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Overconfident Individual and Team Compensation Scheme Sorting: Experimental Evidence

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PREFACE AND ACKNOWLEDGEMENTS

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Most master students find it very hard to pick an interesting topic for their master thesis. Fortunately, this does not apply for me. One year ago, I decided to apply for the master Behavioural Economics with an Economics of Management and Organisation track. I followed the course Economics of Organisations, Quantitative Methods of Applied Economics, Advanced Behavioural Economics, and Experimental Economics, my favourite courses. I knew what I wanted to do for my master thesis: I want to do a controlled experiment to test something with personnel economics, and I require some challenging mathematical model, but with a behavioural aspect. And here it is: "Overconfident Individual and Team Compensation Scheme Sorting: Experimental Evidence".

I want to thank my supervisor dr. J.T.R. Stoop very much for all his support. He was very enthusiastic when I told him for the first time about my topic, which made me motivated to work hard. I really enjoyed my smooth process, thanks to him, because he always replied my emails in less than an hour with helpful feedback. Thus, I was very lucky with Prof. J.T.R. Stoop as supervisor. I would also like to thank Aysil Emirmahmutoglu to be my thesis reader. I really look forward to my future with the knowledge I obtained at the Erasmus University. Thanks to all my lectures and fellow students. I'm ready to take steps in my career, and I'm sure that everything I have learned so far will be useful in my future career.

Romy Tacx

ABSTRACT

This thesis attempts to answer the research question: "Do overconfident individuals and teams sort into different pay-for-performance schemes?". Respondents in a controlled experiment solve as many as possible math questions in two-minutes individually or in a two-person team. They had to choose how they wanted to be paid-out: a piece-rate or a tournament contract. Although I cannot find any evidence that overconfident individuals and teams sort more into competitive environments compared to rational agents, I do find that performance, risk preference, and social behaviour have an effect on sorting behaviour. There are limited gender differences, and no differences between individuals and teams in their level of overconfidence. Males tend to have an overestimation bias, while females face an overplacement bias. Besides this, more productive agents are attracted by tournaments that pay-out higher monetary rewards above piece-rate contracts. However, tournament contracts involve more risk than piece-rate contracts, and put negative externalities on tournament losers. I conclude that piece-rate contracts are mostly preferred by risk-averse and altruistic agents. Overall, overconfidence seems not to be a driver of sorting behaviour among different types of contracts.

Keywords: *Compensation schemes, sorting, overconfidence, teams, laboratory experiments.*

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CHAPTER 1 Introduction

Many businesses face the problem of unmotivated employees that do not act in the best interests of the firm. One way to deal with this issue is to introduce pay-for-performance contracts, where principals offer employees opportunities to earn additional monetary rewards. These agreements try to align the goals and objectives of the agent and the principal. However, this approach has different effects. Each agent reacts differently to incentives, because agents are not homogenous in characteristics. For example, introducing bonuses might result in performance increases, but it could also damage employees' intrinsic motivation. Possible pay-for-performance contracts are piece-rate systems and tournaments. These contracts differ in their level of risk, because piece-rate contracts guarantee a sure monetary reward based on own performance, while tournament contracts only reward top performers relative to a group. It is important to understand what the effects of different compensation schemes are, since firms' workplace is mixed in nature. For example, intrinsic motivation of a very risk-averse agent could be crowded out when he works in a tournament setting. This agent hates to work in a competitive environment, and is no longer able to be satisfied with his job. Contradicting, an agent who likes to compete against colleagues, might be extra motivated to work hard. It is impossible for firms to deal with this issue for every single employee. It is unusual to set individually a perfect attuned compensation contract, because this is very costly. Therefore, it is important to understand which mechanisms of contracts attract different types of employees when one type of pay-for-performance contract is set for all employees.

Firms that operate in risky environments could benefit from overconfident employee's decision-making. Overconfident agents believe that they are more qualified to achieve goals. This is a biased perception, which results in more risk-taking behaviour by overconfident agents that could positively affects firm value (Gervais, Heaton, & Odean, 2011). Therefore, it is preferable by firms to attract overconfident agents compared to rational agents. One way to attract these overconfident agents is by setting the right compensation scheme that benefits overconfident agents. For instance, a tournament contract offers a higher monetary reward compared to a piece-rate contract in case the agent performs better than others. Rational agents have accurate estimations of their chances to win the tournament, while overconfident agents overestimate the probability of winning. This makes tournaments more attractive to overconfident agents compared to piece-rate contracts, since a higher monetary reward makes the agent better off. On the other hand, agents that do not like to compete in risky environments against colleagues, might prefer to work for companies that offer piece-rate compensation contracts. The result of this is that the type of compensation contract offered by firms attracts certain types of employees.

The level of overconfidence might differ among individuals and teams. The literature indicates that working in a team decreases the uncertainty about performance, which makes teams more overconfident than individuals (Tajfel, 1970). A firm that offers mostly teamwork, and operates in a risky environment should attract overconfident team workers, since an overconfidence bias could benefit firms. However, when teams are more overconfident than individuals, it is important for the company to set stronger incentives that align the desires of biased agents.

This thesis attempts to give better insights in the sorting behaviour of overconfident agents and teams by means of a controlled experiment. An understanding of why, and how employees sort into different compensation schemes provide insights on how to improve efficiency in firms, and how to attract different employees who are best for the firm, since compensation schemes are very important determinants for employees to decide upon a job. Therefore, this thesis attempts to answer the following research question:

Do overconfident individuals and teams sort into different pay-for-performance schemes?

The answer to the research question will be of relevance to human resource managers, who try to optimize personnel economics, to behavioral economists, who try to understand the human decision-making process. I contribute to the existing literature by focussing more on the overconfidence aspect of agents. The literature indicates that there are different mechanisms of overconfidence. This thesis describes what the differences between these mechanisms of overconfidence are, and how it affects agents' sorting behaviour. I describe the theoretic framework in Chapter 2 to elaborate on the incentives exposed on agents by a piece-rate and a tournament contract. I also discuss two different mechanisms of overconfidence, and what the effects of overconfidence are on agents' compensation scheme decision. Based on this theory obtained from the literature, I develop hypotheses that I will test. I describe my experimental design and data, as well as, the methodology in Chapter 3. The next chapter shows the results of this research, and Chapter 5 and 6 discuss the limitations and concludes.

CHAPTER 2 Theoretic Framework

A better understanding of the different compensation schemes, overconfidence, and individual versus team behaviour are required to understand why and how employees sort into different compensation schemes. This chapter provides the theoretic framework of these mechanisms and point out which factors can influence the choice of a compensation scheme.

2.1 Compensation Schemes

The agency theory is a very well-known concept. This theory describes the conflicts between agents and principals. The simple agency model claims that principals have reasons to distrust their agents, because of information asymmetries and agents' self-interests. Agents might not act in the best interest of the principal, since agents have other goals and objectives than principals. For example, agents only care about money, while principals care about firm performance. This agency problem arises in fixed-wage pay contracts, where an agent is rewarded with a fixed risk-free hourly wage with no opportunities to get a higher reward. This kind of compensation scheme does not motivate agents to increase productivity or effort, because agents tend to maximize utility where extra effort is costly, and exerting extra effort is not rewarded by the principal (Gibbons R. , s.d.).

The agency problem results in the introduction of mechanisms to align the goals and objectives of agents and principals (Ross, 1973). These mechanisms reduce the level of information asymmetry between the agent and the principal, and prevent agents' opportunistic behaviour. An example of a mechanism is a pay-for-performance compensation contract. Pay-for-performance contracts state that agents get financial and/or non-financial rewards based on how well they perform. For example, an agent who achieves a higher number of sales in a given year receives a monetary bonus. In this way, motivating employees with higher pay-outs when performance increases due to employee's superior effort might result in higher efficiency in the workplace. Examples of these pay-for-performance compensation schemes are piece-rates, bonuses, tournaments, profit-sharing, stock options, and non-financial rewards like vacation days or other arrangements. Common used compensation schemes by firms are piece-rates and tournaments, which I describe in more detail in the next two sections.

2.1.1 Piece-Rates

Following the work of Baker (2002), Gibbons (1998) and Gibbons (s.d), an employee provides services for the principal in trade for a reward for doing his work. A reward is the wage that an employee cares about. This reward can be financial or non-financial. For simplicity, I focus on financial reward. An employee exerts a level of effort, which is the exertion of physical or mental power by the agent, denoted by e. This effort equals zero when the employee does not get a reward. Thus, the reward incentivizes the employee to exert effort. In this simple model, output is observable to the firm, while effort and ability is not directly observable to the firm. The output is a function of agent's effort choice and ability. This is denoted by the following function:

$$y_i = \alpha_i e_i + \varepsilon$$

where y_i is the observable output of agent i, which is an increasing function of agent's effort choice (e_i) and ability (α_i). The ability parameter (α_i) can take a value between $0 \leq \alpha_i \leq 1$, where 0 refers to very low ability agents, and 1 to very high ability workers. This indicates that a lower level of effort is required for high ability to generate output $\overline{y_i}$ compared to low ability agents. Ability is assumed to be normally distributed with mean $\alpha_i = 0.50$ and variance σ^2. The noise is denoted by ε, which is beyond agents' control, and is a uniform distribution with zero mean and variance σ^2. In other words, exerting effort by an agent of a given ability level results in output. This output can be affected by noise.

A pay-for-performance contract incentivizes an agent to increase output, since higher output leads to higher rewards. An agent should increase effort to achieve this higher output level. A piece-rate contract is a pay-for-performance contract, which is a linear function of output:

$$w_i = s + b \times y_i.$$

The agent's wage, denoted by w, includes a fixed and variable reward. The fixed reward, denoted by s, involves no risk. The variable reward, denoted by $b \times y_i$, is a fixed amount (b) for extra output y_i. For example, an agent receives a fixed reward of €50.000 per year plus a variable reward of €50 per extra output y_i. In my model, I assume that the fixed reward (s) is equal to 0.

I assume that agents are risk-neutral, and wants to maximize the expected utility of the pay-off. A risk-neutral agent's pay-off equals the wage w minus the costly action to produce output, denoted by $c(e)$, which is the monetary amount to compensate the agent for exerting effort. The cost function $c(e)$ is assumed to be increasing and convex, which means that an extra hour of work is costlier after ten hours of work compared to one hour of work. The agent's expected utility equals the reward minus the costs:

$$EU_{i,piece} = b \times y_i - c(e_i).$$

I assume that the expected noise is equal to zero. Maximizing the expected utility means that a risk-neutral agent would choose an optimal level of effort given his ability, and his cost function to maximize his reward. Individuals differ in characteristics, referring to ability. Someone can be excellent in solving math equations, while someone else is not. Therefore, individuals differ in their effort allocation when maximizing the expected pay-off.

2.1.2 Tournaments

The simplest tournament contracts state that the performers of a two-person group receives a fixed prize w_1 to the winner, and a fixed prize w_2 to the loser, with $w_1 > w_2$ and $w_2 = 0$ (Lazear & Rosen, 1981). Imagine that risk-neutral agent i competes against risk-neutral agent j in a tournament. Both players do not have information about competitor's ability. Both agents produce an outcome level y, which is observable to the firm. The output function is the same as under the piece-rate model, given by:

$$y_i = \alpha_i e_i + \varepsilon$$

where output (y_i) is an increasing function of effort (e_i) and ability (α_i). Following Lazear and Rosen (1981), the bad luck factor (ε_i) is normally distributed with zero mean and variance σ^2. Agent i wins the tournament when output $y_i > y_j$. This occurs with probability p. Agent i loses the tournament when output $y_i < y_j$, which occurs with probability $1 - p$. Thus, with a probability p agent i is rewarded with w_1, and with a probability $1 - p$ with w_2. The expected utility function under a tournament compensation scheme for both agents is equal to the reward minus the costs of getting the reward. This is given by:

$$EU_{i,tour} = p[w_1 - c(e_i)] + (1 - p)[w_2 - c(e_i)]$$
$$= pw_1 - (1 - p)w_2 - c(e_i).$$

Since $w_2 = 0$ in this model:

$$EU_{i,tour} = pw_1 - c(e_i).$$

Which allocation of effort would a risk-neutral agent choose to maximize the expected pay-off? The cost of effort function dependents on effort, which is easy to imagine. However, the probability of winning the tournament depends on own effort, own ability, competitor's effort, competitor's ability, and bad luck/noise. The probability that agent i wins the tournament is denoted by:

$$P_{i,win} = prob(y_i > y_j)$$
$$= prob(y_i + \varepsilon_i > y_j + \varepsilon_j).$$

Thus, agent i wins the tournament when his outcome y_i exceeds the probability of bad luck (ε_i). This is denoted by:

$$P_{i,win} = prob(y_i - y_j > \varepsilon_j - \varepsilon_i).$$

Let's call the density of bad luck $(\varepsilon_j - \varepsilon_i)$ from now on x. To simplify my model, I assume that the error terms are uniformly distributed with zero mean, and with variance of two times the variance of the error term of the output function, denoted by $(\varepsilon_i - \varepsilon_j \sim U(0, 2\sigma^2)$. The density of bad luck (x) is summarized by $f(x; 0; 2\sigma^2)$. Bad luck is the probability of losing the tournament by agent i, while agent i outperforms agent j. Bad luck is beyond the control of the agent. The probability of winning the tournament by agent i is the integral of the density of bad luck:

$$P_{i,win} = \int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx.$$

Figure 1 shows this integral and an example. Agent i has a higher probability of winning the tournament when agent i outperforms agent j. However, bad luck can make agent i to lose the contest, although he outperforms agent j. The probability of losing the contest by agent i, although he outperforms agent j, decreases when the difference between agents' outcomes rises, because only a very large random shock of bad luck can make agent i to lose. This results in a higher probability of winning the contest by agent i compared to the case where both agents exert the same level of effort.

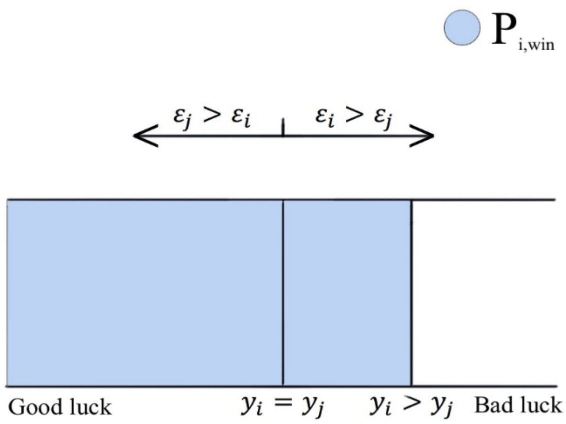


Figure 1: Probability density function $f(x; 0; 2\sigma^2)$ when agent i outperforms agent j

By having identified the probability density function ($f(x; 0; 2\sigma^2)$), the tournament expected pay-off of agent i depends on the probability of winning the tournament and the costs of effort:

$$EU_{i,tour} = \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right]w_1 - c(e_i).$$

The risk-neutral agent have to decide his effort allocation by maximizing his expected utility. An agent would choose an effort allocation that makes him to win the tournament at the lowest costs. Under a piece-rate compensation scheme, an agent maximizes expected utility by choosing only an optimal effort allocation given his ability, reward per extra output, and cost function. In contrast, under this tournament compensation scheme, an agent takes his own ability, potential competitor's ability, cost function, reward, and bad luck into account when choosing an effort allocation. The ability of the competitor is unknown to the agent. An agent has only private information about his own ability, and should make expectations about competitor's ability. A worker, who prefers to win the tournament, would choose an output level that is slightly higher than the output of his competitor to maximize his reward and minimize his cost of effort. The effort allocations differ per expectation. For example, a high ability worker, that expects a high ability competitor, would choose an effort allocation that is higher compared to the case that he expects a low ability competitor. A low ability worker, who expects a low ability competitor, would choose a lower effort allocation compared to the case that he expects a high ability competitor.

Agents differ in characteristics and ability to correctly forecast competitor's ability. People can make wrong or good expectations, which can turn out positively or negatively. A result of this is that people differ in their effort allocation, and perception of the expected outcome by maximising expected utility.

2.1.3 Piece-rate versus tournament

In this section I describe what an individual makes to prefer a pay-for-performance contract above another. Image a situation where a risk-neutral agent can choose between a piece-rate contract or a tournament. An agent is indifferent between a piece-rate contract and a tournament when the expected utilities of both contracts are equal:

$$EU_{i,piece} = EU_{i,tour}.$$

A rational agent is only indifferent between a piece-rate contract and a tournament when a perfect level of the variable pay (b) and the large reward (w_1) in case of winning the tournament is set. However, this is a difficult task to do. For example, image that a correct answer of a quiz is rewarded with €0.50, and the best performer of a two-person tournament is rewarded with €10.00. There is a possibility that good performers can produce more than e.g. twenty correctly answers. Therefore, a good risk-neutral performer would always prefer a piece-rate contract over a tournament, since receiving more than twenty times €0.50 under the piece-rate contract is more than €10.00 in case of winning the tournament, assuming the monotonicity axiom. These persons would only be indifferent between a piece-rate contract and a tournament, when they exactly produce twenty correct answers, and the chance of winning the tournament is 100%. Winning a tournament for sure is unrealistic, because a participant has no private information about competitor's ability to produce a particular outcome. Thus, winning the tournament occurs with a probability depending on one's and competitor's quiz results. The probability of winning a tournament affects the expected outcome of the tournament. A risk-neutral agent who believes he has a very high chance of winning the tournament (because of expected high performance) requires a lower fixed winner amount to entry the tournament compared to an agent who believes his chance of winning is very low. Thus, the optimal level of the winner's reward, given the variable pay in the piece-rate contract, differs per individual.

It is not possible to set per individual a different reward for both contracts. A possible solution to the problem is to set a fixed reward per correct answer for the person who wins the tournament instead of a winner's fixed reward in total. For example, the winner of the tournament receives €1.00 per correct answer instead of the fixed reward of €10.00. In this way, the problem of setting the right fixed reward, where all subjects could benefit from entering the tournament, is avoided by paying the tournament winner per correct answer.

The expected utility functions of a piece-rate contract and a tournament are given by:

$$EU_{i,piece} = b \times y_i - c(e_i), EU_{i,tour} = \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] w_1 - c(e_i).$$

Since the problem of setting the right fixed reward under a tournament (w_1), a fixed reward per correct answers is introduced, denoted by r. The new expected utility function of a tournament is now described by:

$$EU_{i,tour} = \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] ry_i - c(e_i)$$

where y_i is the output produced by agent i, i.e. the number of correct answers in the quiz. Being indifferent between a piece-rate compensation and a tournament means that both expected pay-offs are equal, under the assumption that agents are risk-neutral:

$$EU_{i,piece} = EU_{i,tour}$$

$$b \times y_i - c(e_i) = \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] ry_i - c(e_i)$$

$$b \times y_i = \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] ry_i$$

The perfect setting of the variable pay (b) and the fixed pay per correct answer in the tournament (r) is relative to each other. Preferring a tournament above a piece-rate contract, given the agent performance, means that the fixed reward per correct answer in the tournament is large enough to compensate for the risk of losing the tournament relative to the variable pay in the piece-rate contract (Niederle & Vesterlund, 2007). Image an agent who answered thirty quiz questions correctly. Under the piece-rate contract he would receive $30 \times 0.50 = €15$. In case of a tournament, the agent competes against another player. He believes that his competitor is identical in his ability to perform the task, and thus, he believes that his probability of winning the tournament is 50%. The agent would only be indifferent between the piece-rate contract and the tournament when expected pay-outs are equal of both contracts. Given a variable reward of the piece-rate contract of €0.50 per correct answer, the tournament reward should be two times higher to compensate a risk-neutral agent for the risk to make him indifferent in his entry choice. The tournament reward is denoted by:

$$r = \frac{b}{p_{i,win}} = \frac{0.50}{0.5} = €1.00$$

Thus, given a variable reward (b) under the piece-rate contract, the tournament reward per correct answer should equal €1.00 to make an agent indifferent between the two compensation schemes. This rule only holds in case subjects expect homogenous competitors in ability to perform the task. In general, this is a fair assumption, because employees only compete against colleagues that are on average equally qualified for the job. Employees of the same department compete against each other in a tournament, assuming that an employer only hires employees of the same ability that will work together on a particular department. As an extreme example, a secretary will never compete against a CEO, because it is not an equal fight to get the monetary reward.

Besides this, the variable b and w_1 should be not too small nor too large following the dominance precept. This precept states that subjects should be paid enough to incentivize them to think hard enough about a problem. In other words, to incentivize employees to increase performance. A too small reward might be an insult to the subject, and a too large reward makes a subject too nervous to clearly think about questions.

Assuming the perfectly set variable pay (b) and fixed winner's reward (r), the only mechanisms that can affect a preference between the two compensation schemes are one's output (y_i), competitor's output (y_j), and bad luck (ε). I use examples in the next section to show what agent's expected utilities are in different situations under both contracts that affects a preference for a compensation contract. In these examples, I assume that agents are risk-neutral, the variable pay (b) under the piece-rate contract is equal to €0.50, and the tournament fixed winner's reward (r) is equal to €1.00 per output unit. I do not elaborate on bad luck, since the expected noise is uniformly distributed with zero mean both under a piece-rate and tournament contract. To determine the expected utility, I use an increasing and convex cost function: $c(e_i) = \frac{1}{100}e^2$. The outcomes of the examples hold for any given variable pay (b), fixed winner's reward (r), parameters of output function (y_i) and parameters of cost function $c(e_i)$.

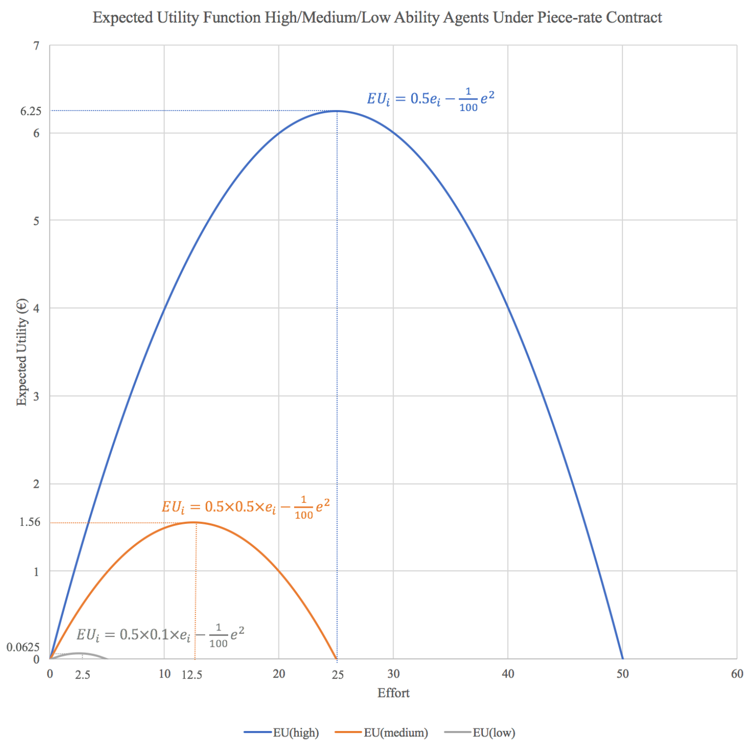
Piece-rate contract:

The expected utility function under a piece-rate contract is:

$$EU_{i,piece} = b \times y_i - c(e_i)$$

$$= 0.50\alpha_i e_i - \frac{1}{100}e_i^2 \begin{cases} 0.5e_i - \frac{1}{100}e_i^2, & \alpha_i = 1 \quad \rightarrow high\ ability \\ 0.5 \times 0.55 \times e_i - \frac{1}{100}e_i^2, & \alpha_i = 0.55 \rightarrow medium\ ability \\ 0.5 \times 0.1 \times e_i - \frac{1}{100}e_i^2, & \alpha_i = 0.1 \rightarrow low\ ability \end{cases}$$

I assume that very low ability workers have an ability parameter that is close to zero and not equal to 0 ($\alpha_i = 0.1$), because estimating the expected utility with $\alpha_i = 0$ is not possible. A risk-neutral agent chooses an effort allocation where the marginal cost (MC) is equal to the marginal reward (MR) to maximize his expected utility. Graph 1 shows the expected utility function of high, medium, and low ability workers under the piece-rate contract. In words, the expected utility of very high ability workers ($\alpha_i = 1$) is maximized when an agent chooses 25 effort units. The expected utility of the high ability worker is equal to €6.25. In case of effort level of 26 units, the marginal benefit of producing one extra unit of output does not outweigh the marginal costs of that additional outcome unit. A low ability worker ($\alpha_i = 0.1$) is not able to produce that level of outcome. Low ability workers achieve a maximum expected utility of €0.0625 when the agent puts in 2.5 effort units. A worker of a medium ability level ($\alpha_i = 0.5$) maximizes the expected pay-off in case of an effort level of 12.5. In graph 1, I elaborate only at the extreme values of ability. Agents of different abilities would expect a pay-off under this type of contract of €$0.0625 \leq EU_{piece,i} \leq$ €6.25. Thus, higher skilled workers have higher effort allocations, and realize a higher expected pay-off compared to lower skilled workers.



Graph 1: Maximum piece-rate expected utility of high, medium, and low ability workers. A high ability worker maximizes his expected utility under a piece-rate contract when he chooses to put in 25 units of effort. In that case, a high ability worker realises an expected utility of €6.25. A low ability worker achieves a maximum expected utility of €0.0625 when he puts in 2.5 effort units. A medium ability worker maximizes his expected pay-off with an effort level of 12.5 units to realize an expected utility of €1.56.

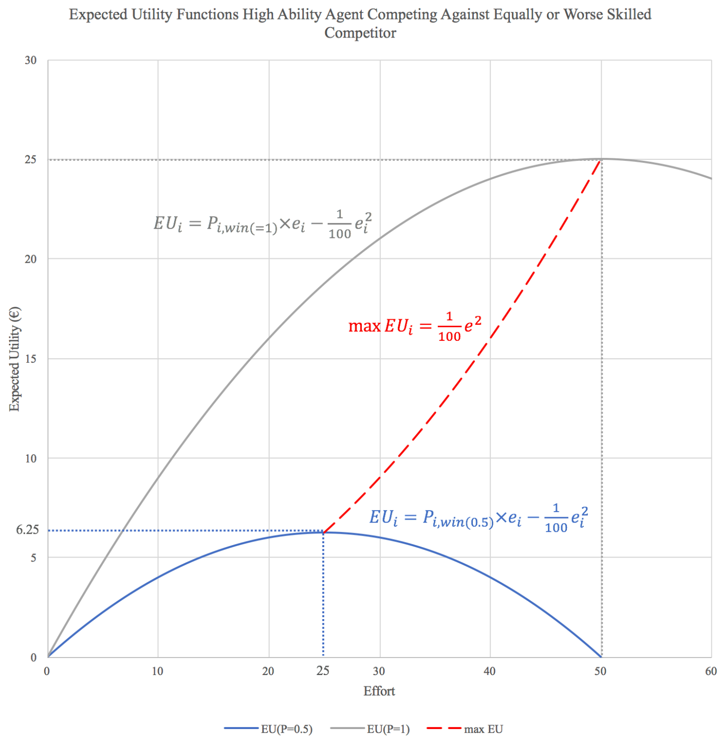
Tournament contract:

Agents would only choose to participate in a tournament when their expected pay-off is lower under a piece-rate contract compared to the tournament. The expected utility function under a tournament contract is:

$$EU_{i,tour} = P_{i,win} r y_i - c(e_i)$$
$$= \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] 1.00\alpha_i e_i - \frac{1}{100} e_i^2$$
$$\begin{cases} \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] 1.0e_i - \frac{1}{100} e_i^2, & \alpha_i = 1 \quad \rightarrow high\ ability \\ \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] 0.5e_i - \frac{1}{100} e_i^2, & \alpha_i = 0.5 \rightarrow medium\ ability \\ \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] 0.1e_i - \frac{1}{100} e_i^2, & \alpha_i = 0.1 \rightarrow low\ ability \end{cases}$$

The expected utility function under a tournament contract depends on one's output, competitor's output, cost of effort, and bad luck. An agent has private information about own ability to produce some output, and I assume that agents have the perfect expertise to predict competitor's ability in this two-player competition. Given this, the agent makes a perfect prediction about competitor's ability before entering the competitive environment. Given agent's own ability, he could believe that the other player is better, worse or equally skilled. In case the agent beliefs that his competitor is of a lower ability level, the probability of winning is perceived to be higher than 50%, i.e. $0.50 < P_{win,i} \leq 1.00$, due to bad luck. For example, a random negative shock can make the agent to lose the contest when the high skilled worker produces just one unit of outcome more than his lower skilled competitor. This random negative shock has less impact once the high ability agent produces much more output relative to competitor's output, which result in a winning probability closer to 100%. Thus, a very high ability agent, who competes against a very low ability competitor, has a higher probability of winning the tournament compared to a situation where two very high skilled agents play against each other. Contradicting, the probability of winning the tournament is $0 \leq P_{win,i} < 0.50$ when the agent beliefs that his competitor is higher skilled than himself, depending on the level of higher ability. Lastly, the probability of winning is 50% when the agents have the same ability.

Let me give three extreme examples: 1) a very high ability agent competes against a worse or equally skilled competitor, 2) a medium agent competes against a worse, equally, or better skilled competitor, and 3) a very low ability agent competes against a better or equally skilled competitor. Firstly, a very high skilled agent ($\alpha_i = 1$) who competes against a very low skilled competitor ($\alpha_j = 0.1$) could face a probability of winning close to $P_{i,win} = 1.00$, and $P_{i,win} = 0.50$ in case competitor is of the exact same ability ($\alpha_j = 1$). Graph 2 shows these two extreme situations. In the first situation, the agent can achieve a maximum expected utility of €25 with an effort allocation of 50 units. In the second situation, the agent can only realize a maximum expected utility of €6.25 with an effort level of 25 units. The two curves are the extremes. However, the expected utility functions, in case of $0.50 < P_{i,win} < 1.00$, are parabolas between these two extremes ($EU_i = P_{i,win\times}e_i - \frac{1}{100}e_i$). The curve $\max EU_i$ is an equation through all the vertices of the expected utility functions with different probabilities of winning the tournament[1]. This implies that high ability workers are able to realize maximum expected utilities of €$6.25 \leq EU_i \leq$ €25 depending on the ability of their competitor, given by the function $\max EU_i$. This function only holds on the range $25 \leq e_i \leq 50$, since an agent with the highest ability level cannot face a better competitor that lowers the probability of winning the tournament below 50%. In summary, the lower competitor's ability relative to one's ability, the higher the expected utility of the tournament.



Graph 2: Maximum expected utility of a tournament when a high ability agent competes against a worse, and equally skilled competitor. A high ability agent ($\alpha_i = 1$) who competes against a low ability agent ($\alpha_j = 0.1$) has a probability of winning the tournament close to 100%, which result in a maximum expected utility of €25. In case the competitor is of the same ability ($\alpha_j = 1$), the probability of winning is 50%, and a maximum expected utility of €6.25 can be realized. All maximum expected utilities for $0.50 < P_{i,win} < 1$ is given by the $\max EU_i$ curve.

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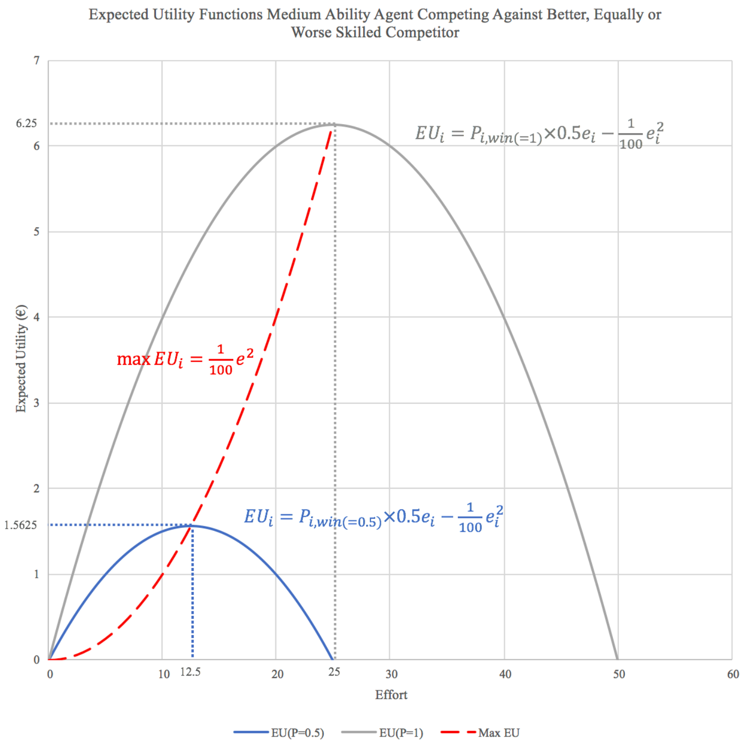
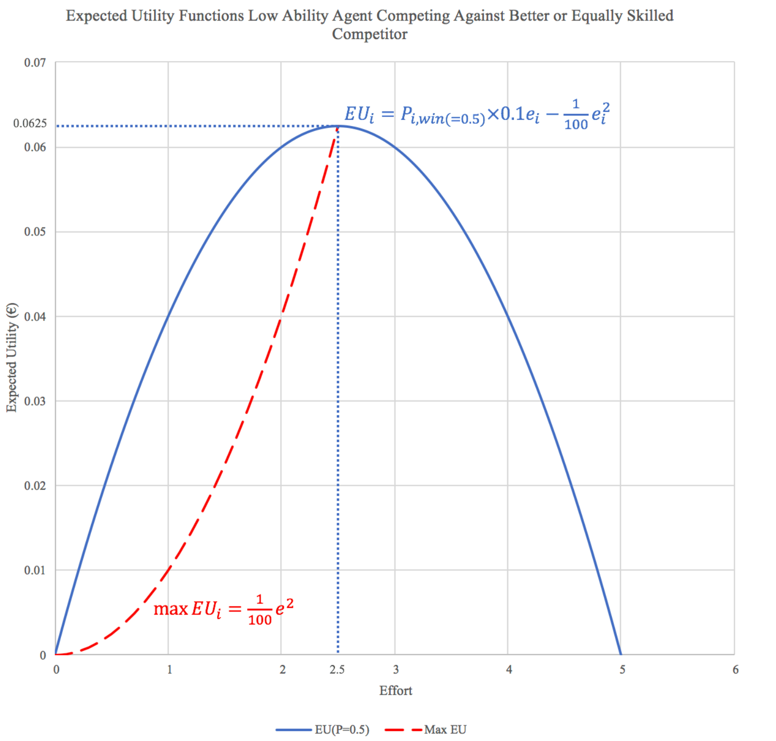
[1] $EU_i = P_{i,win} \times e_i - \frac{1}{100}e_i^2$, $\frac{\partial EU_i}{\partial e_i} = P_{i,win} - \frac{1}{50}e_i = 0 \quad \rightarrow P_{i,win} = \frac{1}{50}e_i$
Substitute $P_{i,win}$ into $EU_i \rightarrow \max EU_i = \frac{1}{100}e_i^2$. The maximum expected utility that can be realized is given by the equation through all vertices of the parabolas. This equation holds for every ability level.

Secondly, a medium skilled $(\alpha_i = 0.5)$ agent can compete against a better $(\alpha_j = 1.0)$, equally $(\alpha_j = 0.5)$, or worse $(\alpha_j = 0.1)$ skilled competitor. The expected utility functions of these three extreme situations are shown in Graph 3. The equation $\max EU_i$ summaries the possible maximum expected utilities for probabilities of winning the tournament between $0 \leq P_{i,win} < 1.00$, where $P_{i,win}$ is depending on the difference between the ability of the two players[1]. In case the competitor is better than the medium skilled agent, an expected utility of €$0 \leq EU_i <$ €1.5625 can be realized, while an expected utility of €$1.5625 < EU_i \leq$ €6.25 can be achieved in case the medium agent is better than his competitor.



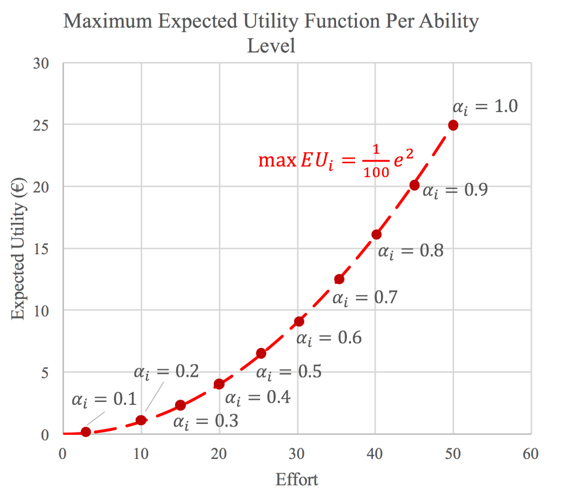
Graph 3: Maximum expected utility of a tournament when a medium ability agent competes against a worse, equally or better skilled competitor. A medium ability agent $(\alpha_i = 0.5)$ *who competes against a lower ability agent could have a probability of winning the tournament close to 100%, which result in a maximum expected utility of €6.25. In case the competitor is of the same ability* $(\alpha_j = 0.5)$*, the probability of winning is 50%, and a maximum expected utility of €1.5625 can be realized. A medium ability agent could also face a probability of winning the tournament close to zero when the competitor is absolute better. In that case an expected utility of €0 can be achieved. All maximum expected utilities for* $0 < P_{i,win} < 1$ *is given by the max* EU_i *curve.*

Thirdly, in an extreme situation, a very low skilled $(\alpha_i = 0.1)$ agent can go against a better $(\alpha_j = 1.0)$, or equally $(\alpha_j = 0,1)$ skilled competitor. In case a competitor of a higher ability level is faced, the expected utility is equal to €0, because the probability of winning the tournament is 0%. In case the competitor is equally skilled, the maximum expected utility of the lowest skilled agent is €0.0625 at an effort level of 2.5 units. This is shown in Graph 4. The agent could also realize a lower expected utility when the probability of winning the tournament is $0 < P_{i,win} < 0.50$, denoted by the $\max EU_i$ curve[1].



Graph 4: Maximum expected utility of a tournament when a low ability agent competes against an equally, or better skilled competitor. A low ability agent ($\alpha_i = 0.1$) who competes against an equal ability agent has a probability of winning the tournament close to 50%, which result in a maximum expected utility of €0.0625. In case the competitor is of a higher ability, the probability of winning could be 0%, and a maximum expected utility of €0.00 can be realized. All maximum expected utilities for $0 < P_{i,win} < 1$ is given by the $\max EU_i$ curve.

In summary, the maximum expected utilities are given by $\max EU_i = \frac{1}{100} e_i$. Graph 5 shows the maximum expected utility that can be achieved per different ability level with a probability of winning the tournament equal to 100%. Only in the case of an agent with low skills ($\alpha_i = 0.1$), a maximum expected utility can be achieved with a probability of winning equal 50%, because this type of agent cannot face a lower skilled competitor, since $0.1 \leq \alpha_i \leq 1$ that results in a probability of winning above 50%. Thus, the maximum expected utility depends on the probability of winning the tournament, which is a function of one's ability and competitor's ability. In case the agent is perfectly capable to predict competitor's ability, the agent has an accurate estimation of his expected utility under a



Graph 5: Maximum expected utility function is a curve through all vertices of the function $EU_i = P_{i,win} \alpha_i e_i - \frac{1}{100} e_i^2$. This graph shows all the maximum expected utilities per different ability level, i.e. a high ability agent ($\alpha_i = 1$) is capable to expected an utility of €25 by participating in the tournament in case the probability of winning is 100%. This function is increasing and convex.

tournament. In this way, the agent can compare the expected utilities under a piece-rate contract and a tournament.

An agent self-selects into a piece-rate or a tournament contract in case the expect utility of the piece-rate contract is higher than the expected utility of the tournament. In Table 1, the different expected utilities per ability level under both contracts are shown. This table indicates that an agent would only prefer a competitive environment when the probability of winning the tournament is higher than 50%, since $EU_{i,tour} > EU_{i,piece}$ when $P_{i,win} > 0.5$. Under the assumption that agent i has perfect information about one's ability, makes accurate assumptions of competitor's ability, and is risk-neutral, an agent would only prefer a tournament when the agent beliefs that he is a better performer than his competitor.

Table 1: Maximum expected utility at different ability levels under a piece-rate contract, and expected utility at different ability levels in case of a better, equally, and worse skilled competitor under a tournament contract.

Piece-Rate Contract		**Tournament Contract**		
$\boldsymbol{EU_{i,piece} = by_i - c(e_i)}$		$\boldsymbol{EU_{i,tour} = \left[\int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx\right] ry_i - c(e_i)}$		
Ability (α_i)	$EU_{i,piece}$(€)	*Better competitor:* $EU_{i,tour}$(€) $at\ P_{i,win} = 0$	*Equal competitor:* $EU_{i,tour}$(€) $at\ P_{i,win} = 0.5$	*Worse competitor:* $EU_{i,tour}$(€) $at\ P_{i,win} = 1$
0.1	0,0625	0	0,0625	
0.2	0,25	0	0.25	1
0.3	0.5625	0	0.5625	2.25
0.4	1	0	1	4
0.5	1.5625	0	1.5625	6.25
0.6	2.25	0	2.25	9
0.7	3.0625	0	3.0625	12.25
0.8	4	0	4	16
0.9	5.0625	0	5.0625	20.25
1.0	6.25		6.25	25

2.2 Overconfidence

Overconfidence refers to a mental state when an individual has more confidence than they should have based on the situation. In economics models, overconfidence is a biased perception of information, and results in the tendency to overestimate the preciseness of the information (Cesarini, Sandewall, & Johannesson, 2006). This bias is well established in the finance literature. Overconfident stock traders tend to believe strongly in their own stock valuations that might be unrealistic. This results in excessive trading volumes that is inconsistent with rationality (Barber & Odean, 2001). As well as in other professional fields, overconfidence is also observed in the decision-making process. For example, overconfident CEOs have biased perceptions about the quality of investment projects. Malmendier and Tate (2005) conclude that overconfidence has a high explanatory power for executive investment behaviour. This result is important to contracting practices and organizational designs. A paper by Gervais, Heaton and Odean (2005) showed these practices. They question how compensation contracts optimally adjust to the overconfidence effect. In their model, they claim that in the contracting stage, the board of directors take the manager's degree of overconfidence into account. Risk-averse and extremely high overconfident CEOs are offered highly convex pay-for-performance contracts that benefits the firm. This means that the CEO is highly incentivized to undertake a risky project, where the risk is disliked and overestimated by the CEO. In contrast, mildly risk-averse overconfident managers are offered less convex pay-for-performance contracts to align the goals and objectives of the manager and the firm. These pay-for-performance contracts can play with the effort allocation of the manager. A convex performance based contract incentivizes a risk-averse overconfident manager to undertake risky projects, and to exert costly effort to achieve successful results. Gervais, Heaton and Odean (2005) also build further on the work of Goel and Thakor (2008), who developed a model that claims that overconfident agents are more likely to promote to a CEO function than rational agents in an intrafirm tournament setting. The overconfident agent sets to narrow confidence intervals in evaluating project options that results in preferring riskier projects above safe projects by the overconfident agent compared to rational agents. The higher the risk, the higher the probability of success, and therefore, getting a CEO promotion. However, overconfidence is only beneficial up to a point where extreme levels of overconfidence reduces firm value. A stereotype male is more overconfident than a female male, which might be an explanation for a higher occupancy rate of males in top executive functions. Huang and Kisgen (2013) test whether firms with female CEOs and CFOs make different decisions in the finance or acquisition field compared to firms with male executives. In their study, they found that firms with male executives are more likely to announce negative returns due to overconfident decisions compared to firms with female executives. Next, they found significant evidence that male executives are more likely to be replaced, because overconfident decisions result in higher shareholder value damage, indicating that females are less overconfident than males.

These literatures indicate that the overconfidence bias affects the decision-making process, and the level of overconfidence differs in gender. Overconfident agents or managers tend to overestimate the precision of information of risky options. Pay-for-performance contracts play with the effort allocation of overconfident agents. The same performance based compensation contract results in a different effort allocation by rational agents compared to overconfident agents. Further, overconfident agents seem to benefit from tournaments, because the expected outcome of risky options is higher than safe options.

Overconfidence seems to have an important role in the decision-making process in economics models. What is overconfidence exactly, and how can you measure overconfidence? It is important to know what the implications of overconfidence are on corporate governance. From the literature it follows that there are three different concepts of overconfidence: overestimation, overprecision, and overplacement (Moore & Swift, 2010).

Overestimation of one's actual performance refers to individual's optimism concerning overconfidence. The overestimation bias states that an individual feels secure about his own ability, performance, level of control, or chance of success to achieve a successful result. For example, an overconfident person could overestimate his ability to complete a mathematical problem within a given time limit. In other words, a person could belief that he is better than he truly is.

Overprecision regards to excessive certainty of correctness of one's beliefs. People tend to be too sure that their answers to questions are correct. To test overprecision, researchers ask participants to state their confidence intervals around their answers. An experimental study by Alpert and Raiffa (1982) asked subjects to specify 98% confidence intervals of answered general knowledge questions. Less than 50% of the cases included the right answers in the 98% confidence intervals, suggesting that overconfident persons set too narrow confidence intervals. They are too sure about their answer. Overprecision is closely related to overestimation, since being certain about the correctness of an answer refers to an overestimation of own ability, and excessive confidence in one's belief. Therefore, for simplicity, I assume that overestimation and overprecision are the same.

Overplacement of one's performance relative to others refers to individual tendency to belief he performs better than his peers. This type of overconfidence is also known as the term "better-than-the-average" effect, where the majority of a group rate themselves better than the median. This type of overconfidence is a result of the desire to view yourself positively (Alicke & Govorun, 2005).

In summary, an overconfident individual tends to overestimate his own ability and/or evaluate his own performance as better relative to others. Previous literature has shown that overconfidence impacts the decision-making process, i.e. overconfident managers prefer risky projects above safe options.

2.2.1 Piece-Rates and Overconfidence

A risk-neutral rational agent that is not overconfident is able to make an accurate prediction of the expected utility under a piece-rate contract. He would maximize his expected utility with perfect private information about one's ability. In case the agent is overconfident, he would overestimate one's ability, and overplace his capacity compared to peers. An overplacement bias has no effect on the expected utility of a piece-rate contract, because the expected utility is only a function of own ability. In case of overestimation of one's ability, the parameter α_i is overestimated in the expected utility function, denoted by

$$EU_{i,piece} = 0.50y_i - \frac{1}{100}e_i$$

with $y_i = \alpha_i e_i$. This ability overestimation results in a higher expected utility of an overconfident agent compared to a rational agent. For example, an overconfident agent with actual ability $\alpha_i = 0.5$ beliefs that his ability is $0.5 < \alpha_i \leq 1$. In that case, the expected utility is expected to be €$1.5625 < EU_{i,piece} \leq$ €6.25[2]. However, after participating in the piece-rate contract, it turns out that $EU_{i,piece} =$ €1.5625, because the agent is not able to allocate his effort such that the higher expected utility can be achieved as expected beforehand. An agent that is underconfident and underestimate his ability would expect that his pay-off is €$0.0625 \leq EU_{i,piece} <$ €1.5625[2], which is lower than his actual pay-off. Overall, the overestimation bias results in an overvalued expected utility of the piece-rate contract.

2.2.2 Tournament and Overconfidence

An agent should make a perfect estimation of one's ability, and competitor's ability to have an accurate estimation of the probability of winning. In this way, the agent can make a realistic estimation of his expected utility in the competitive environment. However, overconfident agents tend to overestimate their own ability, and to overplace themselves compared to their peers. This affects the perception of the expected utility, since overconfident agents have a biased expectation of the probability of winning the tournament. The probability of winning the tournament is given by:

$$P_{i,win} = \int_{-\infty}^{y_i - y_j} f(x; 0; 2\sigma^2)dx.$$

with $y_i = \alpha_i e_i$. Let me describe two situations, and how it affects the expected probability of winning the tournament: 1) an agent overestimates one's performance, and 2) an agent overplaces himself compared to competitor.

Firstly, an agent, who overestimates one's performance, overestimates his ability to produce some level of output. This imperfect estimation of one's ability affects the probability of winning the tournament. An overestimation of ability (α_i) means that the expected output (y_i) is higher than it would be in case ability was perfectly known. This overvaluation results in a larger difference between one's expected output and competitor's expected output $(y_i - y_j)$ that increases the probability of winning the tournament $(P_{i,win})$. Thus, overconfident agents have an overvalued estimation of their

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[2] See Table ,1 p. 15 for maximum expected utilities per different ability level under a piece-rate contract i.e. $\max EU_{i,piece} =$ €6.25 in case of $\alpha_i = 1$, $\max EU_{i,piece} =$ €1.5625 in case $\alpha_i = 0.5$, and $\max EU_{i,piece} =$ €0.0625 in case $\alpha_i = 0.1$.

expected utility. For example, an overconfident agent with actual ability of 0.5 faces a competitor of the exact same ability in the tournament. This leads to a probability of winning the tournament of 50%, since both agents produce the exact same output ($\alpha_i = \alpha_j$). An expected utility of €1.5625 can be realized by the agent[3]. However, the overconfident agent believes that his ability is $0.5 < \alpha_i \leq 1$, and thus, perceives the probability of winning as $0.5 < P_{i,win} \leq 1$. The result of this is that agent i has a higher expected utility (€$1.5625 < EU_{i,tour} \leq$ €6.25) than his actual pay-off ($EU_{i,tour} = 1.5625$) of the tournament (see Table 1, p.15). In this example, the overconfident agent believes that his competitor is lower skilled, because of overestimation one's ability. However, the agent could also face a probability of winning the tournament below 50% when competitor is higher skilled, although the agent is overestimating one's ability. In summary, overestimating one's ability leads to a pay-off that is lower than expected beforehand by the agent. The other way around, an underconfident agent who underestimates his own ability would underestimate the expected utility of the tournament.

Secondly, an overconfident agent, who only overplaces himself towards his competitor, beliefs that his competitor is of lower ability level than himself ($\alpha_i > \alpha_j$) to produce some output (y_i). This results in a larger difference between both players' output $(y_i - y_j)$ that leads to an expected probability of winning of $0.5 < P_{i,win} \leq 1$ perceived by the overconfident agent. For example, an overconfident agent of ability 0.5 goes against a competitor of the same ability $(\alpha_i = \alpha_j)$, but he overplaces himself and assumes that his competitor is worse skilled $(\alpha_i > \alpha_j)$. The worse skilled competitor is expected to produce a lower output, which result in an overestimation of the expected utility by the overconfident agent. The actual pay-off agent i faces is equal to €1.5625, but he expects a pay-off of €$1.5624 < EU_{i,piece} \leq$ €6.25, which makes the tournament seems to be more attractive (see Table1, p.15). Overplacement is not always a bias. A high skilled agent ($\alpha_i = 1$) is rational to believe that he is better than his competitor, because the agent is of the highest ability level. In that case, the agent has no overplacement bias. He is right about being better than is competitor. In general, an absolute overplacement bias always results in an overvalued expected probability of winning the tournament larger than 50%, which results in an unrealistic expected utility. Contradicting, the underplacement bias results in an underestimation of the expected utility of the tournament.

Overall, the overestimation and overplacement bias make agents to overvalue the expected utility compared to rational agents. Higher overconfidence levels result in larger overvaluations compared to lower overconfidence levels.

2.2.3 Overconfident Contract Decision

A risk-neutral agent prefers one contract above another when the expected utility of the contract is higher. Before self-selecting into a piece-rate or a tournament contract, the agent makes an estimation of one's ability and competitor's ability to determine the expected utility of both contracts. The tournament is designed such that the expected utility of the piece-rate and the tournament contract is the same when both players have the same ability, which makes the probability of winning the tournament equal to 50%.

A risk-neutral overconfident agent that overestimates one's ability overvalues the expected utility of both contracts as described in the previous sections. Only when the agent believes that the probability of winning the tournament is higher than 50% makes the tournament more attractive than the piece-rate contract. It is fully rational to choose a tournament when the competitor is truly worse skilled than the agent. However, agents that overestimate their own performance are not always more attracted by the tournament design, because the agent could still believe that he will face a better skilled agent.

A risk-neutral overconfident agent that has an overplacement bias does not overvalue the expected utility of a piece-rate contract, because other players' ability to produce some output does not influence the expected utility under this contract. The piece-rate contract rewards the agent purely based on own performance. However, an overplacement bias results in an overvalued probability of winning the tournament ($0.5 < P_{i,win} \leq 1$). Low ability agents who overplace themselves have a higher chance of being wrong about the assumption that the competitor is worse skilled compared to high ability agents who also overplace themselves. High ability agents who rank themselves higher than their competitors are probability right about this overplacement. In that case, overplacement is rational. Thus, overconfident agents with an absolute overplacement bias self-select into tournaments.

2.3 Compensation Scheme Composition & Overconfidence

In the previous section, I described overconfident individual choices among compensation scheme contracts. However, the variety of the setting is an important determinant of the level of overconfidence. A study by Niederle and Vesterlund (2007) examines whether there are gender differences in the selection into competitive environments. They found evidence that women are less likely to participate in tournaments, although there are no ability differences in gender in their experimental task. Females are less overconfident than men, and dislike to compete against others. This leads to a female-male competition gap. This gap can be reduced by introducing teams (Healy & Pate, 2011). Ambiguity aversion can be an explanation for this. Working in a team increases the uncertainty about teammate's ability, but decreases the risk of performing worse by averaging two performances (Houghton, Simon, Aquino, & Goldberg, 2000). Females tend to be more sensitive to this change of risk, and become more overconfident in teams. This is also proven by Dargnies (2009), who showed that males' preference for tournaments decreased when they work in teams, because their overconfidence level was significantly lower in a team compared to working alone. This suggests that overconfidence gender differences drive the preference for a competitive environment. That groups become more overconfident is also discovered by Tajfel (1970). In his experiment, each team believed that they were better than other teams. Following Puncochar and Fox (2004): “Two heads are worse than one” (p. 582). They showed in their studies that student teams set tighter confidence intervals compared to individual students when performing a quiz. This indicates that teams become surer about the correctness of answers than when they work individually. Besides this, Delfgaauw, Dur, Sol and Verbeke (2013) showed that the gender of the composition of teams affects team performance in a tournament setting. They ran a field experiment among a Dutch retail chain where they introduced a sales competition. There is strong evidence that performance increases when the manager of the team is of the same gender as a sufficiently high percentage of the other team members. One explanation for this is that female participants feel more comfortable working with individuals of the same gender in competitive environments, and males perceive male teammates as more competent, which affects performance positively.

When teams are more overconfident than individuals, a tournament contract would be even more attractive than piece-rate contract to teams than to individuals, because the overestimation and overplacement bias result in a higher overvalued expected utility of the tournament contract than the expected utility of the piece-rate contract. A low ability team that overestimate their performance more than an individual would do, have a higher likelihood of a overplacement bias than an individual that overestimates one’s ability. This results in a higher attractiveness of the tournament than the piece-rate contract. Despite that teams, in general, are more overconfident than individuals, an overestimation bias among teams does not necessary make the tournament contract more attractive than the piece-rate contract. It follows that overconfident teams tend to like tournaments more compared to overconfident individuals.

2.4 Control Variables

In this section, I elaborate on other mechanisms that can drive a preference for a pay-for-performance contract besides overconfidence. Many researchers indicate that females differ in their preferences compared to males in risk-taking behaviour and social behaviour.

It is well known that top executive functions are mostly represented by males. Bertrand and Hallock (2001) used a ExecuComp large data set to conclude that for the years 1992-1997 only 2.5% of the five-highest paid-out top executive functions are represented by females. The small representation of females in high executive functions can largely be explained by ability differences and discrimination. However, there are other explanations for this gender gap. Females differ in their preference to select into competitive environments. For example, males like tournaments because men are less risk-averse, less averse to feedback, and more overconfident than females (Niederle & Vesterlund, 2007). In their experimental research, overconfidence explained 38% of the gender gap to entry tournaments, although performance did not differ among gender. This indicates that females might be as good as men, but females do not entry competitive environments because of different preferences or characteristics.

Risk preference. Females tend to be more risk-averse than males, which results in less risky career choices by women (Croson & Gneezy, 2009). Most top executive functions require risky decision-making. Risk-averse managers are not preferable to the board of directors, which is an explanation for the minority of women in top positions. A study by Arch (1993) reviewed fifty studies and showed evidence that females are indeed more risk-averse than males. She claimed that risky environments are perceived as a challenge by men, but perceived as dangerous by woman. The gender difference in risk preferences is also observed in financial markets. Hinz, McCarthy and Turner (1997) conclude that the majority of females invested in minimum-risk stocks controlling for income, when looking at data of a federal government's Thrift Savings Plan in 1990. In another study, significant results showed that 44% of the boys choose to compete in a mathematical tournament, while only 19% of the girls self-selected into the math competition among a Swedish population (Cárdenas, Dreber, Von Essen, & Ranehill, 2012). In their experiment, participants had to choose whether they wanted to be paid-out according to a piece-rate scheme or a competition after performing a two-minute math test. The boys were more risk-seeking than the girls. Gardner and Steinberg (2005) conducted an experiment to answer the question if risk-preferences differ among individuals and teams. They found that groups take significant more risk than individuals, and the effect is stronger for males than females participating in a team. From these literatures, it follows that risky competitive environments are more attractive to risk-taking agents than to risk-averse agents.

In my theoretic model, a tournament contract involves more risk than the piece-rate contract, since the pay-out is uncertain in the tournament. Risk-neutral agents maximize expected utility under both contracts, and will be indifferent between both contracts when the probability of winning the tournament is 50%. Risk-lovers value the risk higher than risk-averse agents. This means that risk-seeking agents will be indifferent between both contracts when the probability of winning the tournament is lower than 50%, while risk-averse agents require a higher probability of winning the tournament of 50% to be indifferent between both contracts. This implies that risk-averse agents value the tournament less high than risk-seeking agents given the true probability of winning the tournament. Therefore, risk-preference affects sorting decisions.

Social Behaviour. A stereotype female cares more about others than males. This implies that the utility function of an agent includes pay-offs of peers. This holds more for females than males. In the literature, social behaviour is known as altruism. Individuals' altruism level can be described by a dictator game, where a participant is asked to divide an amount of money between him and another participant. Eckel and Grossman (1998) conducted an experiment to see what the gender differences are in a dictator game. Participants had to divide $10, and were anonymous to their pared recipient. They found that women give twice as much than men, which indicates that females show more social behaviour than males. Dufwenberg and Muren (2004) investigated altruistic behaviour of teams with different team compositions. Subjects were randomly assigned to a group, and were asked to divide an amount of money among their group members and one outside person who was part of another team. Female-majority teams donated significantly more money to the non-team member than male-majority teams. They rejected the null hypothesis that female-majority and male-majority groups make the same donations. This finding implies that females, but also teams, show more altruistic behaviour. Next, an experiment by Dohmen and Falk (2006) was designed to investigate whether individuals prefer competitive environment above risk-neutral environments, or not. Significant evidence was found that individuals who score a high altruism level in a trust game are more likely to self-select into a piece-rate contract than in a tournament, because participating in a tournament might lead to a negative externality on the loser of the tournament. A piece-rate contract is individually evaluated, and thus, does not harm other players.

An altruistic individual's utility function is negatively affect by negative utilities of others. In other words, the utility of an altruistic person decreases when the utility of another person goes down. The loser of the tournament receives zero pay-off, which decreases the utility of the tournament winner if he/she is an altruistic individual. Selfish competition winners face a higher tournament utility than altruistic competition winners. Social behaviour only affects the utility of a tournament contract, and not a piece-rate contract. A risk-neutral agent is indifferent between a piece-rate contract and a tournament when the probability of winning is equal to 50%. In that case, an altruistic risk-neutral agent would prefer a piece-rate contract above the tournament, because the agent does not like to harm his competitor. How more the agent cares about others, the more he would prefer a piece-rate contract above a tournament. However, low ability workers that are very altruistic might prefer to participate in a tournament, because the probability of winning the tournament is very low since ability is normally distributed with mean 0.5. In that case, self-selecting into the tournament helps the competitor to achieve a higher utility at the expense of one's utility. The positive utility of the competitor outweigh agent's loss in case the agent participated in the piece-rate. This unusual situation would not occur under the assumption that agents always care more about themselves than about others. Thus, reciprocal agents are less likely to self-select into a tournament than into a piece-rate contract.

2.5 Hypotheses

The aim of this research is to test whether overconfident individuals and teams sort into different pay-for-performance schemes. To answer the research question, I develop hypotheses to test with a controlled experiment. Theory predicts that an overestimation and overplacement bias result in a higher tournament expected utility than piece-rate expected utility. However, an overestimation bias does not necessary lead to a higher attractiveness of the tournament, although an overplacement bias does. By the literature, it is shown that teams are more overconfident than individuals. This implies that teams might prefer a tournament above a piece-rate contract more than individuals. Therefore, the following hypotheses will be tested:

H_1:	Individuals with an overestimation bias do not self-select more into tournaments than piece-rate contracts
H_2:	Individuals with an overplacement bias self-select more into tournaments than piece-rate contracts
H_3:	Teams with an overestimation bias sort more into tournaments than piece-rate contracts compared to individuals
H_4:	Teams with an overplacement bias sort more into tournaments than piece-rate contracts compared to individuals

As an extension to my research question, I test whether females and individuals are less overconfident than males and teams, and therefore, self-select into piece-rates. Besides this, I control for other mechanisms than overconfidence that can drive a preference for a compensation contract, like risk preference and social behaviour. Since tournaments involve more risk than a piece-rates, risk-averse agents value tournaments lower than a piece-rates compared to risk-seeking agents. Altruistic individuals dislike to harm others, which results in a lower attractiveness of the tournament compared to a piece-rate contract.

CHAPTER 3 Data & Methodology

3.1 Experimental Design

An answer to my research question is important for corporate policymakers to understand the effects of different incentives schemes on sorting behaviour of their employees. However, implementing pay-for-performance schemes in the field is a long-term project and very costly. It is not for sure that the new incentives exposed on employees have the expected effects, because in real-life performance, incentive strength, personal characteristics, and preferences cannot be perfectly measured. In this way, there is no clue which factors motivate employees to sort into different environments. For these reasons, I use a controlled experiment that makes me able to precisely define the incentives upon which participants can base their self-selecting decisions, and to measure individuals' characteristics, as well as preferences with a low measurement bias.

Participants of the experiment are asked to perform a work task consisting of mathematical questions individually, or in a two-person team. My focus group are Erasmus students, because these students are overall homogenous in characteristics. Respondents have to exert real effort, and have no perfect information about one's and peers' productivity. I choose for multiplying numbers as mathematical test, because the study by Dohmen and Falk (2006) indicates that this form of test is easy to explain, and students do not differ overall significantly in their productivity. Learning effects are not present in this experiment, because the experiment is a one-shot game.

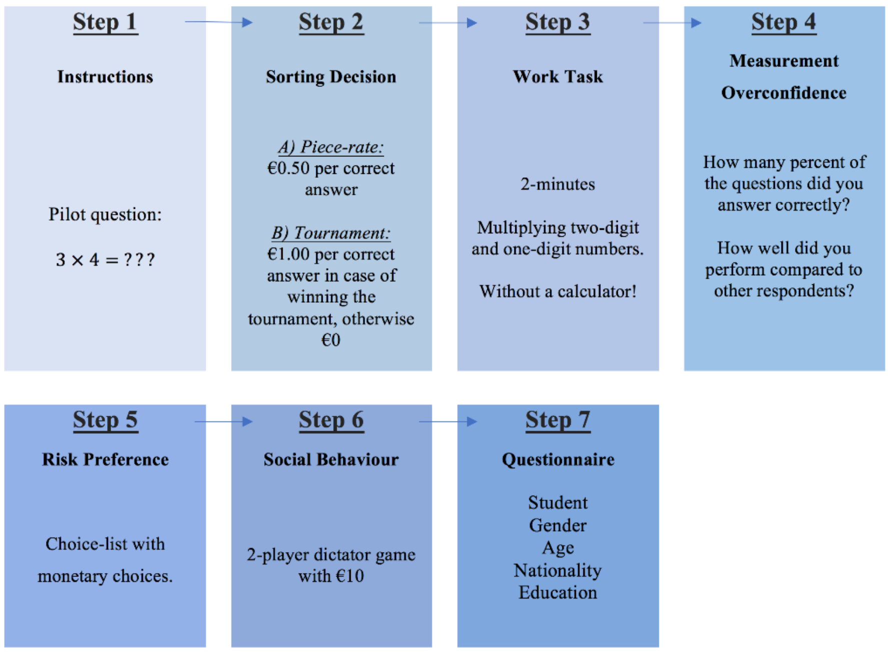

Figure 2: Experimental design

The experimental design consists of seven steps to study the effect of individual and team differences on incentive scheme sorting decisions (see Figure 2). In the first step, subjects receive instructions that they are going to solve as many as possible math questions in 2-minutes. However, a computerized dice is thrown to replicate a random negative shock. The number of eyes of the dice is subtracted from the number of correct answers in the 2-minute work task. This dice represents a performance measurement bias in real life. Agents' performance cannot be measured perfectly by principals in corporates. One participant is randomly chosen to be paid-out for real. Therefore, each subject has to choose how they want to be rewarded: a piece-rate contract, or a tournament contract. For simplicity, respondents are shown Figure 3 to summarize the experiment. Subjects are not allowed to use a calculator, only a pen and scratch paper. After the instructions, respondents receive examples of math question in order to guarantee that the participant fully understands the work task.

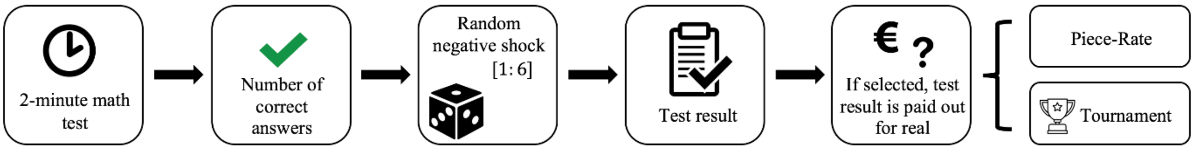

Figure 3: Summary experimental design

In step 2, the subjects are asked to choose between a piece-rate contract or a tournament to be rewarded for their upcoming performance. A piece-rate contract ensures a sure pay-out of €0.50 per correct answer (after correcting for the random negative shock) in the work task. A tournament pays-out €1.00 per correct answer in case the subject performs better than a randomly assigned anonymous competitor. When the two players in the tournament produced the same number of correct answers, the winner of the tournament is chosen with a random draw. By the reward structure of the piece-rate contract and the tournament, the subjects are incentivized to think hard enough about a question described by the dominance precept. A correct answer increases the subject's pay-out, and more is better than less, which means that the saliency and the non-satiation precept are satisfied with these incentives. Subjects remain anonymous to the other participants. This controlled experiment is meant to be parallel with the real world.

Step 3 consists of the work task, where subjects try to solve as many as possible questions correctly in a time limit of 2-minutes. Each subject receives the same work task with the same questions. The difficulty of the question increases per question, for example:

1.	3	×	4	=	???
2.	4	×	11	=	???
3.	12	×	10	=	???
4.	16	×	16	=	???

Figure 4: Examples experimental questions with increasing difficulty

By increasing the difficulty of the questions, high ability subjects distinguish from low ability, because high ability subjects can produce more questions in the same time limit than low ability workers. At the end of the experimental period, the winning subject is informed about his performance and competitor's performance in case of a tournament select by email, unless the subject decides to remain anonymous to the experimenter.

Step 4 of the experiment is meant to measure the level of overconfidence. First, respondents are asked to state how many percent of the questions they answered correctly. The difference between the stated and the actual percentage of correct answers is the level of an overestimation bias. A negative difference refers to underestimation bias, and a positive difference refers to an overestimation bias. To incentivize subjects to state their true belief, I reward the subject with an additional €2 when the difference between the stated and the true percentage of correct answers is zero. The larger the difference, the lower the additional reward:

$$additional\ reward_1(€) = -2|q|^2 + 2$$

where q is the difference between the stated and true percentage. This is a concave function. Secondly, to measure the level of the overplacement bias, I ask subjects to state their rank of the overall group in percentages, i.e. an answer as 10% means that the subject believes that he belongs to the top 10% best performers. The rank is relative to the whole group, because the subject is randomly matched to a competitor in case of a tournament. The level of the overplacement bias is the difference between the stated rank and true rank, where a negative outcome refers to overplacement, and a positive outcome to underplacement. Again, a problem could be that subjects do not think hard enough to state their true belief of rank. Subjects state a rank of 100% when the subjects are rewarded with a correctly stated rank, since the rank of one subjects always falls into a 100% rank. Therefore, to make subjects think hard enough, and let them state their true beliefs, subjects are paid following a concave function:

$$additional\ reward_2(€) = -2|q|^2 + 2$$

where q is the difference between the stated and the actual rank of a subject. Subjects are rewarded with an additional €2 when they have a perfect estimation of their rank. This €2 reward becomes less and less in case the subject is more biased.

To understand what other mechanisms than overconfidence drive a preference for a pay-for-performance scheme, participants are presented a choice list to measure their risk preferences (similar to Dohmen & Falk, 2006). A table with eleven rows consists per row a decision between a risk-free option and a risky lottery. The safe option (option A) consists of receiving €5 for sure, and the risky lottery (option B) consists of receiving €7 with probability p, and only €3 with probability $1 - p$. The risk-free option is the same in each row, but the probabilities of the lottery increases from row to row.

This choice list does not consist of many rows to keep it clear and understandable. Risk-averse individuals prefer a certain option to a risky option, while risk-seeking individuals prefer a risky option above a sure bet. Therefore, risk-averse agents switch at a higher row number from option A to option B compared to risk-seeking agents. The switching point reflects the subject's risk attitude. There are no incentives to motivate subjects to state their true switching point, but I assume that this choice list is easy to understand, and does not require a lot of effort, such that the results are accurate.

In step 6, I elicit subjects' social preferences with a dictator game (similar to Hoffman, McCabe & Smtih, 1996). Each player receives an imaginary €10 to divide between himself and another player. Both players are anonymous to each other. All players should state their amount of money that they are willing to transfer. Very altruistic individuals will transfer a higher amount of money to the other player. However, this dictator game is not incentive compatible, because no one receives the actual divided money. Since not all the resources are available to my experiment, I do not incentivize the subjects, because social behaviour is not the focus of this research. To avoid subjects to give non-accurate answers, I keep the dictator as simple as possible.

The final step consists of a questionnaire to give insights in subjects' personal characteristics, like gender, age, education, nationality, and whether they are a student or not. After the experimental period, I estimate per respondent how many questions are answered correctly, and throw a computerized dice to determine the negative shock. This experimental design is presented to individuals and teams. In case of a two-person team, all steps remain the same, and they must fill in all questions together by interacting with each other. In the final step, both subjects fill in their own personal characteristics separately. Next, I select one respondent and one team randomly to pay-out for real, and determine his/their pay-out including the additional rewards. I will pay-out nothing when the respondent did not leave his email address.

The experiment has a between-subject design with a control group consisting of subjects/teams that self-selected into piece-rates, and the treatment group consisting of subjects/teams that self-selected into tournaments. In this way, I compare the level of overconfidence of the control and the treatment group, controlling for risk preference and social preference. Dohmen and Falk (2006) used a similar mathematical work task among students. Their work task took 5-minutes of participants' time, and the median number of correct answers under a piece-rate treatment was 26, and under a tournament treatment 25. I expected the same productivity that my subjects generate around 10 correct answers within 2-minutes. This indicates that the maximum pay-out, given 10 correct answers with perfectly stated confidence intervals, equals around €15 euro. Thus, my maximum costs for this experiment is €30, which is realistic since I do not have all the available resources to pay-out all my respondents. In Appendix 3 my survey forms are shown.

3.2 Data Description & Methodology

3.2.1 Data Description

For detailed descriptive statistic, I refer to Appendix 1. I scheduled one week at the Erasmus University to ask subjects to fill in my survey individually or in a two-person team on my computer. In total 232 respondents participated in my experiment, including 70 teams and 92 individuals. I had to exclude six individuals and five teams from my dataset, because these respondents are not students, or switched more than once from option A to B in the "choice list" question, which indicates that they did not understand the question. The mean age of my sample is 21.84 years, and 86.11% is from Holland. The majority of the sample (59.26%) is studying for a bachelor degree, 37.96% for a master degree, and 2.78% are in their pre-masters. In total 82 males and 134 females represented my sample. The mean duration of the survey is 7.1 minutes for individuals, and 8.3 minutes for teams. A Mann-Whitney U test indicates that teams take significantly longer to finish the survey than individuals at a significance level of 5% ($N_1 = 86, N_2 = 65, p = 0.01$). Team consultation might be an explanation for this.

The work task consisted of a 2-minute during math test. The best performer of the whole sample answered 28 answers correctly, and the worst performer 0. This number of correct answers includes the random negative shock between one and six that lowers the number of correct answers. Therefore, the worst performer did not answer zero questions correctly, but the random negative shock resulted in zero correct answers. The performance of the whole sample is normally distributed with mean 12.57 (see Figure 5). A test that combines a skewness- and kurtosis test, shows this at a 5% confidence level ($p = 0.06$).

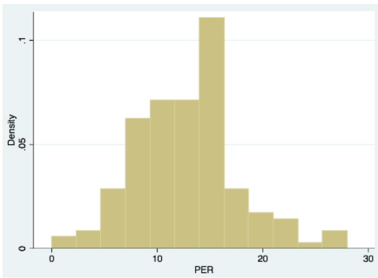

Figure 5: Normal distribution performance

Out of the 65 teams, 58.5% of the teams chose a piece-rate compensation contracts, and 41.5% a tournament contract, compared to 53.5% of the individuals that self-selected into a piece-rate contract, and 46.5% into a tournament. This suggests that teams slightly prefer a piece-rate more often than individuals. However, teams (56.9%) overestimate their own performance more than individuals (46.51%). Teams also overplace themselves more than individuals. The stated rank of teams was in 73.8% of the cases higher than their true rank, compared to 60.5% of the cases among individuals.

The data suggests that individuals and teams do not differ a lot in their risk preferences. Around 36% of the individuals and teams are risk-seeking, and 31% of the individuals compared to 36% of the teams are risk-averse. Out of the individuals, most males are risk-neutral or risk-averse, while most females are risk-seeking or risk-neutral. I cannot detect gender differences in risk preference among teams, because it is impossible to name the gender of a male-female team. The mean donation in the dictator game of individuals is €2.90, and €2.29 in teams. However, a Mann-Whitney U test indicates that female individuals donate significantly more compared to male individuals ($N_1 = 25, N_2 = 61, p = 0.0061$).

3.2.2 Statistical Methodology

In this section, I describe my statistical methodology to test the hypotheses. I use non-parametric tests, since my data consists of independent observations. Advantages of using this type of tests are that outliers have less impact, I can use a small sample size, and variables do not have to be of the interval scale. However, these tests are less powerful than parametric test, and it is harder to reject H_0 when it is false. Therefore, as an extension to my research I run a $probit$ model to estimate the effect of different variables on the probability of choosing a piece-rate or tournament contract.

First, I test whether females differ from males in performance, overestimation bias, overplacement bias, risk preference, social behaviour, and their compensation scheme decision. To test whether there are gender differences in performance, I run a non-parametric Mann-Whitney U test with the variables FEMALE and PIECE. In this way, I can conclude if my sample is equally well skilled in multiplying math questions. As the theory predicts, females are less overconfident than males. Therefore, a $2{\times}3$ Fisher Exact test indicates whether the distribution of the overconfidence level is equal for males and females, or not. To run the test, I use the variables EST and FEMALE, as well as PLACE and FEMALE. Next, $2{\times}3$ Fisher Exact tests with the variables PIECE and EST/PLACE should indicate whether overconfident agents sort more into tournaments than piece-rate contracts, or not. To find out whether females differ in their compensation scheme decisions, I run a $2{\times}2$ Fisher Exact test with variables PIECE and FEMALE. A Mann-Whitney U test with the variables PER and PIECE shows whether tournament choosers are better performers, or not.

Theory also predicts that risk-averse and altruistic individuals are more likely to choose a risk-free contract, like the piece-rate contract. The theory also suggests that a stereotype female is more risk-averse and altruistic than males. To test this, I use a $2{\times}3$ Fisher Exact test to indicate whether two samples are evenly distributed over three risk classes. More specific, I test whether the distribution of risk preference (RISK) is equal among women and men (FEMALE). The same test is used to show whether the distribution of the three different risk classes (RISK) are equally distributed among piece-rate contracts and tournament choosers (PIECE). A Mann-Whitney U test shows if the level of altruism differs in gender and compensation scheme decision. I use the variables ALT and FEMALE/PIECE.

Secondly, I test whether teams differ from individuals in performance, overestimation bias, overplacement bias, risk preference, social behaviour, and their compensation scheme decision. I run a Mann-Whitney U test with the variables PER and TEAM to indicate whether teams are better performers than individuals. Next, to detect differences in overconfidence among individuals and teams, I use two $2{\times}3$ Fisher Exacts tests with the variables TEAM and EST/PLACE. Theory suggests that when teams are more overconfident than individuals, teams should sort more into tournaments than piece-rate contracts. Therefore, I run a 2×2 Fisher Exact test with the variables PIECE and TEAM. Finally, I test whether teams differ from individuals in their risk preference and social behaviour. A 2×3 Fisher Exact test with the variables TEAM and RISK, and a Mann-Whitney U test with variables TEAM and ALT should show the differences between teams and individuals.

Despite I'm not sure whether my data satisfies the assumptions to perform a parametric test, I estimate the following model:

$$\Pr(PIECE = 1) = \phi(\beta_0 + \beta_1 PER_i + \beta_2 EST_i + \beta_3 EST_i \times TEAM_i + \beta_4 PLACE_i + \beta_5 PLACE_i \times TEAM_i + \beta_6 RISK_i + \beta_7 ALT_i + \beta_9 TEAM_i)$$

where

- $\Pr(PIECE = 1)$ = Probability of choosing a piece-rate contract compared to a tournament contract.
- PER_i = Performance of the work task of respondent i after negative random shock
- EST_i = Categorical variable that indicates whether respondent i has an underestimation bias (1), no bias (2), or overestimation bias (3)
- $PLACE_i$ = Categorical variable that indicates whether respondent i has an underplacement bias (1), no bias (2), or overplacement bias (3)
- $RISK_i$ = Categorical variable that indicates whether respondent i is risk-seeking (1), risk-neutral (2), or risk-averse (3)
- ALT_i = Donation (€) in the dictator game
- $TEAM_i$ = Dummy that indicates whether respondent i is part of a team (1), or not (0)

To estimate a *probit* model, I cannot use my variable FEMALE, because this variable has missing values. It is impossible to name the gender of female-male team. Observations are dropped in my analysis in case of missing values, because of a collinearity problem. Therefore, I do not include the gender variable in this analysis.

This model shows what the effects of performance, overconfidence, risk preference, social behaviour, and teams are on the probability of sorting into a piece-rate and tournament contract. Besides this, I include interaction effects to see whether team differences in the level of overconfidence determines a compensation contract decision. By interpreting the coefficients, I can draw ceteris paribus conclusions. To test the hypotheses, I use F-tests to test whether the coefficients are jointly significant. In case of rejection of H_0, I conclude that the variables have a significant effect on the probability of choosing a piece-rate compared to a tournament contract. I test the following hypotheses:

Hypothesis:	**Statistic:**	**In words:**
$H_0(1)$:	$\beta_2 = 0$	Being an individual with an over- or underestimation bias has no significant effect on the sorting decision.
$H_0(2)$:	$\beta_4 = 0$	Being an individual with an over- or underplacement bias has no significant effect on the sorting decision.
$H_0(3)$:	$\beta_3 = 0$	Being part of a team with an over- or underestimation bias has no significant effect on the sorting decision compared to an individual.
$H_0(4)$:	$\beta_5 = 0$	Being part of a team with an over- or underplacement bias has no significant effect on the sorting decision compared to an individual.

CHAPTER 4 Results

In this chapter, I apply my methodology to test the hypotheses, and discuss the results. I adhere a 5% significance level to interpret my results, and numbers are rounded off to two decimals. For full values, I refer to Appendix 2.

4.1 Non-parametric tests

4.1.1 Individuals

First, I use a Mann-Whitney U test to indicate whether there are gender differences in performance. The null hypothesis that the mean performance of females and males do not differ significantly is rejected ($N_1 = 25, N_2 = 61, p = 0.02$). Males tend to be better performers in the two-minute math test compared to females, because of a higher ability level.

The theory predicts that females are less overconfident than males. This is rejected by a Fisher Exact test with null hypothesis that the proportion of over- and underestimation bias among females and males are the same ($N_1 = 25, N_2 = 61, p = 0.00$). Relative more males have an overestimation bias than females. I do find that females tend to overplace their own performance more than males with another Fisher Exact test ($N_1 = 25,\ N_2 = 61, p = 0.03$). In summary, females underestimate and overplace their own performance more than males.

Following the theory, agent's overconfidence results in an overestimation of the probability of winning the tournament, which makes a tournament more attractive than a piece-rate contract in case the overestimated probability of winning is higher than 50%. An overestimation bias does not necessary drive this probability of winning above 50%, because agents can believe that they did better than they truly did, but this does not mean that they are automatically better than a random competitor. Therefore, I expect that agents with an overestimation bias are not more represented in the piece-rate contract than in the tournament.

Result 1:

An overestimation bias does not drive a preference for a compensation contract.

Support for result 1:

A 3×2 *Fisher Exact test shows that the occurrence of an underestimation, an overestimation, or no bias is equally distributed across the piece-rate and the tournament contract* ($N_1 = 67, N_2 = 84, p = 0.78$). *Thus, there is no relation between an overestimation bias and sorting into one type of compensation contract, taken each subjects' and teams' compensation contract decision independently. This result is in line with the theory. The test was run with the categorical variable EST and the dummy variable PIECE.*

A tournament contract is only more attractive when the probability of winning is higher than 50%. In case you overplace your rank, you believe that you are better than a random competitor. Thus, agents with an overplacement bias are more represented in the tournament contract than in the piece-rate contract.

Result 2:
An overplacement bias does not drive a preference for a compensation contract.

Support for result 2:
A 3×2 *Fisher Exact test shows that the occurrence of an underplacement, overplacement, or no bias is equally distributed across the piece-rate and the tournament contract* $(N_1 = 67, N_2 = 84, p = 0.97)$. *Agents with an overplacement bias do not sort more into the tournament than the piece-rate contract. This is not in line with the theory. The test was run with the categorical variable PLACE and the dummy variable PIECE. These variables are measured both on the individual and team level independently.*

Previous findings showed that females tend to overplace themselves more than males, but the Fisher Exact test indicated that an overplacement bias does not drive a preference for a compensation contract. Thus, females and males should sort equally in piece-rate contracts and tournaments. The result of another Fisher exact test is that indeed, females and males are equally represented in both contracts $(N_1 = 40, N_2 = 46, p = 0.15)$. Although this is not in line with the theory, an explanation could be that the two-minute work task results in a mind-set change of the agent. Before the two-minute math test, subjects are asked to choose a compensation contract without a feeling of how they are going to perform. After the work task, they are asked to state their confidence intervals, but now they do have a feeling about their performance. For example, an agent is (over)confident about his ability beforehand, and chooses a tournament contract, but the two-minute work task was harder than expected. The agent is not (over)confident anymore, and ranks his performance lower than he expected before the work task. This indicates that tournament choosers only remain (over)confident when the two-minute work task went well. I use a Mann-Whitney U test to test whether the mean of performance is equal among piece-rate and tournament choosers. The sum of the ranks of performance is higher than expected for tournament choosers than piece-rate choosers, which means that high ability agents tend to choose tournaments, because good performance result in a higher probability of winning the tournament. Low ability agents tend to prefer a piece-rate contract. The null hypothesis that agents sort equally over piece-rates and tournaments independently of performance is rejected with a Mann-Whitney U Test $(N_1 = 67, N_2 = 84, p = 0.04)$.

Tournaments are riskier than piece-rates. Therefore, piece-rate contracts are more attractive to risk-averse agents, while tournaments are preferable by risk-seeking agents. In my sample, there are no gender differences in risk preference. A Fisher Exact test shows that the distribution of risk preference is equal among females and males ($N_1 = 25, N_2 = 61, p = 0.14$). Yet, the proportion of risk-averse agents in a piece-rate contract is significantly higher than the proportion of risk-seeking agents in a piece-rate contract ($N_1 = 67, N_2 = 84, p = 0.04$). This means that piece-rate contracts are preferred by risk haters, and tournaments by risk lovers.

Choosing a piece-rate contract does not put any negative externality on other agents. Theory predicts that altruistic agents prefer a piece-rate contract above a tournament, and vice versa for selfish agents. Females are more altruistic than males (Mann-Whitney U test, $N_1 = 25, N_2 = 61, p = 0.01$). However, females do not sort more into piece-rate contracts than tournament, which means that gender alone does not drive a preference for a certain compensation scheme. As predicted by the theory, more altruistic agents sort more into piece-rate contracts than tournaments (Mann-Whitney U test, $N_1 = 67, N_2 = 84, p = 0.01$).

4.1.2 Teams

A Mann-Whitney U test shows that individuals and teams do not differ in their ability in solving math questions ($N_1 = 86, N_2 = 65, p = 0.95$). Both groups have a mean performance of 12 questions in two-minutes. I expected that teams are better performers than individuals, because two minds are better than one. However, in a team it could be that ability differences within the team result in a separation of tasks during the two-minute work task, i.e. one person is responsible for all calculations, and one person for filling in the answers. In that case, the two agents stop solving questions together, and have a limited benefit of working in a team.

A Fisher Exact test shows that the proportion of over- and underestimation bias among individuals and teams do not differ significantly ($N_1 = 86, N_2 = 65, p = 0.08$). This suggest that individuals and teams are both equally able to estimate their own performance. The same holds for an overplacement bias. A Fisher Exact test shows that the proportion of the over- and underplacement bias in teams does not differ significantly from individuals ($N_1 = 86, N_2 = 65, p = 0.25$). In summary, teams do not differ in their level of overconfidence compared to individuals. Following the theory, it is a surprise that teams are not more overconfident than individuals. An explanation for this finding could be that teams start doubting about their performance because of interaction. An individual has a strong feeling about his own performance, and quickly states the percentage of correct answers or his rank. Contradicting, teams start to interact and start doubting about their performance. Another explanation could be that teams read survey questions more concentrated than individuals, because of team pressure. This results in a better understanding of the additional pay-off in case the team states correctly their percentage of correct answers or rank, which makes agents to think harder. Individuals tend to finish the survey quicker.

The theory points out that a tournament is more attractive than a piece-rate contract, when the probability of winning the tournament is higher than 50%. This probability of winning is overestimated by overconfident agent, and is more likely to be expected as higher than 50%. Therefore, a tournament should be more attractive by teams than individuals, since teams are expected to be more overconfident than individuals.

Result 3:
Teams do not sort more into tournaments than into piece-rate contracts.

Support for result 3:
A 2×2 *Fisher Exact test does not reject the null hypothesis that the proportion of teams and individuals is equal among both contracts* $(N_1 = 67, N_2 = 84, p = 0.62)$. *This is not in line with the theory. The test was run with the dummy variables TEAM and PIECE. This test draws conclusions on the individual and team level, where decisions are measured independently.*

This finding is not surprising, because a previous finding indicated that teams are not more overconfident than individuals. Working in a team does not have a significant effect on the sorting decision compared to an individual, because teams do not differ from individuals in their level of overestimation and/or overplacement bias.

Lastly, teams do not differ from individuals in their risk preference. This is tested with a Fisher Exact test $(N_1 = 86, N_2 = 65, p = 0.69)$. Besides this, a Mann-Whitney U test indicates that teams also do not differ from individuals in their social behaviour $(N_1 = 86, N_2 = 65, p = 0.07)$. Therefore, teams should not be more present in one type of contract, which is confirmed by result 3.

4.2 Parametric tests

Categorical variables should be specified to estimate a *probit* model. I specify the following variables:

- dEST1 dummy that takes value 1 in case a subject has an underestimation bias
- dEST2 dummy that takes value 1 in case a subject has no under- or overestimation bias
- dEST3 dummy that takes value 1 in case a subject has an overestimation bias
- dPLACE1 dummy that takes value 1 in case a subject has an underplacement bias
- dPLACE2 dummy that takes value 1 in case a subject has no under- or overplacement bias
- dPLACE3 dummy that takes value 1 in case a subject has an overplacement bias

- dRISK1 dummy that takes value 1 in case a subject is risk-seeking
- dRISK2 dummy that takes value 1 in case a subject is risk-neutral
- dRISK3 dummy that takes value 1 in case a subject is risk-averse

Besides this, a base category should be left out of the equation to draw relative ceteris paribus conclusions. I choose dEST3, dPLACE3, and dRISK1 as base categories, because these variables include most observations. The estimation of the parameters of the *probit* model are summarized in the following equation:

$$\begin{aligned}\Pr\,(PIECE = 1) \\ &= \phi(0.54 - 0.10PER_i - 0.09dEST1_i + 0.10dEST1_i \times TEAM_i - 0.51dEST2_i \\ &+ 1.75dEST2_i \times TEAM_i + 0.16dPLACE1_i + 1.25dPLACE1_i \times TEAM_i \\ &+ 0.53dPLACE2_i - 0.11dPLACE2_i \times TEAM_i + 0.41dRISK2_i + 0.84dRISK3 \\ &+ 0.12ALT_i - 0.19TEAM_i)\end{aligned}$$

Complete parameter values, standard errors, and p-values are shown in table 2.

Table 2: Estimation Probit Model with Dependent Variable PIECE

PIECE		Coef.	Std. Err.	p-value
PER	β_1	-0.096	0.032	0.003***
dEST1	β_2	-0.091	0.305	0.765
dEST1*TEAM	β_3	0.099	0.508	0.845
dEST3	β_4	-0.507	0.779	0.515
dEST3*TEAM	β_5	1.748	1.000	0.080*
dPLACE1	β_6	0.162	0.405	0.689
dPLACE1*TEAM	β_7	1.254	0.615	0.042**
dPLACE3	β_8	0.526	0.568	0.354
dPLACE3*TEAM	β_9	-0.106	0.962	0.913
dRISK1	β_{10}	0.408	0.276	0.139
dRISK3	β_{11}	0.835	0.281	0.003***
ALT	β_{12}	0.120	0.056	0.033**
TEAM	β_{14}	-0.193	0.340	0.571
_cons	β_0	0.538	0.459	0.241

* 10% significance level
** 5% significance level
*** 1% significance level

I only interpret the sign of the significant parameters at a 5% significance level. For more specificity, I estimate the margins to interpret the magnitude of the parameters. Estimations of the margins are shown in Table 3 (see next page).

I conclude that performance has a negative significant effect on the predicted probability of sorting into a piece-rate contract compared to a tournament contract, ceteris paribus. More specific, an additional correct answer decreases the predicated probability of choosing a piece-rate contract compared to a tournament contract by 0.03% points, ceteris paribus. Better performers are more likely to choose a tournament than a piece-rate contract. However, causality is not guaranteed. It is not sure that tournament choosers are more likely to perform better, or vice versa. For example, tournament choosers are aware that they only receive a reward in case they perform better than a competitor, while piece-rate choosers are sure about their payment. Therefore, agents under a piece-rate contract might be less focused than agents under a tournament contract. The type of contract could in this way influence the performance of agents.

Table 3: Estimation Margins Probit Model with Dependent Variable PIECE

		dy/dx	**Std. Err.**	**p-value**
PER	β_1	-0.032	0.010	0.001***
dEST2	β_2	-0.030	0.100	0.765
dEST2*TEAM	β_3	0.033	0.167	0.845
dEST3	β_4	-0.167	0.255	0.514
dEST3*TEAM	β_5	0.574	0.320	0.073*
dPLACE2	β_6	0.053	0.133	0.668
dPLACE2*TEAM	β_7	0.412	0.194	0.034**
dPLACE3	β_8	0.173	0.185	0.349
dPLACE3*TEAM	β_9	-0.035	0.316	0.912
dRISK2	β_{10}	0.134	0.089	0.131
dRISK3	β_{11}	0.274	0.085	0.001***
ALT	β_{12}	0.039	0.018	0.026**
TEAM	β_{14}	-0.063	0.111	0.570

* 10% significance level
** 5% significance level
*** 1% significance level

Secondly, I conclude that being part of a team without an overplacement bias has a significant positive effect on the likelihood of choosing a piece-rate contract above a tournament. Woking in a team with no overplacement bias decreases the predicted probability of choosing a piece-rate contract above a tournament contract by 0.41% points compared to teams with an under- or overestimation bias, ceteris paribus. Thus, no overplacement bias among teams does make a tournament more attractive than a piece-rate contract. This finding contradicts the theory. However, again I cannot guarantee that my data satisfies the zero conditional mean. Reverse causality might be an issue here, because it could be that the type of compensation contract makes agents more or less overconfidence, instead that the level of overconfidence drives a compensation scheme preference. For example, an agent expects a high performance, but this expectation changed after the measurement period. He performed worse than expected. This lower performance than expected is valued more negative by a tournament chooser than a piece-rate contract chooser, since low performance is costlier in a tournament setting. Therefore, the type of compensation contract could result in an underplacement bias after information about one's performance is received. This reverse causality problem could bias my conclusions. Besides this, an omitted variable bias is my concern here. For example, agents might prefer a piece-rate contract above a tournament contract, because they do not like self-evaluation. Participating in a tournament results in an outcome relative to others, while agent's performance under a piece-rate contract remains anonymous. A piece-rate contract is preferred above a tournament by agents who do not like to be compared to other agents. On the other hand, teams work together and evaluate each other. This might result in a higher level of team's overestimation bias, because feedback results in better performance. Thus, self-evaluation could result in more attractiveness of one type of compensation contract, but also to a higher level of team's overconfidence.

Thirdly, being a risk-averse agent compared to a risk-seeking agent increases the predicted probability of choosing a piece-rate contract instead of a tournament by 0.27% points, ceteris paribus. This is in line with the theory that risk-free piece-rates are more attractive to risk-haters, and risky tournaments are preferred by risk-lovers. Reverse causality or an omitted variable bias is not in major concern. I assume that choosing a type of compensation scheme does not influence your risk preference.

Lastly, social behaviour has a significant effect on the probability of choosing a compensation scheme. Donating one euro more to another player in the dictator game increases the predicated probability of choosing a piece-rate contract compared to a tournament contract by 0.04% points, ceteris paribus. Thus, agents that care more about others are more likely to sort into contracts that do not put negative externalities on others. Causality might be a concern here. Altruism does not necessary result in choosing a piece-rate contract instead of a tournament, but piece-rate contract choosers might become more altruistic than tournaments choosers. This reverse causality problem seems to be not very logical, but I'm not able to test this with my data.

I conclude from this non-parametric test that only performance, team's perfect ability to state their rank, risk preference, and social preference are the drivers of a compensation scheme preference, although reverse causality might be a concern. I cannot find any evidence for my hypotheses that overconfident agents and teams are more likely to sort into tournaments than piece-rate contracts. Therefore, I prefer to use the non-parametric tests to test the hypotheses, since these tests are more applicable to small samples that are not normally distributed.

CHAPTER 5 Discussion & Limitations

As expected beforehand, I cannot find any support for my hypotheses, because this research contains several limitations. Firstly, the setup of my survey was not perfect. I should have asked respondents to choose their compensation scheme after the two-minute work task, instead of beforehand. In this way, both the decision and the level of overconfidence are affected by respondents' performance. Secondly, my respondents were not fully extrinsically motivated to state their true beliefs, because the chance of winning real money is small. Of course, some respondents were reciprocal to me and read the survey questions concentrated. I also did not have all the available resources to set up a lab experiment to guarantee that all subjects do not use a calculator to solve the math questions. As a result, it could be that the level of overconfidence is biased. Besides this, the team setting of my experiment was not perfect. Teams did not take the opportunity to work together that would benefit their performance, because of the time limit. Respondents were stressed, and did not focus on the questions anymore.

The process of data collection was also not optimal. To ask respondents to fill in my survey in two-person teams, I had to visit the Erasmus University with my laptop. Because of limited time to collect data and the slow process with only one laptop available, I could only analyse a small sample. With a larger sample size, it would be easier to draw conclusion. Another pitfall is that my data has a selection bias, because unconsciously I tend to ask only people that I know or look kind to participate in my experiment. Thus, my data is not completely random, which can bias my results. Because I also asked random students to fill in my survey, some of them became irritated. Filling in the survey, I saw that they did not concentrate on questions, because they were busy with their studies.

I tested by data with a between-subject design. However, with this design I cannot guarantee causality. For further research or as an improvement to my research, I would suggest to use a within-subject design. I propose a two-stage experiment where subjects first have to solve math questions under a piece-rate contract (control group). In the second stage, participants are asked to choose between a piece-rate or tournament contract, and perform another mathematical test. Tournament chooser represents the treatment group. In both stages respondents have to state their confidence intervals. This difference-in-difference analysis allows to detect causality.

For improvements to my thesis, I would suggest to measure respondents' level of overconfidence differently than I did in my experiment. I propose to ask respondents to state their confidence interval per question separately, as well as their rank relative to other participants. In this way overconfidence is measured much more precisely. I tested this way of measurement in my pilot version of my survey. The problem was that only the number of correct answers in the math test are rewarded. Therefore, subjects do not state their true beliefs of confidence intervals, because of the time limit. To deal with this problem, I designed an incentive function to make respondents think hard enough. However, this was way too difficult to understand by the pilot respondents. My own experience showed me that survey respondents only wish to finish the survey as fast as possible. To guarantee that the respondents fully understands the incentives put on the overconfidence questions, they had to read very carefully. This will never happen in real life, thus, I decided to leave out this measurement method. In case of a lab experiment, I would recommend to use it instead.

Finally, external validity is of my concern. I used a one-shot experiment for simplicity, but this is not realistic. Employees do have an accurate feeling of how they perform at work, and are more capable to estimate their chances to win tournaments. Employees have years of experience to set accurate expectancies to base their compensation scheme decision on. Respondents in my survey had no idea how difficult the two-minute work task would be, and choose their compensation scheme on intuition. For further research, it would be very interesting to test the same research question in a natural field experiment.

CHAPTER 6 Conclusion

This chapter summarizes the results to answer the research question: "Do overconfident individuals and teams sort into different pay-for-performance schemes?". Previous literature indicated that there are different mechanisms of overconfidence: overestimation and overplacement. Building on the existing literature, I developed a model to point out when overconfident agents prefer to sort into different pay-for-performance schemes. Based on my theoretic model, I conducted a controlled experiment among Erasmus University students to test the hypotheses. Male respondents were better performers in solving math problems than females, but teams did not differ in their performance from individuals. Although the literature suggested it, I cannot find any evidence in my sample that males and teams are more overconfident than females and individuals. Individuals might have a strong feeling about their performance beforehand, and are able to directly state their level of confidence without thinking too much. Contradicting, teams start to discuss their performance that makes them more insecure. Besides that there are no differences in the level of overconfidence among different classes, I do find evidence for my first hypothesis: "Individuals with an overestimation bias do not self-select more into tournaments than piece-rate contracts". Agents with this bias overestimate their performance, but this does not automatically result in a perceived probability of winning the tournament higher than 50%. The expected utility of a tournament is only higher than the expected utility of a piece-rate contract when the probability of winning is higher than 50%. Therefore, a biased perception of own performance does not make agents to sort into competitive environments. Analysing teams, I cannot find any support that teams with an overestimation bias sort more into tournaments than individuals, because previous results showed that teams did not differ in their overconfidence level from individuals.

The theory suggested that agents perceive the probability of winning the tournament as higher as 50% when agents believe that they will perform better than others. Controlling for risk preference and social behaviour, an overplacement bias could make an agent to choose the competitive environment instead of the piece-rate contract. I cannot find any support for this theoretic claim. Individuals and teams do not sort more into a tournament contract than a piece-rate contract, because of a biased perception of performance rank. This result could be explained by the structure of the survey. Overconfident or rational high ability agents choose a tournament above the piece-rate scheme, but after the two-minute work task they become insecure about their performance, because the task was harder than expected. In case the task met the expectations, an agent would not adapt his level of overconfidence. Therefore, agents only remain overconfident when the two-minute work task went well. The level of overconfidence would be in line with the compensation scheme decision, in case the "pay-for-performance scheme" question was asked after the two-minute work task. This is a limitation to my research.

I do find empirical evidence that performance is related to sorting behaviour. Low ability agents tend to prefer piece-rate contracts, and high ability agents choose tournaments. Besides this, evidence has shown that risk-seeking and altruistic agents sort more into the competitive environment than into the risk-free piece-rate scheme. In summary, I cannot conclude that overconfident individuals, as well as teams, sort into different compensation schemes. This is not in line with previous research, but this thesis provides interesting insights in overconfident decision-making processes and pay-for-performance contract designs.

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APPENDIX

1. Descriptive Statistics

Descriptive Statistic 1: Mean Age

Variable	Obs.	Mean	Std. Dev	Min	Max
Age	216	21.847	2.345	16	30

Descriptive Statistic 2: Frequencies Nationality

Nationality	Freq.	Percent	Cum.
American	1	0.46	0.46
Austrian	1	0.46	0.93
Croatian	1	0.46	1.39
Czech	1	0.46	1.85
Dutch	183	86.11	87.96
Filipino	1	0.46	88.42
French	2	0.93	89.35
German	6	2.78	92.13
Greek	7	3.24	95.37
Indonesia	3	1.39	96.76
Polish	1	0.46	97.22
Russia	2	0.93	98.15
Slovenian	1	0.46	98.61
Spanish	3	1.39	100
Total	216	100.00	

Descriptive Statistic 3: Frequencies Education

Education	Freq.	Percent	Cum.
Bachelor	128	59.26	59.26
Master	82	37.96	97.22
Pre-Master	6	2.78	100.00
Total	216	100.00	

Descriptive Statistic 4: Frequencies Female

Female	Freq.	Percent	Cum.
0	82	37.96	37.96
1	134	62.04	100.00
Total	216	100.00	

Descriptive Statistic 5: Mean Duration Survey of Individuals and Teams

Variable	Obs.	Mean	Std. Dev	Min	Max
Duration(s) if TEAM=0	86	428.884	225.072	174	1803
Duration(s) if TEAM=1	65	497.785	249.516	172	1653

Descriptive Statistic 6: Mann-Whitney U Test Duration Survey vs. Team

TEAM	Obs.	Rank Sum	Expected
0	86	5794.5	6536
1	65	5681.5	4940
combined	151	11476	11476
	z	=	-2.787
	Prob > |z|	=	0.0053

Descriptive Statistic 7: Mean Performance (number of correct answers)

Variable	Obs.	Mean	Std. Dev	Min	Max
Performance	151	12.570	4.906	0	28

Descriptive Statistic 8: Test if Performance is Normally Distributed

Variable	Obs.	Pr(Skewness)	Pr(Kurtosis)	Adj. Chi2	Prob>Chi2
Performance	151	0.079	0.113	5.49	0.0641

Descriptive Statistic 9: Tabulate Teams vs. Compensation Contract

	PIECE		
TEAM	0	1	Total
0	40	46	86
1	27	38	65
Total	67	84	151

Descriptive Statistic 10: Tabulate Teams vs. Overestimation Bias

	TEAM		
EST	0	1	Total
1	42	21	63
2	4	7	11
3	40	37	77
Total	86	65	151

Descriptive Statistic 11: Tabulate Teams vs. Overplacement Bias

	TEAM		
PLACE	0	1	Total
1	25	12	37
2	9	5	14
3	52	48	100
Total	86	65	151

Descriptive Statistic 12: Tabulate Teams vs. Risk Preference

	TEAM		
RISK	0	1	Total
1	31	24	55
2	28	17	45
3	27	24	51
Total	86	65	151

Descriptive Statistic 13: Tabulate Gender vs. Risk Preference

	FEMALE		
RISK	0	1	Total
1	5	26	31
2	10	18	28
3	10	17	27
Total	25	61	86

Descriptive Statistic 14: Mean Donation in Dictator Game

Variable	**Obs.**	**Mean**	**Std. Dev**	**Min**	**Max**
Altruism	151	2.640	2.080	0	10

Descriptive Statistic 15: Mann-Whitney U Test Female vs. Social Behaviour

FEMALE	**Obs.**	**Rank Sum**	**Expected**
0	25	801	1087.5
1	61	2940	2653.5
combined	86	3741	3741
	z	=	-2.742
	Prob > |z|	=	0.0061

2. Non-Parametric Tests

2.1 Individual Compensation Scheme Analysis

Result 1: Mann-Whitney U Test Performance vs. Female

FEMALE	Obs.	Rank Sum	Expected
0	25	1334.5	1087.5
1	61	2406.5	2653.5
combined	86	3741	3741
	z	=	2.354
	Prob > |z|	=	0.0186

Result 2: Fisher Exact Test Female vs. Over- and Underestimation

	FEMALE		
EST	0	1	Total
1	8	34	42
2	4	0	4
3	13	27	40
Total	25	61	86
	Fisher's exact	=	0.004

Result 3: Fisher Exact Test Female vs. Over- and Underplacement

	FEMALE		
PLACE	0	1	Total
1	12	13	25
2	3	6	9
3	10	42	52
Total	25	61	86
	Fisher's exact	=	0.029

Result 4: Fisher Exact Test Piece-rate Contract vs. Over- and Underestimation

	PIECE		
EST	0	1	Total
1	30	33	63
2	5	6	11
3	32	45	77
Total	67	84	151
	Fisher's exact	=	0.767

Result 5: Fisher Exact Test Piece-rate Contract vs. Over- and Underplacement

	PIECE		
PLACE	0	1	Total
1	17	20	37
2	6	8	14
3	44	56	100
Total	67	84	151
	Fisher's exact	=	0.967

Result 6: Fisher Exact Test Female vs. Piece-rate Contract

	FEMALE		
PIECE	0	1	Total
0	15	25	40
1	10	36	46
Total	25	61	86
	Fisher's exact	=	0.153
	1-sided Fisher's exact	=	0.086

Result 7: Mann-Whitney U Test Performance vs. Piece-rate Contract

PIECE	Obs.	Rank Sum	Expected
0	67	5652	5092
1	84	5824	6384
combined	151	11476	11476
	z	=	2.103
	Prob > |z|	=	0.0355

Result 8: Fisher Exact Test Risk Preference vs. Female

	RISK			
FEMALE	1	2	3	Total
0	5	10	10	25
1	26	18	17	61
Total	31	28	27	86
		Fisher's exact	=	0.138

Result 9: Fisher Exact Test Risk Preference vs. Piece-rate Contract

	RISK			
PIECE	1	2	3	Total
0	31	20	16	67
1	24	25	35	84
Total	55	45	51	151
		Fisher's exact	=	0.036

Result 10: Mann-Whitney U Test Social Behaviour vs. Female

FEMALE	Obs.	Rank Sum	Expected
0	25	801	1087.5
1	61	2940	2653.5
combined	86	3741	3741
	z	=	-2.742
	Prob > |z|	=	0.0061

Result 11: Mann-Whitney U Test Social Behaviour vs. Piece-rate Contract

PIECE	Obs.	Rank Sum	Expected
0	67	4357.5	5092
1	84	7118.5	6384
combined	151	11476	11476
	z	=	-2.767
	Prob > |z|	=	0.0057

2.2 Team Compensation Scheme Analysis

Result 12: Mann-Whitney U Test Performance vs. Team

TEAM	Obs.	Rank Sum	Expected
0	86	6519.5	6536
1	65	4956.5	4940
combined	151	3741	3741
	z	=	-0.062
	Prob > |z|	=	0.9504

Result 13: Fisher Exact Test Team vs. Over- and Underestimation

	TEAM		
EST	0	1	Total
1	42	21	63
2	4	7	11
3	40	37	77
Total	86	65	151
	Fisher's exact	=	0.083

Result 14: Fisher Exact Test Female vs. Over- and Underplacement

	FEMALE		
PLACE	0	1	Total
1	12	13	25
2	3	6	9
3	10	42	52
Total	25	61	86
	Fisher's exact	=	0.029

Result 15: Fisher Exact Test Team vs. Over- and Underplacement

	TEAM		
PLACE	0	1	Total
1	25	12	37
2	9	5	14
3	52	48	100
Total	86	65	151
	Fisher's exact	=	0.252

Result 16: Fisher Exact Test Team vs. Piece-rate Contract

	TEAM		
PIECE	0	1	Total
0	40	27	67
1	46	38	84
Total	86	65	151
	Fisher's exact	=	0.620
	1-sided Fisher's exact	=	0.329

Result 17: Fisher Exact Test Risk Preference vs. Team

	RISK			
TEAM	1	2	3	Total
0	31	28	27	86
1	24	17	24	65
Total	55	45	51	151
		Fisher's exact	=	0.686

Result 18: Mann-Whitney U Test Social Behaviour vs. Team

TEAM	**Obs.**	**Rank Sum**	**Expected**
0	86	7018	6536
1	65	4458	4940
combined	151	11476	11476
	z	=	1.822
	Prob > |z|	=	0.0685

3. Instruction Forms Experiment

3.1 Survey Individuals

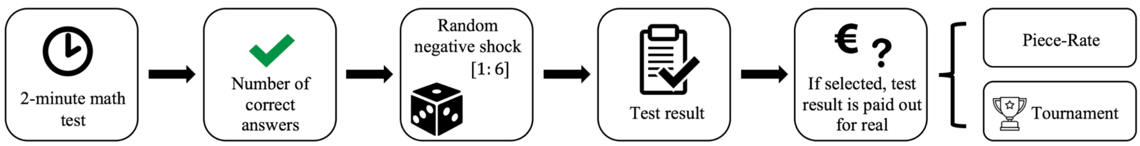
Dear responder,

Thank you for participating! I would like to notify you that your answers are anonymous and will be treated carefully. In order to draw valid conclusions, I would ask you to be as honest as possible, **because one participant is actually going to be paid-out!**

Instructions:

1. You are going to solve together as many as possible math questions in 2-minutes (WITHOUT A CALCULATOR)
2. A random negative shock between 1 and 6 lowers your number of correct answers.
3. One team is randomly selected to be paid-out for real!
4. You can choose how your test result is paid-out:
    a. **Piece-Rate:** €0.50 per correct answer
    b. **Tournament:** €1 per correct answer, but only when you are a better performer than a randomly chosen competitor.

Summarized:



The two-minute math test looks like:

4 * 7 = ???

7 * 5 = ???

The difficulty increases per question.

One participant is randomly chosen to be paid-out for real! How would you like to be paid-out?

- ❍ **Piece-Rate**: €0.50 per correct answer
- ❍ **Tournament**: €1.00 per correct answer, <u>BUT ONLY</u> when you are a better performer than a randomly chosen competitor.

The 2-minute work task is going to start! Please **do not** use a **calculator**. You are allowed to use scratch paper and a pen.

You can trust me that I'm not going to use a calculator.

- ❍ Yes
- ❍ No

When you **click next**, the test is going to start. It doesn't matter when you are not able to answer all questions! Good luck!

Q1	6×9 = ???	
Q2	7×6 = ???	
Q3	7×8 = ???	
Q4	13×7 = ???	
Q5	11×4 = ???	
Q6	15×7 = ???	
Q7	13×9 = ???	
Q8	18×3 = ???	

Q9	$17 \times 7 = ???$	
Q10	$14 \times 5 = ???$	
Q11	$12 \times 6 = ???$	
Q12	$16 \times 8 = ???$	
Q13	$19 \times 2 = ???$	
Q14	$21 \times 8 = ???$	
Q15	$27 \times 6 = ???$	
Q16	$23 \times 4 = ???$	
Q17	$28 \times 3 = ???$	
Q18	$22 \times 9 = ???$	
Q19	$25 \times 7 = ???$	
Q20	$24 \times 15 = ???$	
Q21	$26 \times 20 = ???$	
Q22	$30 \times 18 = ???$	
Q23	$36 \times 3 = ???$	
Q24	$37 \times 4 = ???$	
Q25	$34 \times 8 = ???$	

Q26	38×3 = ???	
Q27	33×7 = ???	
Q28	36×6 = ???	
Q29	35×9 = ???	
Q30	32×5 = ???	
Q31	39×2 = ???	
Q32	37×11 = ???	
Q33	34×15 = ???	
Q34	38×18 = ???	
Q35	33×14 = ???	

That was it! Time Flies. Please continue.

Please rate how many percent of the questions you answered correctly. Don't take into account the questions you didn't answer because of the time-limit.

You receive an **additional pay-out of €2** when your **stated percentage** is exactly your **true percentage**. You earn **less and less than €2** when the deviation between your stated and true performance increases.

How well did you perform?

I answered ....% of the questions correctly.

0 10 20 30 40 50 60 70 80 90 100

%

Please rate you rank.

You receive an additional **pay-out of €2** when your **stated rank** is exactly your **true rank**. You earn **less and less than €2** when the deviation between your stated and true rank increases.

The <u>lower</u> the percentage, the <u>better</u> you perform.

Thus, "I belong to the top **10%** of the group" means that you did the test very well!
And, "I belong to the top **100%** of the group" means that you did the test very bad!

How well did you perform compared to other respondents?

I belong to the top ....% of the group:

100 90 80 70 60 50 40 30 20 10 0

Rank

Imagine you participate in a lottery. You have to choose between a sure option and a risky option. Please choose for each row either option A or B according to your preferences.

Note that you are only allowed to **SWITCH** your answers between columns A and B **ONCE**!

			Option A	Option B
A)	100% chance to win €5	B) 0% chance to win €7 and 100% chance to win €3	❍	❍
A)	100% chance to win €5	B) 10% chance to win €7 and 90% chance to win €3	❍	❍
A)	100% chance to win €5	B) 20% chance to win €7 and 80% chance to win €3	❍	❍
A)	100% chance to win €5	B) 30% chance to win €7 and 70% chance to win €3	❍	❍
A)	100% chance to win €5	B) 40% chance to win €7 and 60% chance to win €3	❍	❍
A)	100% chance to win €5	B) 50% chance to win €7 and 50% chance to win €3	❍	❍
A)	100% chance to win €5	B) 60% chance to win €7 and 40% chance to win €3	❍	❍
A)	100% chance to win €5	B) 70% chance to win €7 and 30% chance to win €3	❍	❍
A)	100% chance to win €5	B) 80% chance to win €7 and 20% chance to win €3	❍	❍
A)	100% chance to win €5	B) 90% chance to win €7 and 10% chance to win €3	❍	❍
A)	100% chance to win €5	B) 100% chance to win €7 and 0% chance to win €3	❍	❍

Imagine you play a dictator game. You receive €10 and you have to divide this amount of money between you and a randomly chosen anonymous player.

How much will you donate to the other player?

0 1 2 3 4 5 6 7 8 9 10

Donation (€)

I'm a student

- ❍ Yes
- ❍ No

What is your gender?

- ❍ Male
- ❍ Female

What is your age?

____

What is your nationality?

____

What is your education level at the moment?

- ❍ Bachelor
- ❍ Pre-master
- ❍ Master
- ❍ Doctor
- ❍ Other, namely _______________________

Thank you very much for participating!

Please leave your **email** to find out after the experimental period if you are selected to be paid-out! For any questions, contact me on romytacx@hotmail.com.

My email adres is:

3.2 Survey Teams

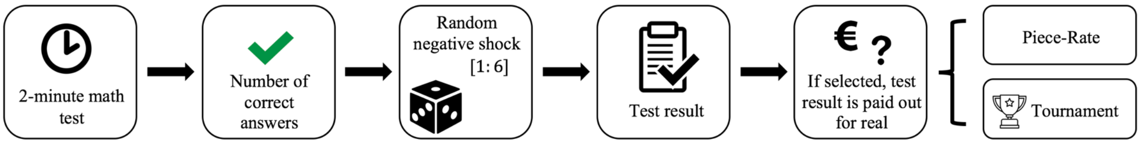
Dear responders,

Thank you for participating! I would like to notify you that your answers are anonymous and will be treated carefully. In order to draw valid conclusions, I would ask you to be as honest as possible, because **one participant is actually going to be paid-out!**

Instructions:

5. You are going to solve together as many as possible math questions in 2-minutes (WITHOUT A CALCULATOR)
6. A random negative shock between 1 and 6 lowers your number of correct answers.
7. One team is randomly selected to be paid-out for real!
8. You can choose how your test result is paid-out:
    a. **Piece-Rate:** €0.50 per correct answer
    b. **Tournament:** €1 per correct answer, but only when you are a better performer than a randomly chosen competitor.

Summarized:



The two-minute math test looks like:

4 * 7 = ???

7 * 5 = ???

The difficulty increases per question.

One team is randomly chosen to be paid-out for real! How would you like to be paid-out?

- ❍ **Piece-Rate**: €0.50 per correct answer
- ❍ **Tournament**: €1.00 per correct answer, BUT ONLY when you are a better performer than a randomly chosen competitor.

The 2-minute work task is going to start! Please **do not** use a **calculator**. You are allowed to use scratch paper and a pen.

You can trust me that I'm not going to use a calculator.

- ❍ Yes
- ❍ No

Make all questions together and don't split up the questions!

When you **click next**, the test is going to start. It doesn't matter when you are not able to answer all questions! Good luck!

01 56

Q1	$6 \times 9 = ???$	
Q2	$7 \times 6 = ???$	
Q3	$7 \times 8 = ???$	
Q4	$13 \times 7 = ???$	
Q5	$11 \times 4 = ???$	
Q6	$15 \times 7 = ???$	
Q7	$13 \times 9 = ???$	
Q8	$18 \times 3 = ???$	

Q9	$17 \times 7 = ???$	
Q10	$14 \times 5 = ???$	
Q11	$12 \times 6 = ???$	
Q12	$16 \times 8 = ???$	
Q13	$19 \times 2 = ???$	
Q14	$21 \times 8 = ???$	
Q15	$27 \times 6 = ???$	
Q16	$23 \times 4 = ???$	
Q17	$28 \times 3 = ???$	
Q18	$22 \times 9 = ???$	
Q19	$25 \times 7 = ???$	
Q20	$24 \times 15 = ???$	
Q21	$26 \times 20 = ???$	
Q22	$30 \times 18 = ???$	
Q23	$36 \times 3 = ???$	
Q24	$37 \times 4 = ???$	
Q25	$34 \times 8 = ???$	

Q26	38×3 = ???	
Q27	33×7 = ???	
Q28	36×6 = ???	
Q29	35×9 = ???	
Q30	32×5 = ???	
Q31	39×2 = ???	
Q32	37×11 = ???	
Q33	34×15 = ???	
Q34	38×18 = ???	
Q35	33×14 = ???	

That was it! Time Flies. Please continue.

Please rate how many percent of the questions you answered correctly. Don't take into account the questions you didn't answer because of the time-limit.

You receive an **additional pay-out of €2** when your **stated percentage** is exactly your **true percentage**. You earn **less and less than €2** when the deviation between your stated and true performance increases.

How well did you perform?

I answered ....% of the questions correctly.

0 10 20 30 40 50 60 70 80 90 100

%

Please rate you rank.

You receive an additional **pay-out of €2** when your **stated rank** is exactly your **true rank**. You earn **less and less than €2** when the deviation between your stated and true rank increases.

The lower the percentage, the better you perform.

Thus, "I belong to the top **10%** of the group" means that you did the test very well!
And, "I belong to the top **100%** of the group" means that you did the test very bad!

How well did you perform compared to other respondents?

I belong to the top ....% of the group:

100 90 80 70 60 50 40 30 20 10 0

Rank

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Imagine you play a dictator game. You receive €10 and you have to divide this amount of money between you and a randomly chosen anonymous player.


How much will you donate to the other player?

0 1 2 3 4 5 6 7 8 9 10

Donation (€)

<u>Let participant 1 fill in this:</u>

I'm a student

- ❍ Yes
- ❍ No

What is your gender?

- ❍ Male
- ❍ Female

What is your age?

____

What is your nationality?

What is your education level at the moment?

- ❍ Bachelor
- ❍ Pre-master
- ❍ Master
- ❍ Doctor
- ❍ Other, namely ______________________

Let participant 2 fill in this:

I'm a student

- ❍ Yes
- ❍ No

What is your gender?

- ❍ Male
- ❍ Female

What is your age?

______

What is your nationality?

______

What is your education level at the moment?

- ❍ Bachelor
- ❍ Pre-master
- ❍ Master
- ❍ Doctor
- ❍ Other, namely ____________________

Thank you very much for participating!

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