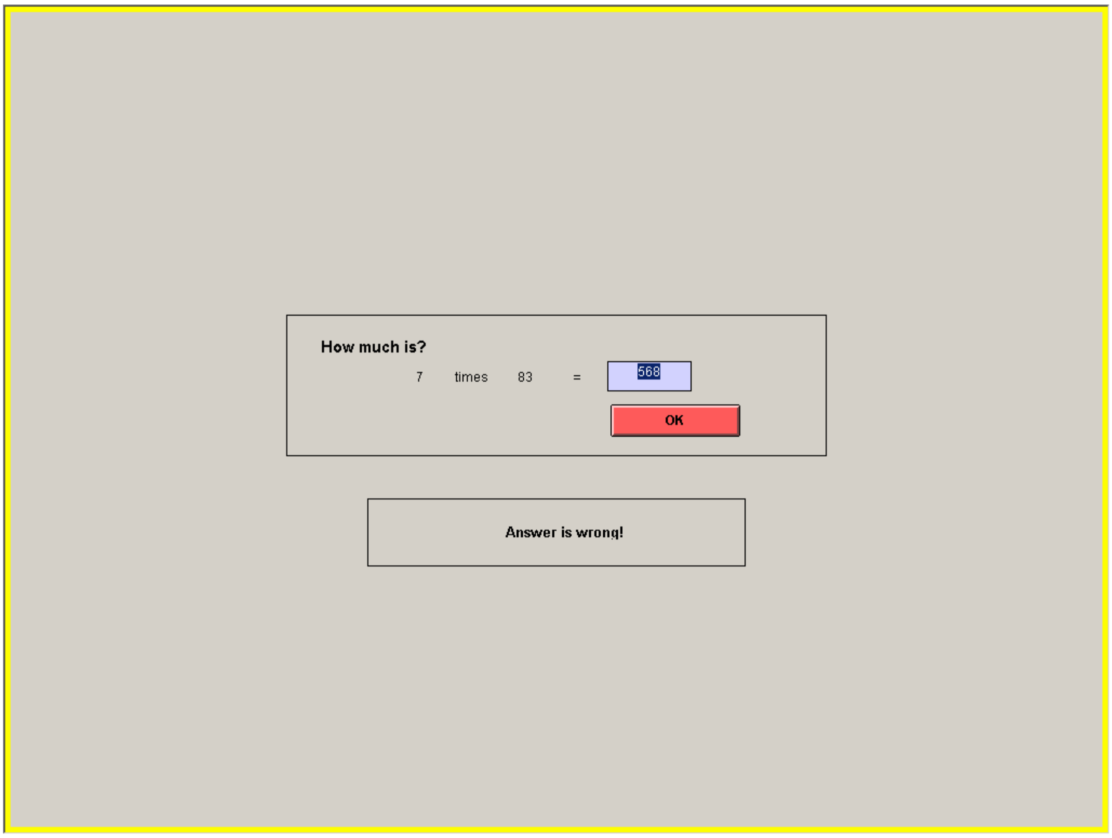
Further instructions were presented on screens at the beginning of each step of the experiment. We show only the most important screens.



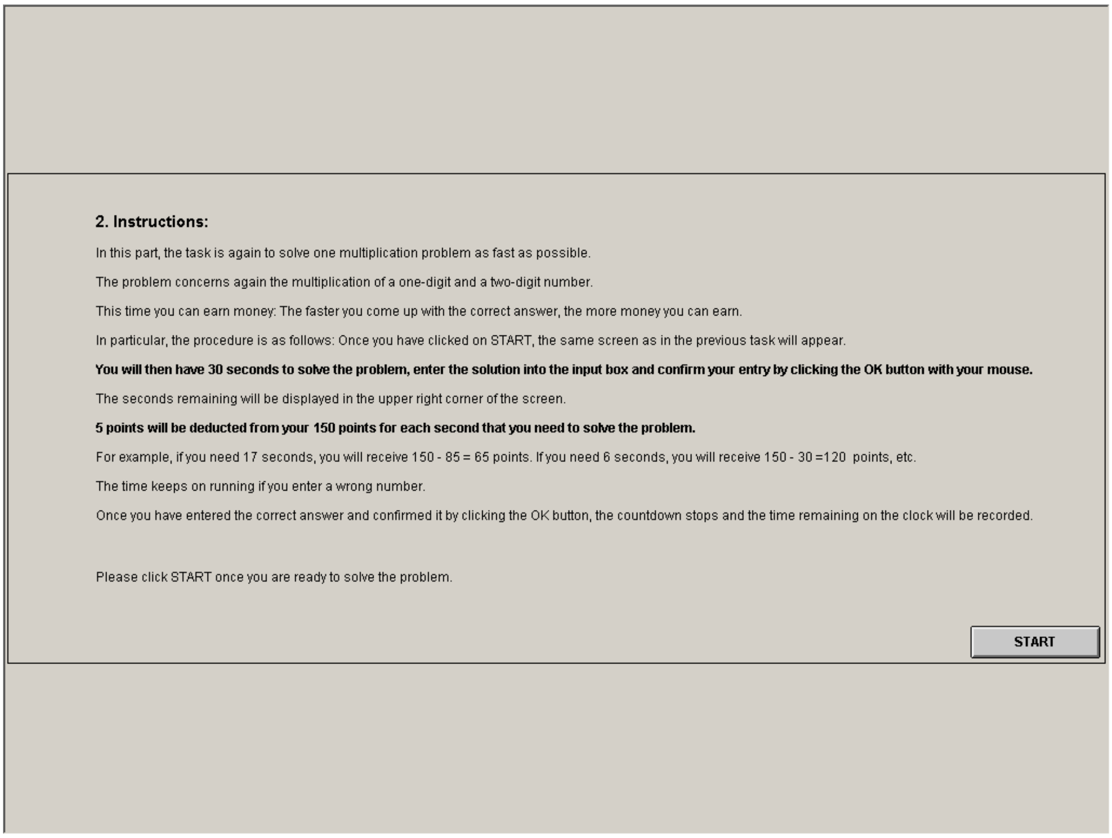
After subjects had entered the correct answer "48", the next screen appeared:

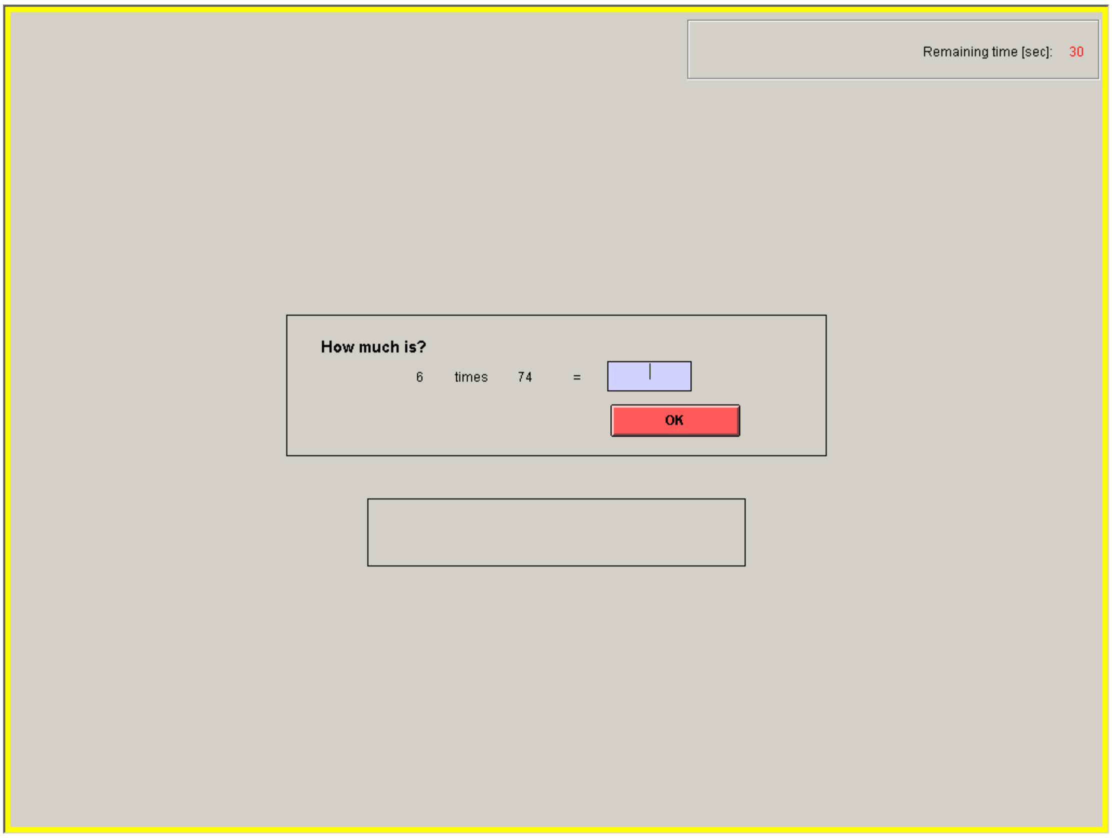


If subjects entered a wrong answer, the following screen appeared:



The screens for step 2 of the experiment were as follows:





The important screens for step 3 were as follows:

3. Instructions:

In this part, the task is again to solve multiplication problems involving a one-digit and a two-digit number.

Again, you can earn money. This time the rules are as follows:

For each multiplication problem that you solve correctly, you will receive 10 points.

During a period of 5 minutes of time you can solve as many problems as you want to.

The input screen is again identical to the input screens in the previous tasks.

The input screen will inform you in addition about the number of problems you have solved correctly.

The time remaining in seconds will be displayed in the upper right corner of the screen.

A new problem will not appear on the screen until you have entered the correct answer to the problem that is currently displayed on the screen

and have confirmed your result by clicking the Ok button with your mouse.

After you have entered a number on the input srceen, a text message will indicate whether your answer was correct and whether a new problem is being displayed.

Once the Ok button has been clicked, the number that has been entered on the input screen will be highlighted in blue and remains displayed in the input box.

In order to enter the solution to a new problem or to revise your answer, you do not have to delete the highlighted number. Instead, you can simply overwrite this number.

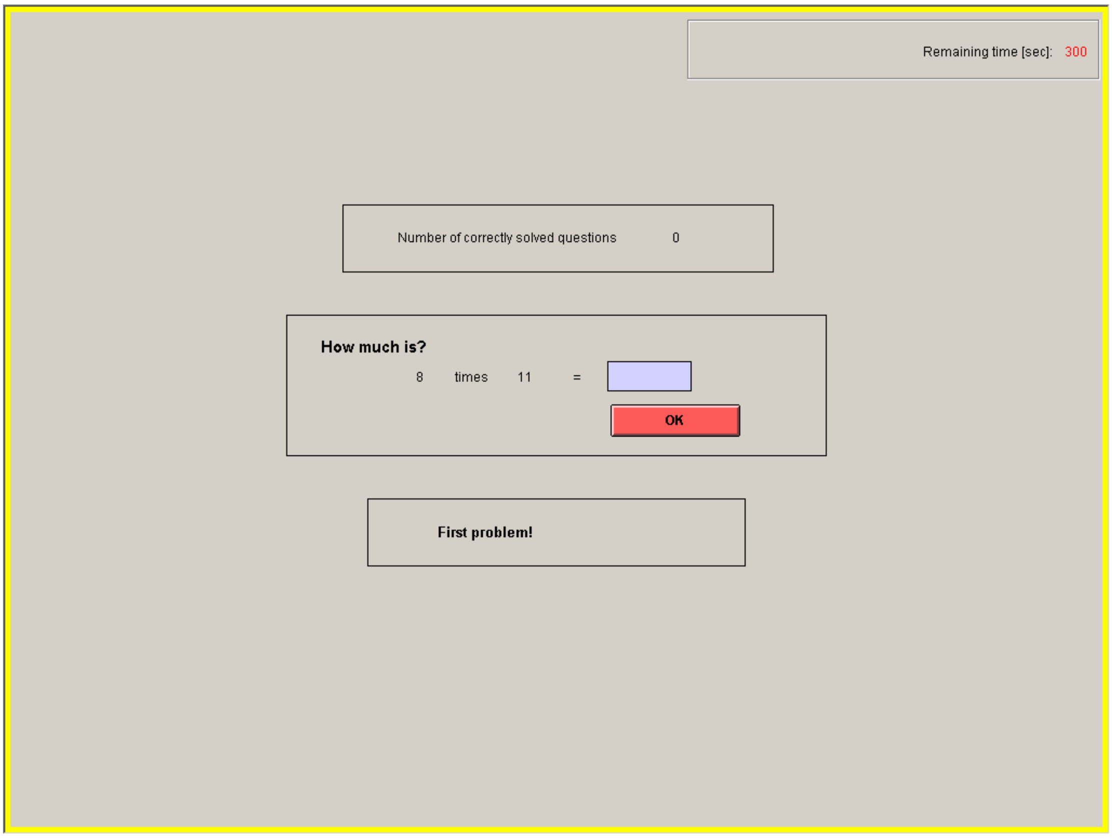
Please click "START", once you are ready to start solving problems.

START

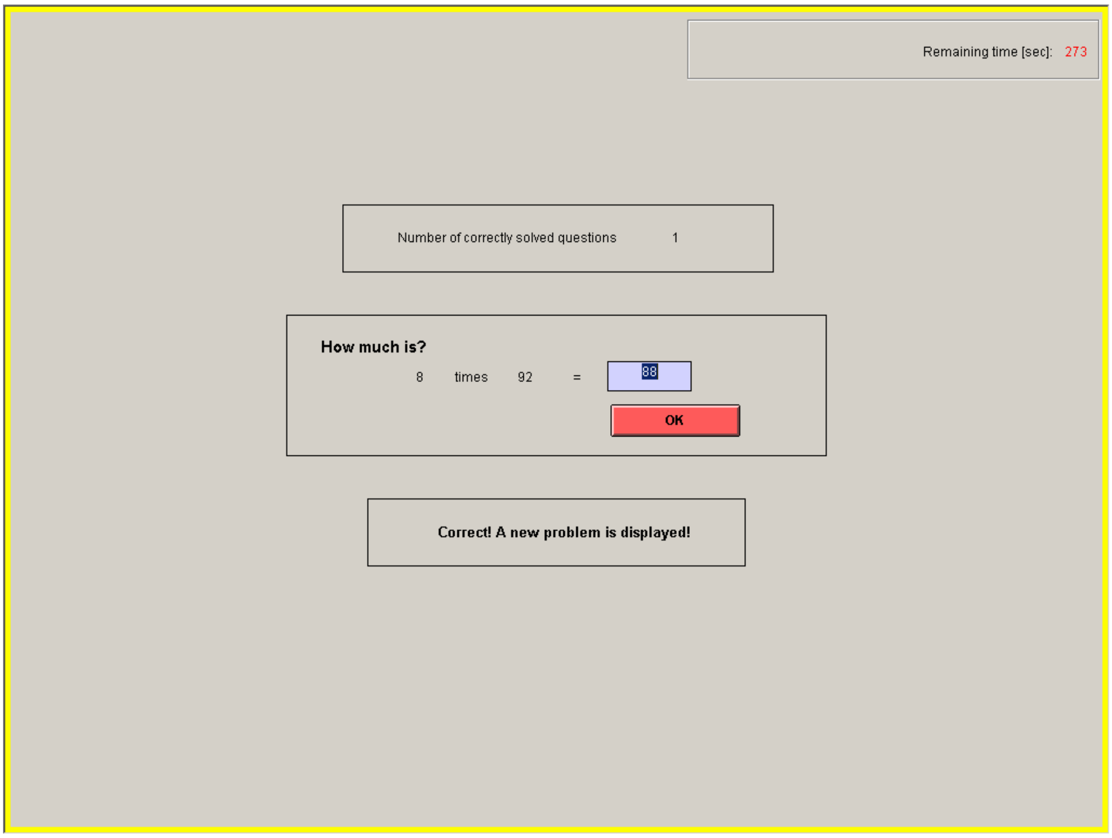
Remaining time [sec]: 9

Calculating will start after a countdown of 10 seconds.

The remaining time until the task will start is displayed in the upper right corner.

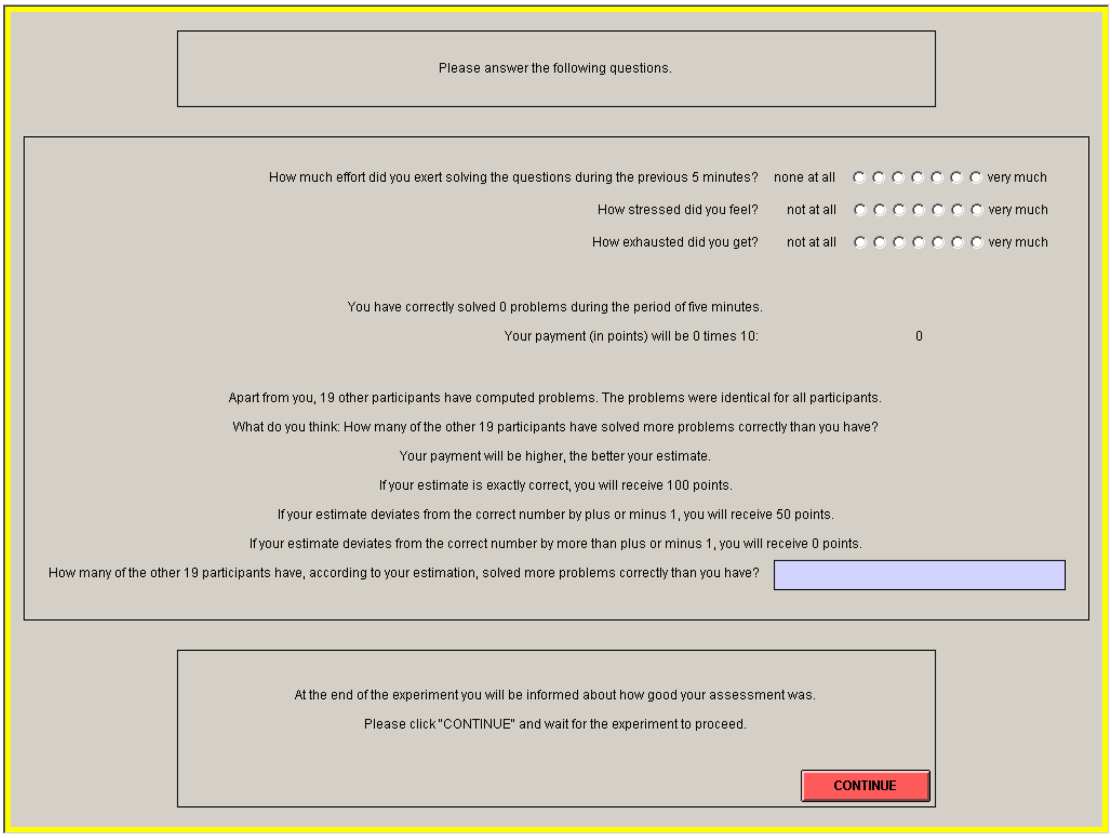


If the correct answer "88" had been typed in and confirmed, the next screen appeared:



Subjects were informed about whether they had solved their problems correctly or not.

After the working period of five minutes, the following screen was displayed to elicit self-reported effort (step 4) as well as subjects' relative self-assessment (step 5):



Please answer the following questions.

How much effort did you exert solving the questions during the previous 5 minutes? none at all ○ ○ ○ ○ ○ ○ ○ very much

How stressed did you feel? not at all ○ ○ ○ ○ ○ ○ ○ very much

How exhausted did you get? not at all ○ ○ ○ ○ ○ ○ ○ very much

You have correctly solved 0 problems during the period of five minutes.

Your payment (in points) will be 0 times 10: 0

Apart from you, 19 other participants have computed problems. The problems were identical for all participants.

What do you think: How many of the other 19 participants have solved more problems correctly than you have?

Your payment will be higher, the better your estimate.

If your estimate is exactly correct, you will receive 100 points.

If your estimate deviates from the correct number by plus or minus 1, you will receive 50 points.

If your estimate deviates from the correct number by more than plus or minus 1, you will receive 0 points.

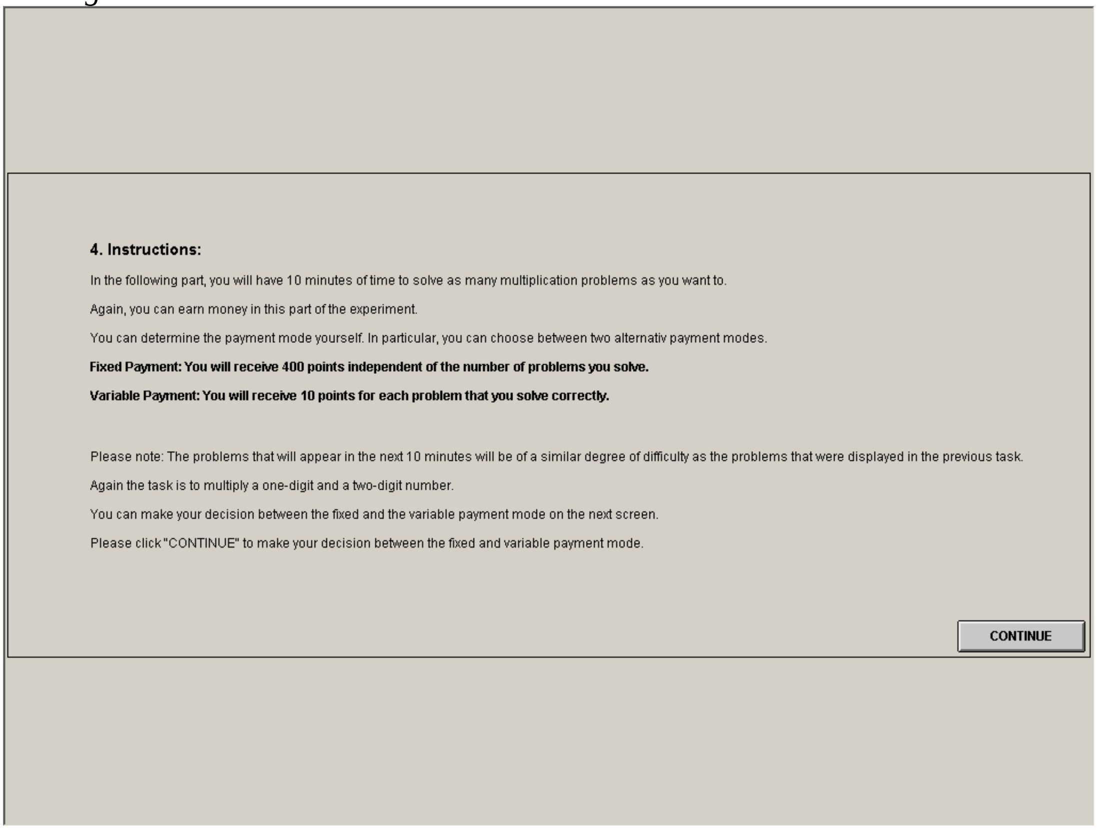
How many of the other 19 participants have, according to your estimation, solved more problems correctly than you have?

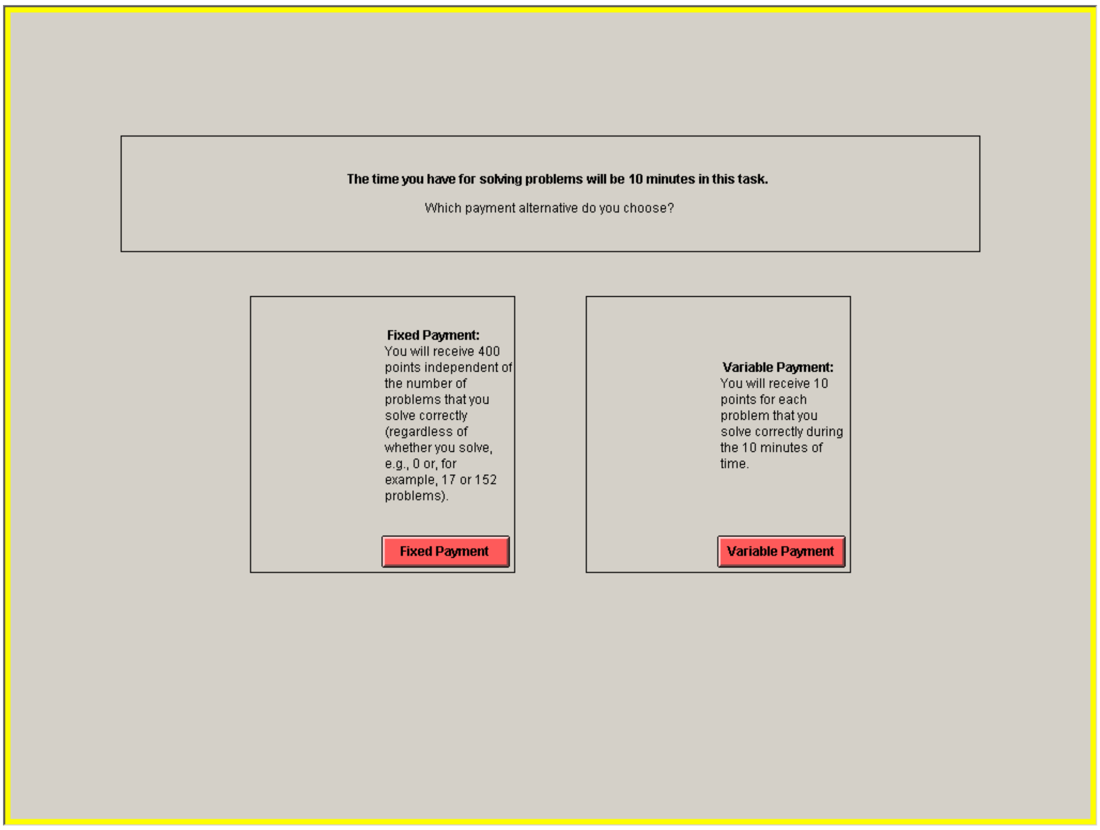
At the end of the experiment you will be informed about how good your assessment was.

Please click "CONTINUE" and wait for the experiment to proceed.

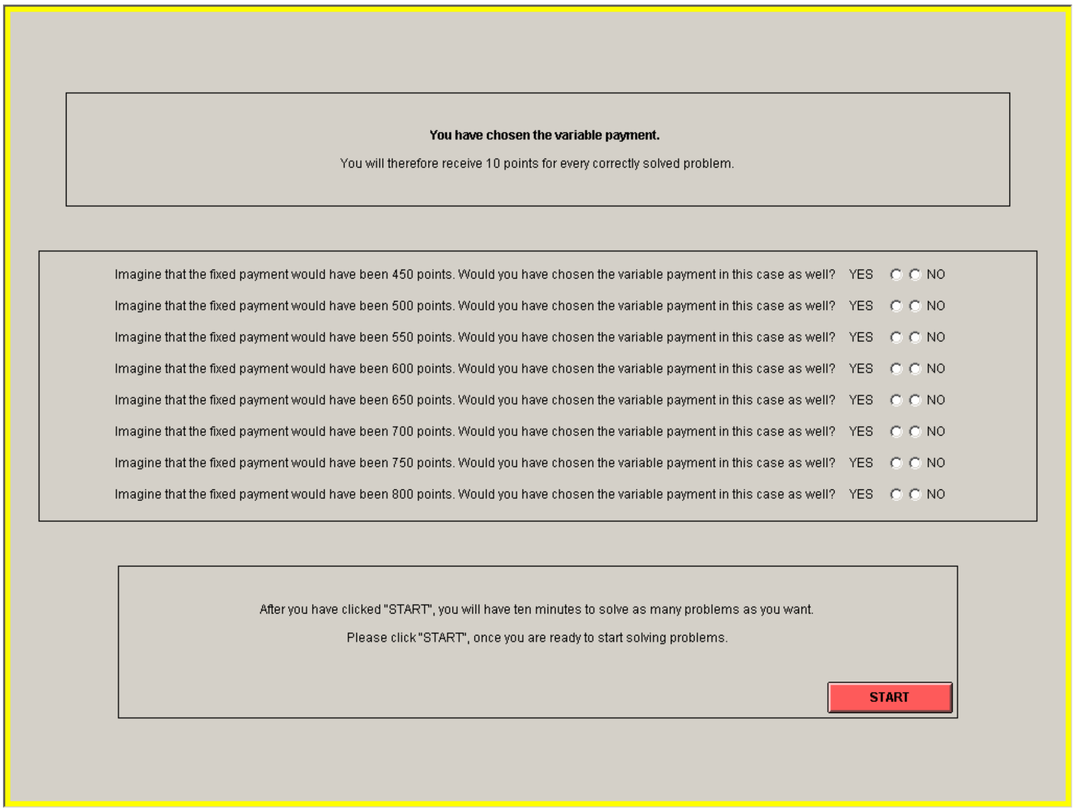
CONTINUE

The next two screens are the screens for the sorting decision (step 6). We show the screens for the piece-rate treatment. The screens for the tournament and the revenue-sharing treatments were similar.

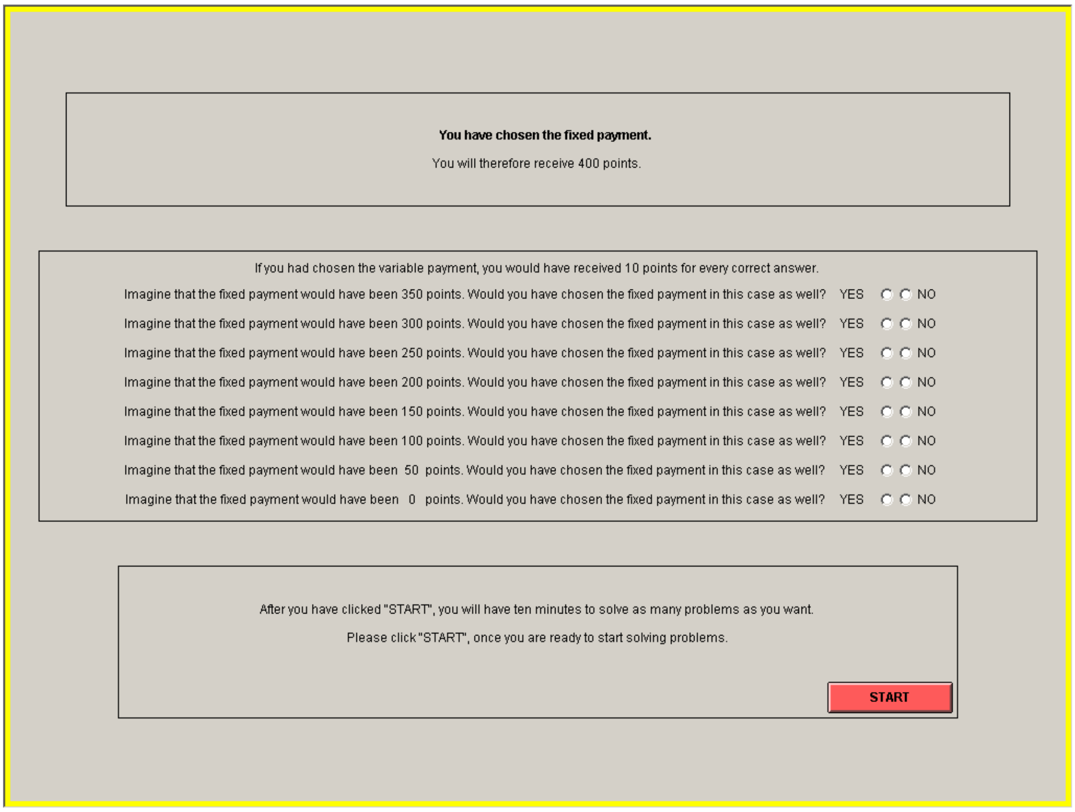




Next, subjects had to indicate their "hypothetical" sorting decision for different levels of the fixed payment (step 7). In case the subject had opted for the variable payment, the screen looked like this:



In case the subject had opted for the fixed payment, the screen looked like this:



The input screens for solving the problems during the 10-minute working time (step 8) were the same as in step 3. After the working time of ten minutes, self-reported efforts were elicited in step in exactly the same way as in step 4.

The screens for the trust game screens (step 10) looked as follows:

5. Instructions:

In this part of the experiment you will be randomly matched by the computer with one of the other 19 participants to form a group of two.
Every participant receives an initial endowment of 120 points.
In every group of two there are two roles: a sender and a receiver, each of which is assigned to one of the two group members.

The experiment consists of two stages:
In the **first** stage the sender can transfer an amount to the receiver.
The amount transferred can be a multiple of 20 between 0 and 120 points, i.e., 0, 20, 40, 60, 80, 100 or 120 points.
The amount that is transferred will be tripled by the experimenter.

Examples: If the sender transfers 60 points, the receiver receives 180 points.
If the sender transfers 10 points, the receiver receives 30 points. If the amount sent is 0, the receiver receives 0 points, etc.

At the end of the first stage the receiver has an amount at his disposal equal to the sum of his initial endowment and the tripled amount of the sender´s transfer.

In the **second** stage the receiver can now send back an amount to the sender.
This back transfer will not be tripled. The back transfer has to be an amount between 0 and 480.
The back transfer determines the final payoffs.

The payoff functions are therefore:
For the sender: 120 - amount sent + back transfer
For the receiver: 120 + 3 * amount sent - back transfer

Example: The sender transfers 40 points.
At the end of the first stage the sender therefore has 120 - 40 = 80 points and the receiver 120 + 3* 40 = 240 points.
In the second stage the receiver chooses a back transfer of 50 points.
The resulting payoffs in this case are: For the sender: 120 - 40 + 50 = 130 points. For the receiver: 120 + 3 * 40 - 50 = 190 points.

At the end of this part of the experiment the computer randomly determines whether you will be sender or receiver.
Because you do not know yet whether you will be sender or receiver, you will now have to make a decision for each of the two roles.
To do so you will have to make a decision on two separate screens: First as a receiver, then as a sender.

Please click "CONTINUE" to make your decisions.

CONTINUE

Suppose you are in the role of the receiver!

Because you do not know yet which amount the sender will send you,

you have to decide for every possible amount sent which amount you want to transfer back.

The back transfer is an amount between 0 and 480 points.

Suppose...	The respective amounts of points at the end of the first round are...	How many points do you send back?
the sender transfers 0 points	120 points for the sender and 120 points for you	
the sender transfers 20 points	100 points for the sender and 180 points for you	
the sender transfers 40 points	80 points for the sender and 240 points for you	
the sender transfers 60 points	60 points for the sender and 300 points for you	
the sender transfers 80 points	40 points for the sender and 360 points for you	
the sender transfers 100 points	20 points for the sender and 420 points for you	
the sender transfers 120 points	0 points for the sender and 480 points for you	

Please click "CONTINUE"!

CONTINUE

Suppose you are in the role of the sender!

Please indicate the amount you want to transfer.

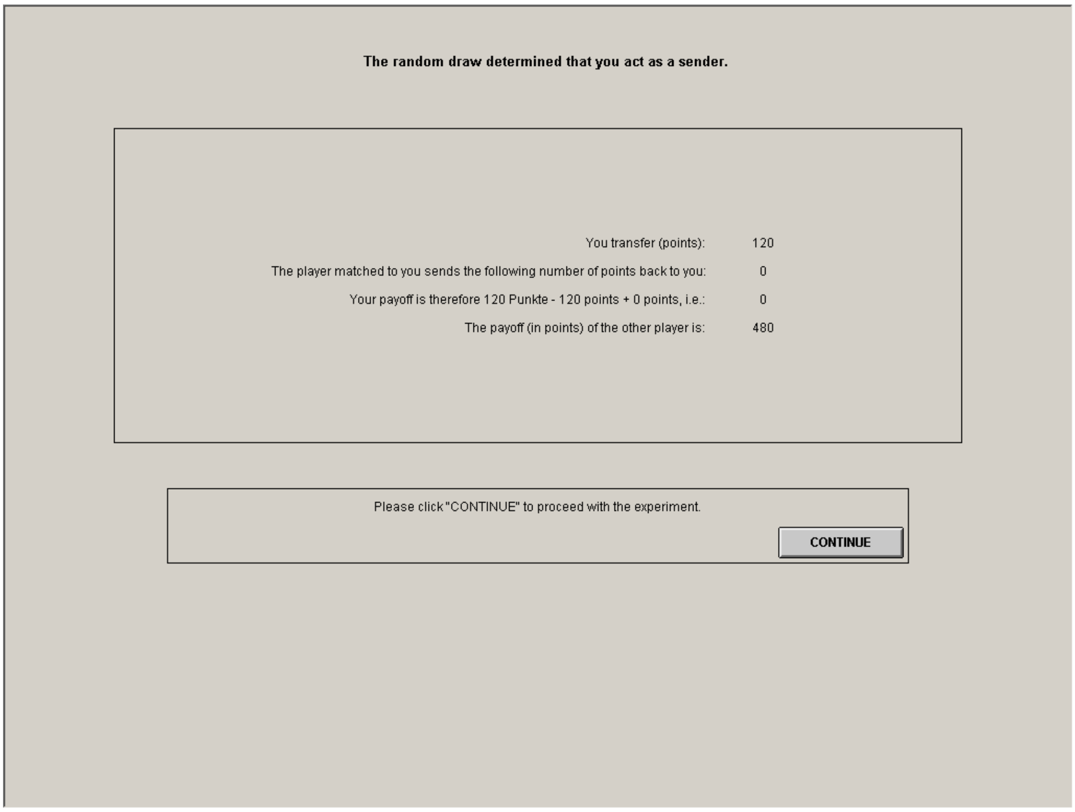
You can either transfer 0 points, 20 points, 40 points, 60 points, 80 points, 100 points, or 120 points.

Please click the amount that you want to transfer and confirm your choice by clicking "OK"!

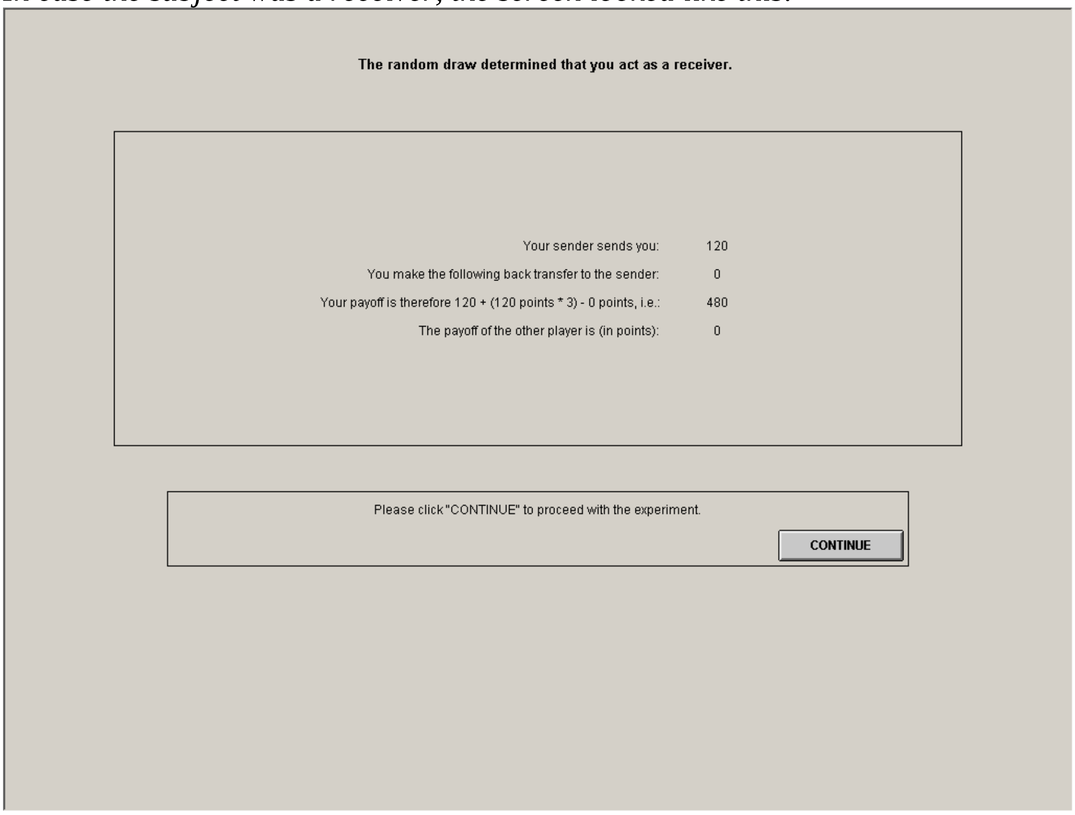
How much do you want to send to the receiver?
- 0 points
- 20 points
- 40 points
- 60 points
- 80 points
- 100 points
- 120 points

OK

The next screen informed subjects about their role in the trust game, about the respective decisions, and about payoffs. In case the subject was a sender, the screen looked like this:



In case the subject was a receiver, the screen looked like this:



The next two screens concern the elicitation of risk attitudes with simple lotteries.

6. Instructions:

This part concerns the choice between a **lottery** and a **safe payment**.

On the following screen, 15 situations will be displayed. The lottery is the same in each situation, but the safe payment varies.

In the lottery you get 400 points with 50 percent probability and 0 points with 50 percent probability (determined by a random draw of the computer).

The following screen will present the 15 situations. Please decide in each situation whether you opt for the lottery or for the safe payment.

Once you have made you choice in each situtation, the computer will randomly draw one situation.

In accordance with your choice in that situation you will either take part in the lottery or you will receive the safe payment.

Please click "CONTINUE" in order to make your decisions.

CONTINUE

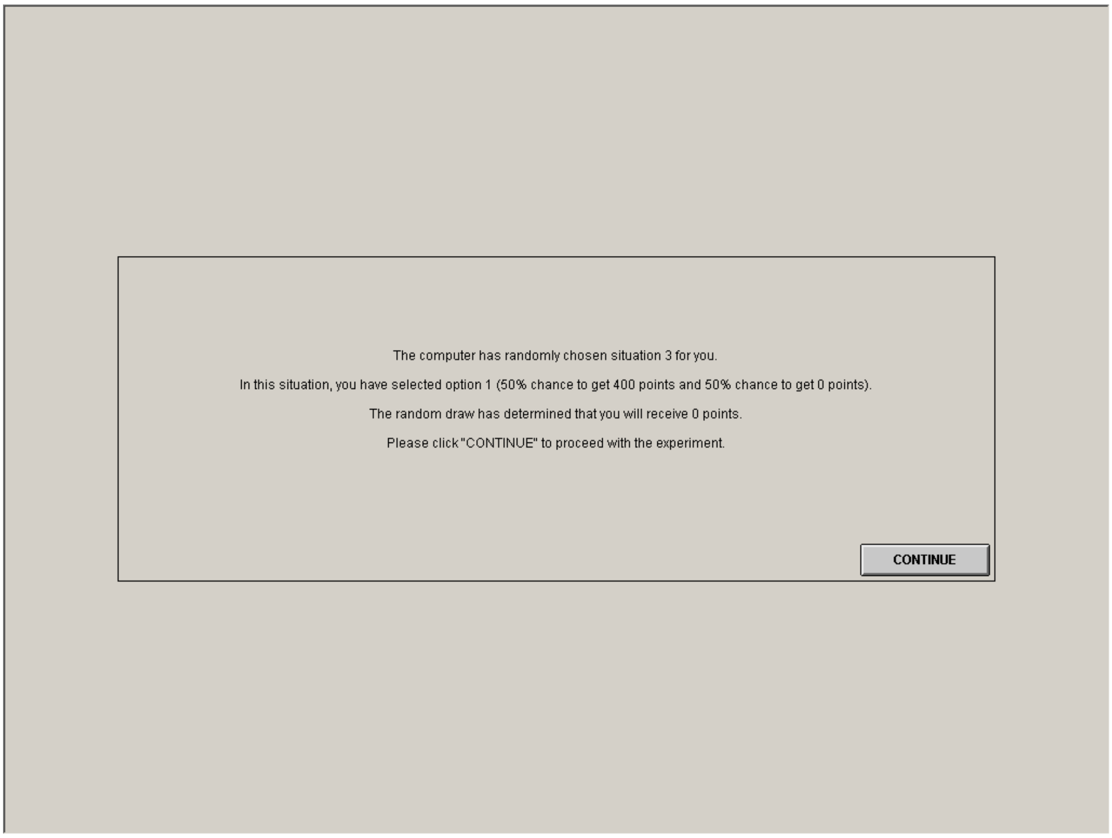
Please decide in each situation, whether you opt for the lottery or for the safe payment.

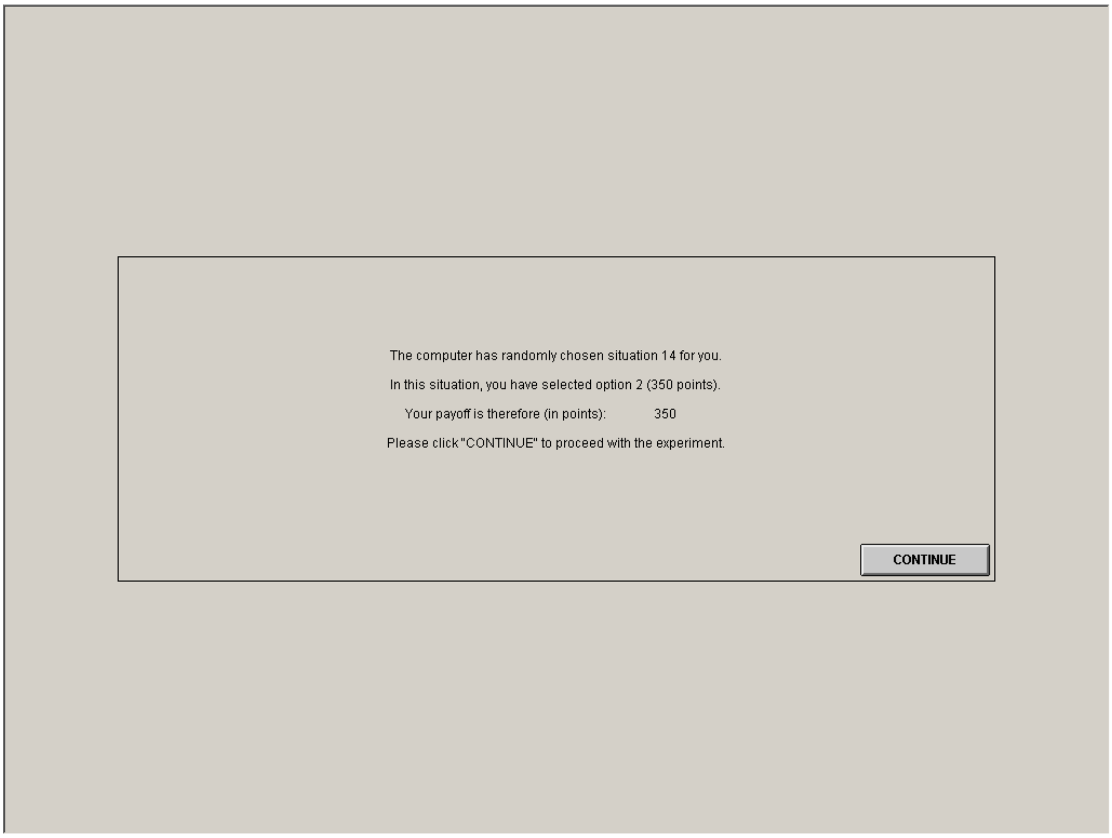
Situation	Lottery	Safe payment	Your choice
1	50% chance to get 400 points and 50% chance to get 0 points	25 points	lottery ○ ○ safe payment
2	50% chance to get 400 points and 50% chance to get 0 points	50 points	lottery ○ ○ safe payment
3	50% chance to get 400 points and 50% chance to get 0 points	75 points	lottery ○ ○ safe payment
4	50% chance to get 400 points and 50% chance to get 0 points	100 points	lottery ○ ○ safe payment
5	50% chance to get 400 points and 50% chance to get 0 points	125 points	lottery ○ ○ safe payment
6	50% chance to get 400 points and 50% chance to get 0 points	150 points	lottery ○ ○ safe payment
7	50% chance to get 400 points and 50% chance to get 0 points	175 points	lottery ○ ○ safe payment
8	50% chance to get 400 points and 50% chance to get 0 points	200 points	lottery ○ ○ safe payment
9	50% chance to get 400 points and 50% chance to get 0 points	225 points	lottery ○ ○ safe payment
10	50% chance to get 400 points and 50% chance to get 0 points	250 points	lottery ○ ○ safe payment
11	50% chance to get 400 points and 50% chance to get 0 points	275 points	lottery ○ ○ safe payment
12	50% chance to get 400 points and 50% chance to get 0 points	300 points	lottery ○ ○ safe payment
13	50% chance to get 400 points and 50% chance to get 0 points	325 points	lottery ○ ○ safe payment
14	50% chance to get 400 points and 50% chance to get 0 points	350 points	lottery ○ ○ safe payment
15	50% chance to get 400 points and 50% chance to get 0 points	375 points	lottery ○ ○ safe payment

Please click "OK" once you have made your choice for all situations.

OK

Subjects were informed about the outcome of the lottery experiment on the following screen:





Finally subjects answered a set of questions, including questions about risk attitudes, personality as well as math and high-school grades. They were then also informed about all outcomes and the resulting final payoffs.