Measuring Preferences for Competition*

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Abstract

Recent research identified the willingness to compete as an important determinant of individual differences in labor market outcomes like salaries, bonuses and promotions. However, there is no consensus yet as to what are the underlying factors behind competitive behavior. Are participants who are willing to compete more capable, more confident, more tolerant of risk, or are they competing because they enjoy competition per se? This paper contributes to the discussion on preferences for competition and on how to measure them. In this study, we propose an experimental design that tests whether a preference for competition exists by controlling for the role of risk preferences by design and measuring for overconfidence carefully. Our findings provide strong evidence of a preference for competition at the individual level that exists irrespective of risk attitudes. Also, this preference seems to be well defined for most individuals as people are either competition averse or competition seeking and there is small variation of preferences when confronted with different competition stakes. Lastly, our results suggest that preferences for competition are substantial in some cases given that people are willing to pay a significant amount of money for entering or avoiding competition.

Keywords: preferences, competition, consistency, beliefs, risk, non-parametric, MPL.

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1 Introduction

In recent decades, economists have started to pay attention to non-cognitive factors as important determinants of economic behavior. After reviewing the economic literature, Heckman et al. (2019) conclude that factors such as psychological traits and preferences explain and cause important life outcomes, like wages and health. More recently, the literature in experimental economics has started to focus on one of these traits, preferences for competition. Competition and the psychological disposition to select into a competitive environment are present in most aspects of our lives, for instance, the workplace, education, social status, markets, and many more. Besides the relevance of competition in our daily lives, several studies have linked the laboratory measurement of preferences for competition with labor market outcomes and educational choices (Buser et al., 2014; Berge et al., 2015; Reuben et al., 2015; Buser et al., 2017a,b; Reuben et al., 2017; Kamas and Preston, 2018; Zhang, 2019; Buser et al., 2020).

Since the seminal paper by Niederle and Vesterlund (2007), many influential experimental studies have documented individual heterogeneity in preferences for competition (for reviews see, e.g., Niederle, 2014; Dariel et al., 2017). However, it is yet unclear what underlying factors are driving such heterogeneity (Gillen et al., 2019; van Veldhuizen, 2017). Is it due to individual differences in risk attitudes, confidence levels, ability to perform in such an environment, or due to individual differences in a taste for competition? Given the relevance of competitive behavior and the possible interaction with other factors, it is crucial to develop an accurate measure of preferences for competition irrespective of all the other factors present in a competitive environment. We contribute to this discussion by developing an experimental approach that controls for the role of risk preferences by design and accounts for the other factors present in this type of environment. In addition, our method generates a rich data-set that allows us to test with a high degree of confidence whether individual choices are consistent in a competitive environment, and therefore, to test for the existence of a preference for competition.

In the experimental literature, an individual's preference for competition is typically measured using one choice of remuneration schemes when doing a real-effort task. One of the issues associated with this measurement is that it relies entirely on a single individual decision. This could be problematic given that individual choices can be noisy as there is evidence that individuals make different choices when confronted several times with the same set of options (Tversky, 1969; Camerer, 1989; Hey and Orme, 1994; Agranov and Ortoleva, 2017). A second possible limitation is the use of a regression-method approach to measuring preferences for competition, where after controlling for confounding traits such as risk preferences and overconfidence, the residual individual behavior is attributed to the competitive trait. This reduced form approach can bias the measurement of competition considering that it highly depends on accounting properly for the control variables, as it has been extensively discussed in recent literature (Hausman, 2001; Green et al., 2010; Westfall and Yarkoni, 2016; Gillen et al., 2019).

This project builds on previous work and improves upon its limitations to test whether a preference for competition exists. Following the approach by Niederle and Vesterlund (2007), we elicit preferences for competition by the selection between two remuneration schemes for future performance in a real effort task. In addition, by adjusting the experimental task we are able to control for individual risk preferences by design and to generate a rich data set at the individual level which is crucial to test for consistency and measure preferences for competition irrespective of individual risk attitudes. In the task, participants choose between individual and competitive pay. The former scheme depends solely on individual performance whereas the latter depends on relative performance. Different from the design proposed by Niederle and Vesterlund (2007), the remuneration under the individual pay is not certain and involves the same risk that the competitive pay has. We obtain participants' belief of winning the competition before the selection of the payment-scheme and include these beliefs in the individual pay. Thus, the probabilities used in the individual pay are around the range of the subjective probability of winning the tournament for the tournament pay. This approach has the advantage to ensure that the decision between the individual and competitive pay are comparable in terms of risk levels and accounts for individual subjective beliefs of winning the tournament at the moment of choosing of the scheme.

Similar to Niederle and Vesterlund (2007), in our experimental design we use the individual choice between the two schemes as our measurement of preferences for competition. However, an additional new feature of our design is that we represent choices between the two payment-schemes as gambles in a multiple price list (MPL) where we vary the stakes under an individual and competitive pay (i.e., prizes and probabilities in both schemes). This has the advantage of generating several choices at the individual level which allows us to measure preferences with a high degree of confidence by looking at the participants switching behavior within a MPL. Also, thanks to this feature of our design we can test the consistency of preferences for competition across a wide array of environments, such as competition with different prizes and group sizes. Varying the group size gives the possibility to test the intuition that increasing the number of competitors decreases competition seeking behavior as the chances of winning the tournament decrease (Che and Gale, 2003; Garcia and Tor, 2009; Boudreau et al., 2011; Hanek et al., 2016).[1]

Another main feature of our methodology is that it controls for the role of risk preferences by design. This feature has a number of advantages. First, fixing risk preferences removes the need to statistically control for this trait, which can be potentially contaminated due to measurement error. Second, it allows us to capture a measure of preferences for competition in a non-parametric way and directly in our design without the need of using a regression-method approach. Hence, we obtain participants' preferences for competition by looking directly at their decisions between the competitive pay and the individual pay in the MPLs. That is, by measuring individuals' willingness to pay for entering or leaving competition. For instance, in our setup, someone who is competition neutral will always switch from one pay to the other when the expected utility of both payment-schemes is equal in the MPL. Someone who is competition averse will always switch from the competitive pay to the individual pay when the expected utility of the former payment-scheme is higher than the one from the later payment-scheme, and the opposite for someone is competition seeking.

Our main findings reveal the following. We find strong evidence of a preference for competition that is highly consistent at the individual level. Specifically, after controlling for risk preferences by design and accounting for individual beliefs and performance, we observe that most participants in our sample switch from one payment-scheme to the other when they are not indifferent between them. This behavior suggests that preferences for competition exist irrespective of risk attitudes. Our findings also suggest that most of the participants have a substantial preference for competition. In fact, 75% of participants are competition seeking (45%) or competition averse (30%). In addition, these preferences seem to be

[1] We note however that the opposite intuition could also hold: an increasing number of competitors could increase competition seeking behavior as social comparison concerns might play a stronger role. This could increase the anticipated utility of being the winner in a bigger group.

defined and common for most of the individuals as we observe that after introducing changes in the competition stakes, there is not much variation in the direction of the preferences for competition at the individual level. Our findings also reveal two more interesting patterns. First, competition seeking behavior increases in bigger groups as we observe that 51% of participants in a group of six people are competition seeking in contrast to a 36% of participants that are competition seeking in a group of three people. Second, the common finding that men are more competitive seeking than women (Gneezy et al., 2003; Booth and Nolen, 2012; Dariel et al., 2017; Saccardo et al., 2018), seems to vanish when we control for risk preferences by design and confront participants to different competition stakes. This suggests that risk preferences might drive the observed gender difference in competitive environments as recently suggested by Gillen et al. (2019) and van Veldhuizen (2017).

The remainder of this chapter is as follows. Section 2 provides a literature review and Section 3 describes our theoretical framework. We describe the experimental design and procedures in Section 4. In Section 5, we present our results for consistency behavior and measurement of preferences for competition. In Section 6, we discuss our results, and lastly, we conclude in Section 7.

2 Literature review

This paper contributes to the discussion on competitive behavior and on how to measure it in the laboratory. Starting with the seminal paper of Niederle and Vesterlund (2007) (henceforth NV), there has been a lot of attempts in trying to capture willingness to compete, especially in the context of gender differences (for reviews see, e.g., Niederle, 2014; Dariel et al., 2017). These studies are based on the NV measure and document individual heterogeneity in competitiveness. Specifically for the context of gender differences, this evidence suggests that men are twice as likely as women to select into competition and that these gender differences in selection are partly captured by gender differences in a taste for competition.

In the classical experimental task of NV, an individual's preference for competition is measured by using the choice of a remuneration scheme when doing a real-effort task. Specifically, participants can choose between two different schemes: a piece-rate, that depends only on individual performance; and a tournament rate, that depends on relative performance. The tournament option is considered a competitive scheme as it requires participants to compete against each other. With the help of a regression-based approach and after controlling for individual's overconfidence, risk preferences, and ability, the choice between the two remuneration schemes is considered as individual's preference for competition.[2]

In addition to measure the competitive trait in the lab, there is evidence that a higher willingness to compete positively correlates with labor market outcomes and educational choices. In particular, individual competitiveness seems to explain career choices in secondary (Buser et al., 2014, 2017a,b; Zhang, 2019) and tertiary education (Reuben et al., 2017; Kamas and Preston, 2018), performance of entrepreneurs (Berge et al., 2015), salaries, bonuses, and industry choice (Reuben et al., 2015), and many

[2]Other factors associated to individual heterogeneity in a competitive environment are differences in ambiguity attitudes and feedback aversion (Wozniak et al., 2016; Ertac and Szentes, 2011; Friedl et al., 2017). In our study, we do not target these factors since they do not take place in our experimental setting or they are inherently present in a competitive environment as in the case of ambiguity.

more (Buser et al., 2020).

Despite the wide use of the lab measurement of preferences for competition and the important role at the moment of explaining educational and labor market choices, there is not yet an agreement on what this lab measure captures. The vast majority of studies rely on a single individual measure and uses a regression-based method, whose accuracy depends strongly on the ability to control successfully for all the other determinants present in a competitive environment. One potential limitation of this approach is that a measurement error or misspecification in any of these determinants can bias the interpretation of the results (Hausman, 2001; Green et al., 2010; Westfall and Yarkoni, 2016; Gillen et al., 2019).

For the specific case of gender differences, two studies have attempted to address preferences for competition with a different approach. First, Gillen et al. (2019) develop a statistical technique to correct for measurement error in the risk attitudes and overconfidence measures used in the NV design. Their findings suggest that the role of the competitive trait in explaining the gender gap in competition disappears, after accounting for the measurement error of these two traits. Second, van Veldhuizen (2017) proposes a modified version of NV to differentiate by the experimental design between risk attitudes, overconfidence, and preferences for competition. His design introduces treatments that remove sequentially the role of competition and overconfidence, and compares these treatments with the classical NV outcome.[3] In contrast to most of the previous studies in competition, his findings suggest that the gender gap in competition is mainly captured by gender differences in risk preferences and overconfidence. As in van Veldhuizen (2017), we also control for risk preferences by design. However, one main difference with his approach is that in our experimental setting competition is always present, given that it is our main trait of interest. Also, differently from van Veldhuizen (2017) we do not rely on one single individual choice, but we capture individual preferences for competition by confronting individuals to a wide range of scenarios generated with the MPL setting. This new feature of our design allows us to test for consistency of preferences for competition.

3 Theoretical framework

In this section, we describe the theoretical background used to capture preferences for competition. In the experimental task, participants choose between an Individual Pay and a Competitive Pay for remuneration in a real effort task. Like in the NV design, the task consists in adding-up sets of four two-digit numbers during four minutes. Under Competitive Pay, participants get a high amount (HA) per each correct sum if they answer the highest number of correct sums in a group of three or six people, and a low amount (LA) otherwise. Differently from the classical NV design, Individual Pay does not pay participants a certain amount per each correct sum. Instead, the Individual Pay is a lottery that offers the same high amount as the Competitive Pay offers in case of being the winner in the group with a probability $prob_i^H$ and the same low amount in case of losing with a probability $1 - prob_i^H$. Having the same monetary payoffs in the lotteries participants face under both payment-schemes ensures that risk

[3]For a different approach on how to control risk attitudes by design please refer to Geraldes (2020). His approach is different from the NV approach and also to ours. Specifically, when controlling for risk preferences by design he only uses individuals that self-selected into the non-competitive payment since the beginning of the experiment. In consequence, in Geraldes (2020) preferences for competition are not measured irrespective of the role of risk attitudes as we do in our design.

preferences do not play a role.[4] This feature of our design accounts for the concerns raised by Gillen et al. (2019) and van Veldhuizen (2017), as our setting does not rely on the assumption that risk and competitive preferences are orthogonal.

Using the classical NV framework, several studies show that there are four correlated factors influencing participants' willingness to select one payment-scheme over the other (for reviews, see, e.g., Niederle, 2014). The first one is risk preferences, given that Competitive Pay implies a winner-takes-all situation and not winning the tournament results in earnings equal to zero. The second one is beliefs about the chances of being the winner in the group. Oftentimes, participants have (over)optimistic views about their true performance in the adding task, resulting in an overconfidence bias influencing their decision to take Competitive Pay. The third one is participants' ability levels to perform well in the adding task. Lastly, a preference for competition can also push someone to select a Competitive Pay if this person derives pleasure (i.e., an utility) from a competitive environment. In our framework, we remove the confounding effects of risk preferences by design and hold the effect of overconfidence constant, and we are thus able to identify the role of preferences for competition directly from the decision between Competitive Pay and Individual Pay.

Following expected utility theory, we assume that there is a utility function $U(\pi_i, C)$ that evaluates payoffs under Competitive Pay, and depends on the monetary payoffs π (from the high and low amounts) and the utility derived from competition C. In addition, the same utility function evaluates differently the payoffs under the Individual Pay, as competition is not present, i.e., $U(\pi_i, 0)$. Thus, the competitive trait can then be represented by how differently the same payoffs are evaluated between $U(\pi, C)$ and $U(\pi, 0)$ holding constant and at the same level beliefs and objective probabilities. We assume the following utility function:

$$U(\pi_i, C) = U(\pi_i, 0) + \theta_i. \tag{1}$$

Where π_i represents the monetary value of the lotteries for either the high or low amounts and θ_i is the parameter that captures the individual i willingness to pay for entering or for leaving competition.[5] Hence, assuming separability between preferences for competition and risk, an individual i chooses Competitive Pay irrespective of her risk preferences if:

$$belief_i * U(\pi_i^H, C) + (1 - belief_i) * U(\pi_i^L, C) > prob_i^H * U(\pi_i^H, 0) + (1 - prob_i^H) * U(\pi_i^L, 0). \tag{2}$$

[4]In the original experimental task of NV, Individual Pay and Competitive Pay are called as piece-rate pay and tournament pay, respectively. What we call in our theoretical framework high amount, low amount, and certain amount corresponds to a payoff in the NV task of 2\$, 0\$ and 0.25\$ per correct sum, respectively.

[5]For the proposed functional form of U, we follow two assumptions used in a well-known class of utility functions in the literature in experimental economics. First, we assume additive separability between U and θ. In our experimental design, θ is independent of risk preferences and we do not allow for changes in the curvature of U to changes in θ. One could relax this assumption by allowing the parameter of preferences for competition θ to be present in the curvature itself.** We also assume quasi-linearity of preferences between the payoffs achieved in the Competitive and Individual Pay. That is, $U(\pi_i, C)$ is a linear function of θ and an increasing function of π_i, as $U'(\pi_i, 0) > 0$.

where $belief_i$ is the subjective belief of being the winner in the group under the Competitive Pay, $prob_i^H$ is the probability in the Individual Pay of obtaining the high amount (HA), π_i^H and π_i^L denote the high and low amounts in euros for individual i, respectively (i.e., HA$*sums_i$ and LA$*sums_i$, where $sums_i$ is the number of correct sums of individual i in the addition task). Since risk preferences influence equally both sides of Equation 2 and we account carefully for individual beliefs, we ensure that the choice of Competitive Pays depends only on the individual's preferences for competition.[6]

With the help of our experimental setting, we measure non-parametrically the monetary equivalent of θ_i, called ω_i, by calculating the difference in the expected utility of Competitive Pay and Individual Pay at the switching point in the MPL. Since in our experimental setting the choice between Individual Pay and Competitive Pay takes place in five MPLs with ten choices in each list, $prob_i^H$ is the switching probability in the Individual Pay for individual i for obtaining the high amount within a MPL. Specifically, the switching probability $prob_i^H$ corresponds to the average between the probability of the high amount in the switching row and the probability of the high amount in the row after the individual switched in the MPL.[7] Given that individuals face several choices, we take the median value of ω_i for each subject as their preference for competition:[8]

$$\omega_i = (prob_i^H - belief_i)(U(\pi^H) - U(\pi^L)). \tag{3}$$

The intuition behind equations (1) and (3) is that given someone's reported subjective belief $belief_i$, an individual is considered to be competition seeking if she switches to an Individual Pay when her reported belief $belief_i$ is lower than her switching probability $prob_i^H$. Similarly, an individual is considered to be competition averse if she switches to an Individual Pay when her reported belief $belief_i$ is higher than her switching probability $prob_i^H$. As a result, competition seeking participants have ω_i greater than zero, competition averse participants have ω_i smaller than zero, and competition neutral participants have ω_i equal to zero.[9]

3.1 Experimental Design

We propose a variation of the experimental task developed by Niederle and Vesterlund (2007) to measure preferences for competition and to control for participants' risk preferences by design. Participants perform an adding task under a selected payment-scheme: Individual Pay or Competitive Pay. We use participants' choice of the payment-scheme as our measurement for their taste for competition. To account for individual beliefs at the moment of selecting the payment scheme, we elicit participants' beliefs of the relative performance in the adding task before they select their preferred payment-scheme. We include two treatment variations in our experimental design. As a robustness check of our experimental design, we vary between subjects the timing of the belief elicitation task (i.e., before or after the selec-

[6]Differently from the classical framework NV, in our experimental setting the low amount is not equal to zero in all the decision sets. This allows us to explore the role of different prize stakes in participants' taste for competition.

[7]For MPL without a switch, we use the lowest or the highest value of $prob_i^H$ depending on whether the individual always stayed in the Individual Pay or in Competitive Pay.

[8]To arrive at Equation 3, we assume without loss of generality that $U(\pi, 0) = U(\pi)$. In Appendix A.1, we describe the steps to arrive from Equations 2 and 1 at Equation 3.

[9]As described in detail in Section 4, we only obtain ω_i for participants that have a unique switching point to fully trust our measurement.

tion of the payment-scheme). Also, to test for the role of the number of competitors on preferences for competition, we vary within-subjects the group size between three and six people. In the following, we describe in detail each of the parts of the experimental design and the different treatment variations.

Each experimental session starts with an unincentivized practice round of the adding task of three minutes and continues with the following four parts. In the first part, we elicit participants' beliefs of being the best performer in the adding task. In the second part, participants have to choose between two different payment-schemes for their future performance. In the third part, they perform an adding task under a selected payment-scheme. Lastly, they complete a demographic questionnaire. The instructions for each part are provided at the beginning of the respective part and can be found in Appendix A.9.

Importantly, before the belief elicitation task, participants are familiarized with the adding task because of the practice round. Participants are also informed they will have to choose between the two payment-schemes for their future performance in the adding task. In addition, although participants know their own absolute performance, they are never informed about the performance of others in the adding task.[10] Relative performance is only revealed at the end of the experiment if the Tournament Rate is selected for payment purposes.[11]

Part 1: Belief elicitation task

After the practice round in the adding task, participants guess the likelihood of being the winner in their group (i.e., the probability of having the highest amount of correct sums). An important feature of our belief elicitation task is that participants can answer the belief elicitation question by providing the likelihood of being the winner or the percentile ranking of their performance in an interactive slider.[12] An advantage of this feature is that participants that struggle thinking in terms of probabilities can answer in terms of ranking instead. Also, we provide them a ranking table displaying the likelihood of

[10] Note that this feature creates naturally ambiguity in the tournament as in the tournament payment-scheme participants do not know their relative performance. This is the ambiguity that is usually inherently present in a competitive environment and can be solved by providing feedback on relative performance as proposed by Wozniak et al. (2016). Another way in which ambiguity is present in a tournament is by not knowing the number of competitors as recently suggested by Flory et al. (2015), Balafoutas and Sutter (2019) and Gee (2019). In our setting, the number of competitors is always common knowledge.

[11] Although this feature introduces differences in feedback between the two payment-schemes, feedback on relative performance is one of the key differences between a competitive environment and a non-competitive environment. Also, we believe this is not a concern in our design for two reasons. First, participants never received explicit information about feedback being revealed only if the Tournament Rate was selected for payment purposes. Therefore, participants could not anticipate feedback under only the Tournament rate. Second, although participants still could have beliefs on differences in feedback provision between the two schemes, previous evidence suggests that feedback aversion does not play a role in a setting similar to ours (Niederle and Vesterlund, 2007).

[12] For the likelihood of being the winner, participants can choose an answer ranging from 0 (meaning they are completely certain that they are not the winner of their group) to 100 (meaning they are completely certain that they are the winner of their group). For the percentile ranking, participants can choose an answer raging from top 100% (meaning they are completely certain they performed worse than all other participants of the study, i.e., the worst performer) to the top 0% (meaning they are completely certain they performed better than all other participants in the study, i.e., the best performer). An example of the two sliders can be found in Appendix A.9, Figure 15. Note that participants answer only one of the two questions, either the likelihood or the ranking, and by doing so the other question was instantaneously answered as well. In other words, for every provided likelihood participants could see online the corresponding ranking, and for every provided ranking they could see online the corresponding likelihood.

being the group's winner associated with any possible rank.[13]

The earnings in this first part can be either €0 or €20, depending on how close the likelihood the participants choose is to the actual probability of wining the tournament. We incentivize beliefs using a robust binarized scoring rule (BSR) (Karni, 2009). In particular, given a stated likelihood of being the winner $belief$, the BSR incentive offers a $1-(1-belief/100)^2$ chance of earning €20 in case of being the winner, and a $1-(belief/100)^2$ chance of earning €20 in case of being one of the losers. This framework has the advantage that it is easy to implement, is incentive compatible for a wide range of risk preferences and has been shown to outperform other belief elicitation methods (Gächter and Renner, 2010; Wang, 2011; Hossain and Okui, 2013; Harrison and Phillips, 2014; Trautmann and van de Kuilen, 2015). In addition, to increase the chances of true reporting in beliefs, we provide participants with information concerning the quantitative incentives in the elicitation method. Using an interactive interface participants could see online the expected earnings in euros associated with any selected likelihood or rank.[14] Differently from the classical procedure where participants are shown the payment function directly, our procedure removes the need of participants to comprehend the mechanism behind the payoffs in order to understand its incentive-compatibility.

Part 2: Selection of the payment-scheme

After the belief elicitation task but before performing the adding task, participants choose how they want to be paid for each correct sum. Specifically, they can decide between Individual Pay and Competitive Pay in 5 different decision sets that are completely independent of each other. Each decision set is a MPL that contains a series of 10 rows of choices where the left-choices correspond to Competitive Pay and the right ones to Individual Pay. Participants need to make a choice in each of the 10 rows of choices for each of the five decision sets, thus each participant makes a total of 50 choices.

Under Competitive Pay, the earnings depend on individual performance and the performance of others in their group. Participants are randomly assigned to different groups of three or six participants, respectively. The order of the groups is counterbalanced within participants. The participant who correctly solves the highest number of sums in their group is the group's winner. In case of any tie, the winner is determined randomly among the tied group members. If the participant is the group's winner, she earns the high amount (HA) per correct sum, otherwise, she earns the low amount (LA) per correct sum. Under Individual Pay, participant's earnings depend on individual performance and chance. That is, they earn the HA per correct sum with some probability p between 0% and 100% and the LA per correct sum with some probability $1-p$. In Table 1 we display an example of a decision set.[15]

This task has two key features. The first one is that the probabilities in the Individual Pay are estimated at the individual level using as a reference the subjective belief obtained from the belief elicitation task. Specifically, for each decision set, we randomize the position of the subjective belief, and decrease (for the lower rows) or increase (for the higher rows) monotonically the subjective belief in

[13]The ranking table is displayed in Figure 14 in Appendix A.9.

[14]In Appendix A.9, Figure 15 is displayed the actual screens that participants see during the experiment for the belief elicitation task.

[15]Please refer to Appendix A.2, Table 3 for the HA and LA in all the five decision sets.

Table 1. Example of a decision set

	Competitive Pay		Individual Pay			
	Win(€)	**Lose(€)**	**Win(€)**	p**(Win)**	**Lose(€)**	p**(Lose)**
1.	4	1	4	0,17	1	0,83
2.	4	1	4	0,20	1	0,80
3.	4	1	4	0,23	1	0,77
4.	4	1	4	0,26	1	0,74
5.	4	1	4	0,29	1	0,71
6.	4	1	4	0,32	1	0,68
7.	4	1	4	0,35	1	0,65
8.	4	1	4	0,38	1	0,62
9.	4	1	4	0,41	1	0,59
10.	4	1	4	0,44	1	0,56

Note: This is an example of one decision set with a high amount of €4 and a low amount of €1, and a subjective individual belief of 35%.

equally spaced steps.[16] An advantage of this feature is that when participants face a decision between Competitive Pay and Individual Pay in each decision set, the probability of getting the HA under the Individual Pay is around the range of the reported belief for being the winner in their group. In this way, we account for individual beliefs of being the winner at the moment of choosing between the two payment-schemes. The second feature is that the Competitive Pay and the Individual Pay have always the same level of risk within a decision set. Hence, the HA and LA are always the same in all 10 rows for both payment schemes. The only aspect that varies from row to row is the probability of getting the high and low amount under the Individual Pay.

These two features of our design ensure that we control for risk preferences by design and account for beliefs at the moment that participants choose between the Competitive Pay and the Individual Pay in each row. Thus, the difference in the expected utility of Competitive Pay and Individual Pay at the switching point in each decision set captures participants' preferences for competition. For instance, a participant is considered to be competition seeking if she switches to the Individual Pay when her belief of winning the tournament is lower than the probability of winning the HA under the Individual Pay. Similarly, she is competition averse if she switches to the Individual Pay when her belief of winning the tournament is higher than the probability of winning the HA under the Individual Pay.

Part 3: Performance under selected payment-scheme

After the selection of the payment-scheme in the five MPLs, participants perform the adding task knowing the payment-scheme and the specific rate under which they will be paid for each answer in the task.[17] The adding task consists in adding-up sets of four two-digit numbers during four minutes. The

[16]Note that we randomize the position of the beliefs in the MPL from two rows above or below the fifth row. In that way, we avoid that the beliefs are placed in one of the corners of the list. In Appendix A.2, we describe in detail how the probabilities in the Individual Pay are calculated using as a reference the subjective belief.

[17]After participants choose from all 5 decision sets, one of them is randomly selected. Within the selected decision situation, one of the 10 rows is randomly chosen as well. The type of payment the participants chose in the selected row is used to

numbers are randomly drawn by the computer from a uniform distribution with a support of 1 to 100. Participants are not allowed to use a calculator, but they are provided a scratch paper. Every time they submit an answer, the computer immediately informs them whether the answer is correct or incorrect and a new sum is generated. In addition, the computer keeps a record of the number of correct sums participants have. Importantly, although participants know their absolute performance, they are never informed about the performance of others in this task.

Part 4: Demographic questionnaire

As a final step, we ask all participants to complete a demographic questionnaire about characteristics such as gender, age, number of siblings and position among them, nationality, and level of education.[18] In addition, we add three unincentivized survey questions to elicit general competitiveness on a 7-point scale (Buser et al., 2020; Fallucchi et al., 2020).[19]

Treatment variations

We use a 2x2 design, where between-subjects we vary the timing of the belief elicitation task, and within-subjects we vary the size of the groups for the Competitive Pay. The reason behind the first treatment variation is that eliciting beliefs before the selection of the payment scheme as we described in Part 2 could raise concerns of hedging effects. Therefore, we include an additional treatment where beliefs are elicited after the selection of the payment-scheme as a robustness check to account for this concern.[20] Since we need participants' reported belief to estimate the probabilities displayed in the Individual Pay, for this treatment we obtain the probabilities of the LA and HA differently. Specifically, two additional decision sets are added at the beginning of Part 2 to estimate participants' subjective probability of being the winner with the following 4 steps. First, we confront participants with an initial decision set to understand their direct preferences between the Competitive and the Individual Pay with their switching behavior in this initial decision set. Second, we use participants' choices in this first decision set, and more specifically the number of times they choose the Competitive Pay, to estimate the probabilities in the Individual Pay for the second additional decision set. Third, we use the probability in the switching row and the number of times participants chose Competitive Pay in the second additional decision set to derive their final prediction. Forth, with the final prediction, we estimate the probabilities of the Individual Pay for the final five decision sets in the same way we did in the other treatment.[21]

We also vary the group size between three and six members within-subjects to analyze whether participants are more or less willing to compete in larger groups, and therefore, test for the role of the number of competitors on shaping individual preferences for competition. Due to this within treatment

determine how much they will receive per correct sum in the adding task.

[18] We include controls for the number of siblings as some evidence suggests that having an older sister is positively associated with women's preferences for competition and negatively associated with men's preferences for competition (Okudaira et al., 2015).

[19] The survey questions used to measure general competitiveness can be found in Appendix ??.

[20] Note that this second treatment has mainly a robustness check purposes, as we do not expect preferences for competition to change with the order of belief elicitation task.

[21] In Appendix A.2, we describe in detail the four steps and how the probabilities are estimated in this second treatment.

variation, all participants have to answer the belief elicitation question and select the payment scheme twice, one time for a group size of three people and another time for a group size of six people. Lastly, the order of the group size is counter-balanced at experimental session level.[22]

3.2 Experimental procedures

The study was conducted at the Behavioral and Experimental Economics Laboratory (BEElab) at Maastricht University. The experiment consisted of 11 sessions of 22 participants on average. We recruited in total 224 participants, 133 women and 91 men, through the online recruitment system ORSEE (Greiner, 2015).

All participants signed an informed consent before participating in the study. They received a €5 show-up fee and the total earnings were on average of €25. One of the tasks was selected for payment purposes at the end of the experiment and this was known by the participants from the beginning. The experiment was programmed and executed with the software z-Tree (Fischbacher, 2007).

4 Results

To study whether a preference for competition exists, we first check whether individual choices between a competitive and a non-competitive environment are consistent in terms of switching behavior. Once we confirm that competitive behavior is consistent in our experimental setting, we test whether such choices can be captured non-parametrically by a preference for competition with the location of the switching point in each decision set.

This section is divided into three parts. First, we present a consistency analysis in terms of switching behavior in the MPLs for the selection of the payment-scheme; second, we show the results for the measurement of participants' preferences for competition and its variation at the individual level. Lastly, to link our findings with the literature on gender differences in competition, we test for gender differences in both our measurements of consistency and preferences for competition. For the whole analysis, we separate our sample by the group size in the competition (i.e., by groups of three or six people).[23] Since we do not observe significant differences in behavior between the two belief treatments (i.e., belief elicitation before or after the selection of the payment scheme), we pool the data from both treatments for the whole analysis.[24] The order of the group size is counter-balanced, meaning that some participants play first in a group of three people and some others in a group of six. For the main analysis we pull together both orders, but as we expect to have some differences in behavior between both orders, in Appendix A.5 we report the results separating by the order of the group size, for both consistency and preferences.[25]

[22] Note that given the sample size of each experimental session (between 12 and 24 participants) the chances of a participant being matched with the same person twice are larger than zero. However, participants never received feedback on their relative performance in the group. Also, anonymity was always ensured during the whole experimental session.

[23] In Appendix A.3 Table 5, we provide the descriptive statistics of our sample by group size.

[24] We run two separate OLS regressions to test the effect of the belief treatments on the selection of the Competitive Pay and on the reported subjective belief of winning the tournament. Using a post estimation test, we do not observe any significant difference between treatments in either the selection of the Competitive Pay or the reported belief ($p = 0.337$ and $p = 0.128$, respectively)

[25] Using two separate OLS regressions, we test the effect of the group size order on the selection of the Competitive Pay

4.1 Switching behavior

In this subsection, we conduct a consistency analysis for the switching behavior during the choice of payment-scheme for future performance. Specifically, our measurement of consistency has two main dimensions. Since we did not impose a single switch restriction in our setting, the first dimension captures the number of times participants switch within a decision set. We consider an individual to be consistent if she switches at most once in a decision set. The second dimension is about the direction of the unique switch, which we define as rational switch. That is, a switch from the payment-scheme with the lowest expected value to the one with highest expected value, and not the other way around (i.e., from Competitive Pay to Individual Pay). Contrary, an irrational switch is one that happens from Individual Pay to Competitive Pay. Importantly, we are not only interested in participants that have at most one rational switch in all five decision sets, but we also want to check that most of the consistent behavior is not driven by no-switching behavior in most of the decision sets. For this purpose, we present a consistency analysis on the intensity of the individual level switching behavior. That is, out of the five decisions sets, in how many decision sets there was a rational switch, there was no switch or there was an irrational switch.

Sub-table 6a displays the average consistent and inconsistent switching behavior at the decision set level for the two group sizes. That is, the percentage of decision sets that fell into each of the four possible switching behavior (i.e., multiple switch, irrational switch, rational switch, and no switch,). Regarding the participants competing in a group of three players, we observe that around 96% of the decision sets display a consistent switching behavior, with 77% of the sets having a single rational switch and 19% no switch. A similar pattern is present in the decisions sets with a group of six players. That is, 95% of sets have a consistent behavior, where 76% have a single rational switching behavior an 19% have no switch. We can conclude that for both group sizes a bast majority of the decision sets (95.5%) have either a single rational switch or no switch at all (i.e., participants remain always under the same payment scheme). Using a two-sample t-test with equal variances, we do not observe any significant difference between group's sizes for the percentage of sets with an irrational switch versus the sets without an irrational switch ($p = 0.651$).

Analyzing switching behavior at set level provides a good general indication of consistency in our competitive environment. However, to obtain an individual measure of preferences for competition we need to look only at individuals whose switching behavior across the five decision sets is always rational and not fully driven by not switching behavior in most of the cases. Sub-table 2b shows the percentage of participants with inconsistent and consistent switching behavior. An individual is considered to have inconsistent switching behavior if it has at least one set with a multiple or an irrational switch. In contrast, we consider an individual to have consistent switching behavior if it does not have any decision set with multiple or irrational switches. This is the case for 91% and 88% of subjects in our sample for a group of three and six people, respectively. In addition, within the consistent category, we check which percentage of subjects have a rational switch in a majority of sets (i.e., three or more) or in all sets.[26]

and on the reported subjective belief of winning the tournament. A post estimation test, we observe a significant change in the reported belief but not do in the selection of the Competitive Pay ($p < 0.001$ and $p = 0.276$, respectively).

[26]Please note that for the category of "Rational switch in three or more sets" in Sub-table 7a, the sets in which participants did not switch refer to sets where there was no-switch at all as in this category there are only participants with no irrational switch.

Table 2. Consistency behavior within decision sets and individual level

a. Switching behavior *within decision sets*

	Group Size	
	Three [n=1120]	Six [n=1120]
Inconsistent behavior		
Multiple switch	2.23%	2.50%
Irrational switch	1.88%	2.14%
Consistent behavior		
Single rational switch	76.96%	75.98%
No switch	18.93%	19.38%

Note: percentage of decision sets with a rational and irrational switching behavior. For the decision sets with consistent behavior, there are two possibilities: single rational switch (i.e., from competitive pay to individual pay) or no switch at all. For the decision sets with irrational behavior, there are two possibilities as well: switch more than once or switch irrationally (i.e., from individual pay to competitive pay).

b. Switching behavior *within individuals*

	Group Size	
	Three [n=224]	Six [n=224]
Inconsistent behavior		
At least one set with multiple or irrational switch	8.93%	11.61%
Consistent behavior		
No sets with multiple or irrational switch	91.07%	88.39%
Rational switch in three or more sets	75.89%	75.00%
Rational switch in all five sets	54.46%	45.54%

Note: percentage of individuals with a consistent and inconsistent switching behavior for both group sizes and the corresponding number of individuals [n]. Individuals with inconsistent behavior are those that have at least one decision set with multiple switches or with an irrational switch. For the participants with consistent behavior, we display three categories: individuals that have no sets at all with multiple switches or with an irrational switch; individuals that have a rational switch in three or more decision sets (i.e., switched rationally in a majority of sets), and no switch in the other sets; or individuals with a rational switch in all five decision sets (i.e., switched rationally in all sets).

For participants in a group of three people, we observe that 76% of participants switch rationally in three or more sets and 54% participants switch rationally in all five sets. Similarly, for participants in a group of six people, 75% switch rationally in three or more sets and 46% participants switch rationally in all five sets. Using a two-sample t-test with equal variances, we do not observe any significant difference between group's sizes for the percentage of participants with an irrational switch versus the sets without an irrational switch ($p = 0.351$).

The results from Table 2 suggest overall that most of the participants in a group of three and six people of our sample have no irrational switch in any of the sets and switched rationally in at least three decision sets. Since no-switching behavior is problematic for measuring preferences for competition, for the rest of our analysis we keep only participants with a rational switch in the majority of decision sets (i.e., three or more sets) and no irrational switch in the other sets. That is, 76% of the participants in a group size of three and 75% of the participants in a group of six (170 participants out of 224 for a group size of three and 168 participants out 224 for a group size of six).[27]

To sum up, we conclude that competitive behavior is highly consistent and rational at the individual level for both group sizes. Furthermore, and even more relevant for measuring preferences for competition, we observe that most of the switching behavior is not driven by participants that did not switch at all from the Competitive Pay to the Individual Pay.

4.2 Measurement of Preferences for Competition

In this subsection, we look at the location of the switching point for the participants that have one rational switch in most of the decision sets and do not have any sets with irrational switch (170 participants for a group size of three and 168 participants for a group size of six). We are interested in the values of ω_i obtained from Equation 3 at the individual level for a group of three and six people. If participants have a defined competition seeking or competition averse behavior, we should observe an ω_i greater or smaller than zero in most of the decision sets.

Figure 1 displays the distribution of the median preferences for competition at the individual level for the two different group sizes. That is, per individual we obtain the median value of preferences for competition across the five different decision sets for each of the two group sizes. The patterns in Figure 1 suggest that at least 65% and 82% of the participants have a preference different from zero for a group of three and six, respectively.[28] In addition, a test for equality of matched pairs reveals that the median subject is slightly competitive in a group of six people ($p < 0.001$), but not in a group of three ($p = 0.938$). Lastly, we also observe that participants are more competitive in larger groups (exact Mann-Whitney ranksum test for equality of medians, $p < 0.001$). This suggests that increasing the number of competitors in the tournament makes participants more competition seeking.

In conclusion, the patterns displayed in Figure 1 suggest that the majority of consistent participants

[27]In the Appendix A.6, we present results including also the participants with an irrational switch or the ones who did not switch in more than two decision sets. We do not observe differences when compared to the main results presented in this section.

[28]For a group of three people, these are the summary statistics of ω_i: mean=-0.62, median=-0.08, sd=6.08, min value=-23.45 and max value=19.71. For a group of six people, the summary statistics of ω_i are: mean= 1.71, median=2.27, sd=15.53, min value= -60.48 and max value=55.95. Note that for simplicity, in Figure 1 we censored ω_i to values between -16 and 16.

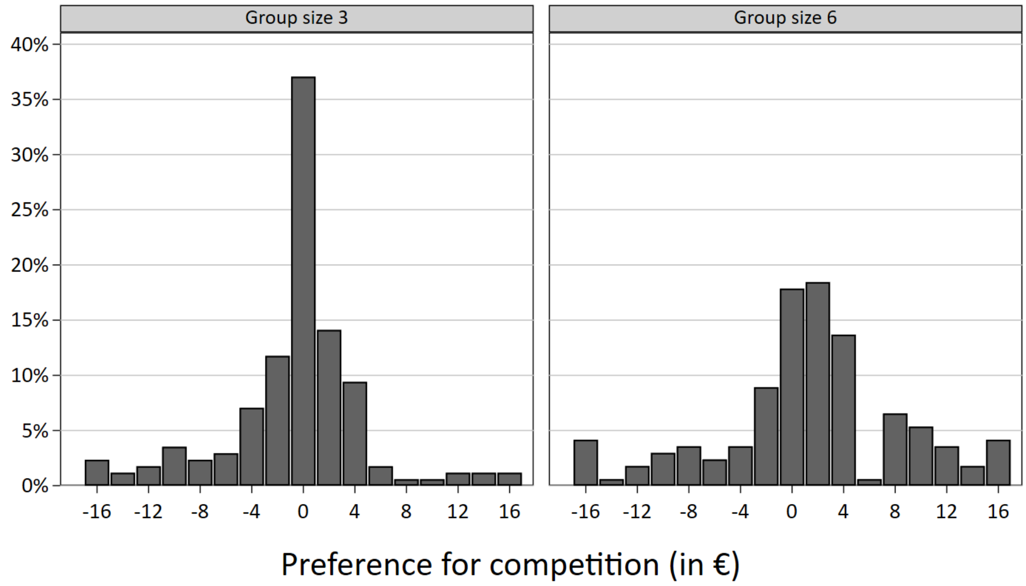

Figure 1. Distribution of ω_i at the individual level.

are either competition averse (i.e., $\omega_i < 0$) or competition seeking (i.e., $\omega_i > 0$).[29] [30]

To obtain the value of ω_i, we aggregate preferences for competition across the five decision sets for each individual. However, if an individual displays very different preferences for competition across the five decisions sets, the value of ω_i does not provide a good measure of individuals' preferences. To claim the existence of a defined preference for competition, we check for the variation and strength of preferences for competition at the individual level. This analysis is possible with our experimental design because we have more than one measure of preferences per individual. Preferences for competition are defined if they display low variation at the individual level and if they have the same strength in most of the decision sets (either competition seeking or averse in at least four decision sets). First, we check for the variation of preferences for competition by looking at the individual variation of preferences for competition across the five decision sets and compare it to the variation between participants. This analysis helps us to understand whether preferences for competition have a small dispersion and are not

[29] Note that although a decision error could center the distribution of ω_i to zero as it seems to be displayed in Figure 1, we believe this is not a concern in our results for two reasons. First, for a group size of six people, there is a preference for competition significantly different from zero. Second, we observe a small variation of preferences for competition at the individual level in both group sizes. In fact, one would expect a high variation of preferences at individual level if there is a decision error in the individual choices (Falk et al., 2018).

[30] As a robustness check, we examine whether any potential noise in beliefs influences the observed preferences for competition. In our experimental design, participants provide twice the belief of winning the tournament not only in terms of probability, but also in terms of ranking. In fact, although the self-reported probabilities between the two individual measures might change, we expect the self-reported ranking to be relatively stable at the individual level. Exploiting this feature of our design, we capture noise in beliefs by looking at the absolute differences between the two self-reported measures of ranking. Consequently, we test whether the variance of preferences for competition differs between individuals that have a sizeable difference between their two ranks (i.e., big noise in beliefs) and those who do not have differences in their rankings (i.e., small noise in beliefs). A test with equal variances reveals that there is not a significant change in the variance of preferences for competition between individuals that have big versus small noise in their beliefs ($p = 0.1325$ and $p = 0.8979$). This finding suggest that any potential noise in beliefs does not contaminates our measure of preferences for competition.

due to mistakes, and therefore, capture a defined taste for competition in our sample (Falk et al., 2018). One would expect that in the presence of a high mistake rate in individual choices, the within variation will exceed the between variation of preferences competition. A total variance decomposition analysis shows that the within individual variation in preferences for competition is smaller than the between individuals variation. Specifically, around 74% and 78% of the total variation of preferences is due to between individual variation, for a group size of three and six, respectively.[31]

In short, we observe that preferences for competition are well defined using a measure of variance decomposition. That is, for both groups sizes around 76% of the variation of preferences for competition is due to between individuals variation. As a next step, we analyze in detail the variation of preferences for competition across the five decision sets by looking at the strength of preferences at the individual level (i.e., whether they are competition seeking or averse in at least four out five of decision sets). Figure 2 displays the percentage of participants that have either competition seeking ($\omega_{i,n} > 0$) or competition averse ($\omega_{i,n} < 0$) preferences in four or more decision sets, or have not defined preferences for competition.[32]

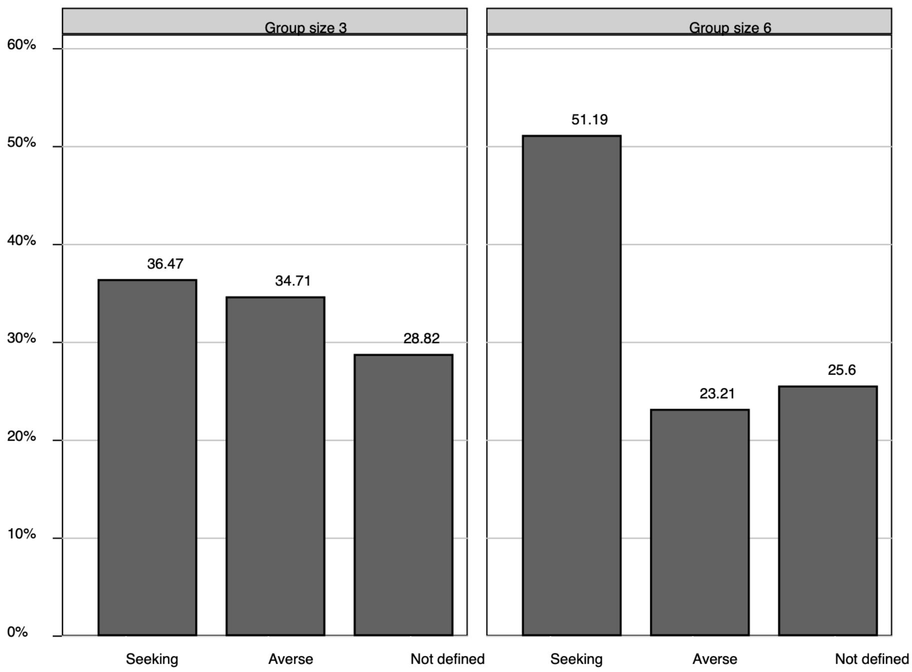

Figure 2. Intensity of Preferences for Competition, ω_i

The left panel in Figure 2 reveals that for participants competing in a group of three, 73.5% have a defined preference for competition. That is, a preference that is the same in at least four decision sets. Precisely, 36.5% have a defined competition seeking preference, 34.6% have a defined competition averse and 28.82% of participants do not have a defined preference for competition. The right panel

[31]The variance decomposition breaks down the individual-level variation into the variance of the average preference across individuals and the average of the within-individual variance. Formally, the between-individual variation corresponds to the R^2 of an OLS regression of all individual-level preferences for competition on a set of individual dummies.

[32]The "Not defined" category in Figure 2 refers to participants that have consistent switching behavior but do not display competition seeking or averse preferences for competition in at least four decision sets.

in Figure 2 reveals a similar panel for a group of six people as 78.6% have a defined preference for competition. Specifically, we observe that 51.2% have a defined competition seeking preference, 23.2% have a defined competition averse preference and 25.6% participants do not have a defined preference for competition. Using a two-sample Wilcoxon rank-sum test, we observe significant differences in the strength of preferences for competition between the two group sizes ($p < 0.001$). In line with the observed differences in the distribution of preferences for competition between the two groups sizes (see Figure 1), Figure 2 confirms that participants have more defined competition seeking preferences when they are competing in a group of six people than when they are competing in a group of three.[33]

Overall, the results from this section suggest the existence of a preference for competition that is not only highly consistent, but also well defined at the individual level. For a group of three and six people, around 74% of the participants that have a consistent switching behavior have defined preferences against or for competition.

4.3 Gender differences

Since our findings might be informative for the literature in gender differences in competitiveness, we also test whether there are gender differences in the outcomes presented above, both in terms of consistency and preferences for competition. All the respective tables and figures for this section can be found in Appendix A.8.

To compare competitive behavior between men and women, we need to ensure first that there are no gender differences in the consistency of the choices they make in a competitive environment. For our two measurements of consistency in switching behavior, our findings do not reveal any significant gender differences. Specifically, there are no significant gender differences between men ($mean = 0.982$, $sd = 0.004$) and women ($mean = 0.978$, $sd = 0.004$) for the percentage of sets with an irrational switch versus the sets without it (two-sample test with equal variances, $p = 0.4758$). Similarly, we do not find significant difference between men ($mean = 0.917$, $sd = 0.020$) and women ($mean = 0.883$, $sd = 0.019$) for the percentage of participants with an irrational switch versus the sets without an irrational switch (two-sample test with equal variances, $p = 0.2435$).

[33] As a robustness check, we test how much the observed individual preferences for competition resemble to preferences obtained from random choices in a competitive environment like ours. We compare the distribution of the intensity of preferences for competition displayed in Figure 2 with the distribution of preferences of someone whose preferences are either positive or negative in each of the five decision sets with equal probability. Using a Chi-Square test of independence between the random preferences and the actual preferences for competition, we observe that both distributions are significantly different from each other, $X^2(4, N = 170) = 27.84, p < 0.01$.

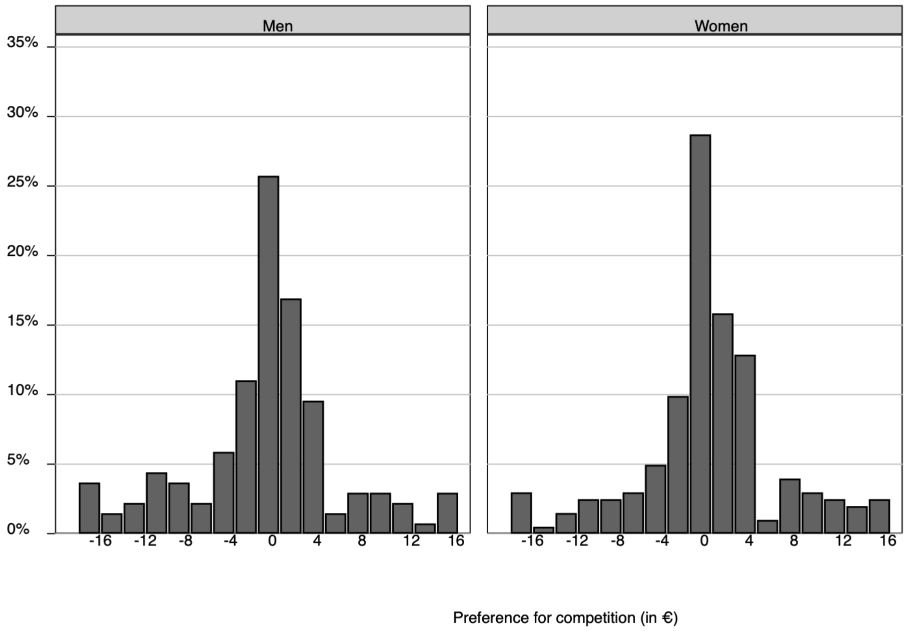

Figure 3. Preferences for Competition (in euros) - Distribution of ω_i at individual level.

For our measurement of preferences for competition, we consider only the men and women with a majority of decision sets with a rational switch. For men, we remain with 67 participants (out of 91) for the group size of three and with 69 (out of 91) for a group size of six. For woman, we remain with 103 participants (out of 133) for the group size of three and with 99 (out of 133) for a group size of six. Figure 3 displays the distribution of the median preferences for competition by gender (i.e., ω_i). Using a two-sample Wilcoxon ranksum test for equality medians, we do not observe gender differences in preferences for competition ($p = 0.203$) nor significant differences in the variance of preferences for competition between men and women ($p = 0.107$).[34] Lastly, using a two-sample Wilcoxon rank-sum test, we also do not find significant differences in the intensity of preferences for competition between men and women ($p = 0.112$). In conclusion, we do not find any evidence of gender differences in preferences for competition or consistency in competitive behavior in our laboratory setting.

5 Discussion and conclusions

This study uses an experimental design to measure non-parametrically preferences for competition at the individual level. We modify the experimental task developed by Niederle and Vesterlund (2007) to control for risk preferences by design, account for overconfidence carefully, and generate a rich data set at the individual level. Our results reveal the existence of a highly consistent preference for competition, that can be captured irrespective of risk preferences and is highly defined for most of the participants as

[34] A total variance decomposition analysis shows that the within individual variation in preferences for competition is smaller than the between individuals variation for both women and men. For women, a 75% and 77% of the total variation of preferences is due to between individual variation, for a group size of three and six, respectively. For men, a 72% and 79% of the total variation of preferences is due to between individual variation, for a group size of three and six, respectively. The between-individual variation corresponds to the R^2 of an OLS regression for each gender and group size of all individual-level preferences for competition on a set of individual dummies.

it does not vary with changes in the competition stakes or group size.

To test for consistency of individual's choices in competition, we look at the switching behavior during the selection of the payment-scheme. Our results reveal that competitive behavior is highly consistent and rational, and that this is the case for both belief treatments and group sizes. In fact, 95% of the decision sets contain a rational choice and 89% of participants make all choices rationally. That is, the majority of sets and participants have at most one single switch between the Competitive and Individual Pay. We also observe that most of these rational choices are not driven by extreme behavior where there is no switch at all (i.e., 76% of the participants of our sample switched rationally in most of the decision sets). Given that our main goal is to measure preferences for competition, we need to guarantee that individual choices can be interpreted directly from the choices between the two payment-schemes in the different decision sets. We ensure this by calculating preferences for the 76% of the participants that have a rational switch in most of the sets and taking the individual median preference for competition across the five decision sets.

We capture individual preferences for competition by looking directly at the location of the switch in each decision set. Our findings suggest that most of the participants have a preference for competition, as 75% of our sample switches when they are not indifferent between the two payment-schemes. In addition, such preferences for competition are well defined at the individual level for most of our sample as 74% of participants have a small variation in their preferences across the five decision sets. These findings lead us to conclude that most of our participants display a defined competition seeking or competition averse preferences. Moreover, connecting this result to our theoretical framework, it suggests that preferences for competition can have an additive shape in the utility participants derive from money in a competitive environment. Although our design only introduces the possibility of an additive shape for these preferences, we believe that this finding can be informative to develop a more accurate measure of preferences for competition. For instance, knowing that there is a fixed taste for competition irrespective of one's risk attitudes, but conditional only on the competition stakes can inform better policymakers when targeting competitive environments. Note that a natural extension to our setting will be to allow for interactions between risk and competition preferences in the utility function.

Recently, the existence of the competitive trait has been questioned given the limitations of the most common approach used to measure this trait, see for instance Gillen et al. (2019); van Veldhuizen (2017). However, extensive literature in experimental economics has pointed out the relevance of preferences for competition in explaining individual heterogeneity in a competitive environment, and also differences in educational and labor market outcomes (Buser et al., 2014; Berge et al., 2015; Reuben et al., 2015; Buser et al., 2017a,b; Reuben et al., 2017; Kamas and Preston, 2018; Zhang, 2019; Buser et al., 2020; Fallucchi et al., 2020). Our findings contribute to this discussion as they suggest that even after accounting for risk preferences by design and measuring overconfidence carefully, the trait of competition explains highly individual differences in a competitive environment.

Our results also reveal that 75% of participants have competition seeking (45%) or competition averse preferences (30%). This profile of preference suggests a high heterogeneity of preferences for competition. Given that competition is present in every aspect of our lives, for instance in markets, education, and social status, it seems crucial to acknowledge that a high share of the population dislikes competition or do not even have a particular taste for it (around 22% of our participants do not have a consistent preference for or against competition). Also, a possible venue for future research will be to understand how this individual heterogeneity interacts with other individual traits or cultural aspects of our lives.

Our study suggests that the median participant is competition seeking and that this type of preference is significantly stronger in participants that compete in a group of six in comparison to a group of three people. Moreover, bigger groups also display a higher variance of preferences at the individual level. Interestingly, when looking at differences in beliefs between the two group sizes, we find that participants are less confident of winning the tournament in a group of six than in a group of three people as one would expect. It is intriguing that despite having lower beliefs of winning the tournament in a group of six people, participants are more competition seeking in bigger groups than in small ones. Unfortunately, our design cannot bring light on the driving factors of these results, as social comparison and reputation might play an important role when changing the number of competitors and we did not target them in our design.[35] We believe a more detailed design that allows for changes in social comparison and reputation will be needed to understand the driving differences of preferences for competition with a different number of competitors.

In general, the findings on group size suggest that the number of competitors plays an important role at the moment of shaping individual preferences for competition. There are very few attempts to test the role of the group size on competitors' behavior. Overall, the literature in psychology suggests that competitors' motivation decreases when the number of competitors increases, and that this effect is mediated by social comparison (Garcia and Tor, 2009; Hanek et al., 2016). However, these studies do not account for participants' overconfidence or risk attitudes, which makes it difficult to compare them with our setting. Regarding contests, the literature in economics suggests that increasing the number of competitors decreases the chances of any competitor to win, and therefore, reduces incentives to exert effort (Che and Gale, 2003). In addition, it is also suggested that higher uncertainty reduces the negative effect of added competitors on incentives (Boudreau et al., 2011). In a setting free of uncertainty like ours, we do not observe the same pattern for bigger groups of competitors, given that the level of effort is the same in both group sizes. These opposite findings might highlight the role of uncertainty in a competitive environment. We believe further research is needed to precisely address the role of the number of competitors on preferences for competition, and also to target the role that risk preferences can play in it.

To account for possible hedging effects, we include as a robustness check a treatment variation where we vary the order of the belief elicitation task with respect to the selection of the payment-scheme. We perform a separate analysis for these two treatments in Appendix **??**. Our results do not reveal significant differences in the switching behavior or the existence of preferences for competition between these two treatments. However, we observe some puzzling differences in the size of these preferences between these two treatments. Preferences for competition have more extreme values (both negative and positive) in the treatment where beliefs are elicited after the selection the payment-scheme. Also, we observe a higher variance in preferences in the treatment where beliefs are elicited after. Lastly, the intensity of preferences changes between our two treatments. Similar to changes in the group size, these findings reveal that changes in the environment, such as asking beliefs before or after, can shape differently individual preferences for competition. Although it is known that the belief elicitation method can influence participants' actions in a strategic setting (Blanco et al., 2010; Rutström and Wilcox, 2009;

[35]In principle, these factors should not play a role in our design as we did not provide relative feedback to our participants. However, we cannot ensure this as we did not elicit individual beliefs on this matter.

Gächter and Renner, 2010), there is not much evidence on the consequences of changing the order of the belief elicitation has on economic behavior and this could be addressed in future research.

An additional point of discussion concerning the belief elicitation task is about the possibility of a biased measure of beliefs due to our elicitation technique. Although we cannot ensure that our belief elicitation method is completely free of measurement error, we consider there are some reasons why we can trust the beliefs provided by participants in our study. First, we use the binarized quadratic scoring rule which offers incentives for truth-telling for a wide range of risk preferences and outperforms other scoring rules and unincentivized elicitations mechanisms (Gächter and Renner, 2010; Wang, 2011; Hossain and Okui, 2013; Harrison and Phillips, 2014; Trautmann and van de Kuilen, 2015). Second, in our setting, there is not an objective prior and it is impossible to test the accuracy of beliefs with respect to a true outcome. An accurate belief of being the winner is not the one that approaches the truth chance of being the winner in the competition, but it is the actual belief that participants use at the moment of choosing whether to compete or not. In consequence, the best we can do in our design is to increase the chances of true telling when it comes to the belief elicitation task. With an incentivized BSR we partly ensure this is the case. Lastly, after the belief elicitation task, we add some noise to the participants' subjective beliefs for the selection of the payment-scheme to construct the probabilities in the Individual Pay. We consider that this noise could help us to account for small deviations participants might have in their beliefs.

Furthermore, recent evidence suggests that providing precise information on the BSR quantitative incentives can alter the truth-telling over an objective prior (Danz et al., 2020). Danz et al. (2020) findings suggest that the false reports in beliefs arise from thinking in terms of probabilities, but it is not entirely clear if this will apply as well to expected earnings. We believe that in our experiment this is not a concern given two features of our belief elicitation task. First, even though we provide details about the quantitative incentives, participants are only informed about the consequences of their selected beliefs in terms of expected earnings and not in terms of the probability of winning the prize. Second, participants have an additional interface that translates every possible likelihood of being the winner in the tournament into terms of ranking (i.e., how one's performance ranks in comparison to the performance of all the other participants). This novel feature of our design helps participants that have problems with thinking in terms of probabilities to understand better the belief elicitation task.

Lastly, we also test for gender differences in consistency and preferences for competition in our experimental setting. Contrary to most of the literature in gender differences in competition (Gneezy et al., 2003; Booth and Nolen, 2012; Dariel et al., 2017; Saccardo et al., 2018), our findings suggest that men and women do not differ in preferences for competition. We show that the common finding that women are less likely to select into a competitive environment because they dislike competition more than men (Niederle, 2014), seems to vanish when we control for risk preferences by design. This result is in line with Gillen et al. (2019) and van Veldhuizen (2017) who also observe that gender differences for competition are not captured by the competitive trait. We consider this finding can help to inform policies oriented to increase the representation of women in competitive environments. For instance, targeting other traits such as risk attitudes, overconfidence, and other factors not present in this experiment, could be more effective than targeting the trait of competition itself.

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Appendix

A.1 Theoretical framework – Additional details

To obtain Equation 3 in our theoretical framework, we use the following two equations:

$$belief_i * U(\pi_i^H, C) + (1 - belief_i) * U(\pi_i^L, C) > prob_i^H * U(\pi_i^H, 0) + (1 - prob_i^H) * U(\pi_i^L, 0),$$

and

$$U(\pi_i, C) = U(\pi_i, 0) + \theta_i.$$

In addition, we assume without loss of generality that $U(\pi, 0) = U(\pi))$ to obtain the following expression:

$$belief_i * [U(\pi_i^H) + \theta_i] + (1 - belief_i) * [U(\pi_i^L) + \theta_i] > prob_i^H * U(\pi_i^H) + (1 - prob_i^H) * U(\pi_i^L)$$
$$belief_i * [U(\pi_i^H) - U(\pi_i^L)] + \theta_i + U(\pi_i^L) > prob_i^H * [U(\pi_i^H) - U(\pi_i^L)] + U(\pi_i^L)$$
$$\theta_i > (prob_i^H - belief_i)[U(\pi^H) - U(\pi^L)]$$

A.2 Experimental design – Additional details

In this first section of the appendix we provide additional details for our experimental design. Specifically, we provide additional information for the selection of the payment-scheme task and the belief elicitation tasks.

Part 2 - Selection of the payment-scheme

In Table 3, we describe the HA and LA for the five decision sets in Part 2 of the experimental design.

Table 3. Values for the lotteries in the five decision sets

Decision set	High amount (HA in euros)	Low amount (LA in euros)
1	4	0
2	6	0
3	1.5	0
4	4	1
5	2	0.5

Part 1a - Beliefs before selection of the payment scheme

In this subsection, we explain in detail how we obtain the probabilities for the Individual Pay from the subjective beliefs participants provide in the belief elicitation task. We refer to the subjective belief as *Prediction* and use it to estimate the reference probability, i.e. *Refprob*, used in the Individual Pay. As a first step, we take *Prediction* and add a random number between 2.5 and -2.5, as displayed below:

$$Refprob = round[Prediction + (1 - 2 * random()) * 2.5, 1]; \tag{4}$$

Thus, for each decision set x, where $x \in [1,5]$, and group size $size$, where $size \in \{3,6\}$, we ensure the $Refprob$ has a minimum value within the range of the subjective belief, with the following logic formula[36]:

$$\begin{aligned} Refprob = \min[Refprob, 92 + \; & if(x = 2, 4, 0) \\ & if(x = 3, -4, 0) \\ & if(x = 5, -8, 0) \\ & if(x = 4 \;\&\; size = 6, -4, 0) \\ & if(x = 4 \;\&\; size = 6, -4, 0)] \end{aligned} \tag{5}$$

And that for each decision set x and group size $size$, $Refprob$ has a maximum value within the range of the subjective belief, with the following logic formula:

$$\begin{aligned} Refprob = \max[Refprob, 10 + \; & if(x = 2, -5, 0) \\ & if(x == 3, 5, 0) \\ & if(x == 5, 10, 0) \\ & if(x = 4 \;\&\; size = 6, 5, 0) \\ & if(x = 6 \;\&\; size = 6, 5, 0)] \end{aligned} \tag{6}$$

With this value of $Reprob$, we calculate for each decision set x the probability in the Individual Pay in every row z (i.e. $IP_x(z)$), with the formulas in Table 4, where $z \in [1, 10]$.

Table 4. Probability values for the Individual Pay in Treatment 1

Decision set x	**Probability in the Individual Pay** $IP_x(z)$
1	$IP_1(z) = Refprob + 2 * (z - 6)$
2	$IP_2(z) = Refprob + 1 * (z - 6)$
3	$IP_3(z) = Refprob + 3 * (z - 6)$
4	$IP_4(z) = Refprob + if(size == 3, 2, 3) * (z - 6)$
5	$IP_5(z) = Refprob + 4 * (z - 6)$

[36] Note that the expression $if(x = a, b, c)$ is interpreted as: if the decision set is equal to a, then take the value of b, otherwise take the value of c.

Part 1b - Beliefs after selection of the payment scheme

In this second treatment, participants face two additional decision sets to the five decision sets they face in treatment one. In the following steps, we describe in detail how we obtain the probabilities displayed in the Individual Pay in the five decision sets.

1. From the first additional set, we take the number of times participants choose the Competitive Pay and multiply this amount by ten (we call this value $Prediction_1$). With $Prediction_1$, we generate the probabilities for the second additional decision set for each row z in the Individual Pay, where $z \in [1, 10]$. Specifically, for each row z, the individual probability is calculated with the following logic equation:

$$IP(z) = 30 + if(Prediction_1 > 35, 25, 0) + if(Prediction_1 > 65, 20, 0) + 5 * (z - 6) \tag{7}$$

   Equation 7 calibrates the obtained value of $Prediction_1$ and transforms it into 10 different probabilities $IP(z)$ for each row z in the Individual Pay. That is, it ensures that for any value of $Prediction_1$, the probabilities in $IP(z)$ do no exceed 100 and are in the range around their predicted belief from the first set.

2. After we obtain the switching behavior of participants in the second additional decision set, we take the number of times participants choose the Competitive Pay and multiply this amount by ten (we call this value $Prediction_2$). Similar to the first prediction, we calibrate $Prediction_2$ with With Equation 8:

$$Prediction_2 = 2.5 + if(Prediction_1 > 35, 25, 0) + if(Prediction_1 > 65, 20, 0) \tag{8}$$

3. With Equation 8, we calibrate this prediction with the number of times the individual choose the Competitive Pay in this second set: $FinalPrediction = Prediction_2 + 5*(\textit{Number of times Competitive Pay})$. With this last $FinalPrediction$, we calculate the reference probability (i.e. $Refprob$) as we did for treatment 1 (see equations 4, 5, 6, and Table 4).

A.3 Descriptive statistics by group size

Table 5 displays a summary of the average amount of correct sums in the adding task and the average reported belief of being the winner in a group of three and six people. Participants solve on average 11 sums correctly in both groups and report an average belief of being the winner of 53% in a group of three and 41% in a group of six people. A two-sample Wilcoxon ranksum (Mann-Whitney) non-parametric test reveals the following patterns for the different means displayed in Table 5. There are no differences in performance conditional of the group size ($p = 0.792$), but significant differences in the reported beliefs between the two group sizes ($p < 0.01$). This finding suggests that people believe to have lower chances of winning the tournament in a group of six people than in a group of three. In addition, we observe that there are significant differences in performance between men and women in a group of three and six people (two-sample Wilcoxon ranksum Mann-Whitney test, $p = 0.051$ and $p = 0.027$, respectively). The non-parametric test also shows that there are significant differences in beliefs between men and women only in a group of six people but not in a group of three people ($p = 0.046$ and $p = 0.307$, respectively).

Table 5. Summary behavior in the experimental tasks

	Group size	**Women** (n=133)	**Men** (n=91)	**All** (n=224)
Adding Task performance	3	10.87	12.27	11.44
	6	10.72	12.07	11.27
	Average	10.80	12.17	11.35
Average reported belief of being the winner	3	52.49	54.80	53.43
	6	37.90	44.72	40.67
	Average	45.19	49.76	47.05

Note: values represent the average performance in the adding task or average reported belief for each category, i.e., different group sizes, gender, and all participants.

A.4 Mean Preference for competition

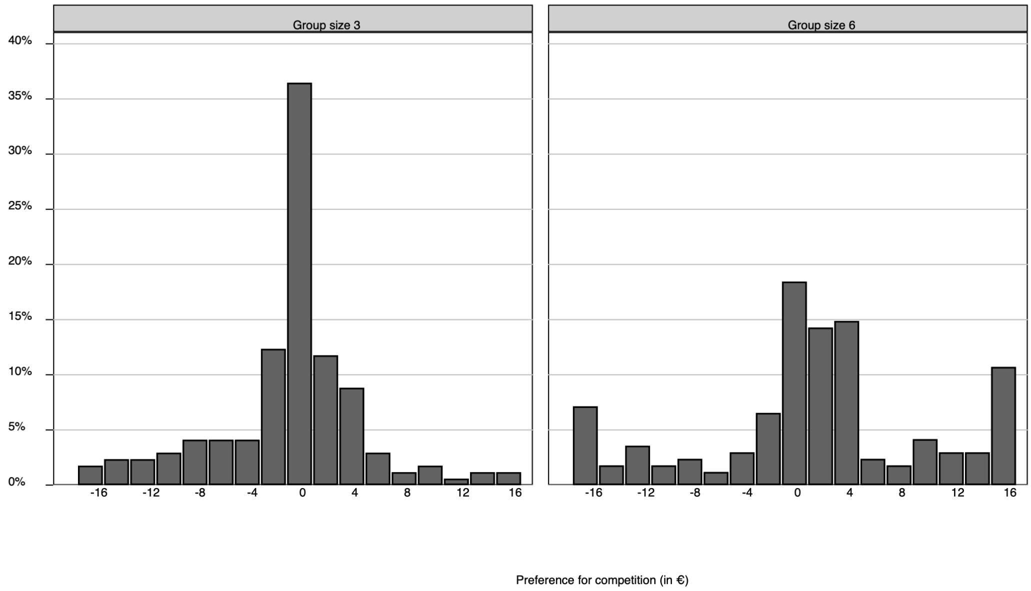


Figure 4. Mean Preferences for Competition by size

A.5 Analysis separate by ORDER

In this subsection we present the results for consistency and measurement of preferences for competition separate by the order in which they played the experimental task (i.e., first or second time).

Table 6. Consistency behavior within decision sets and individual level by order and group size

a. Switching behavior *within decision sets*

	Order 1		Order 2	
	Size 3 [n=550]	Size 6 [n=570]	Size 3 [n=570]	Size 6 [n=550]
Inconsistent behavior				
Multiple switch	3.64%	2.63%	0.88%	2.36%
Irrational switch	2.73%	2.11%	1.05%	2.18%
Consistent behavior				
Single rational switch	76.91%	78.07%	77.02%	73.82%
No switch	16.73%	17.19%	21.05%	21.64%

Note: percentage of decision sets with a rational and irrational switching behavior. For the decision sets with consistent behavior, there are two possibilities: single rational switch (i.e., from competitive pay to individual pay) or no switch at all. For the decision sets with irrational behavior, there are two possibilities as well: switch more than once or switch irrationally (i.e., from individual pay to competitive pay).

b. Switching behavior *within individuals*

	Order 1		Order 2	
	Size 3 [n=550]	Size 6 [n=570]	Size 3 [n=570]	Size 6 [n=550]
Inconsistent behavior				
Multiple or irrational switch	11.82%	11.40%	6.14%	11.82%
Consistent behavior				
No multiple or irrational switch	88.18%	88.6%	93.86%	88.12%
Rational switch in three or more	79.09%	78.07%	72.81%	71.82%
Rational switch in all five	52.73%	49.12%	56.14%	41.82%

Note: percentage of individuals with a consistent and inconsistent switching behavior for both group sizes and the corresponding number of individuals [n]. Individuals with inconsistent behavior are those that have at least one decision set with multiple switches or with an irrational switch. For the participants with consistent behavior, we display three categories: individuals that have no sets at all with multiple switches or with an irrational switch; individuals that have a rational switch in three or more decision sets (i.e., switched rationally in a majority of sets), and no switch in the other sets; or individuals with a rational switch in all five decision sets (i.e., switched rationally in all sets).

Table 6 displays the average switching behavior at set level and individual level by order (sub-tables 6a and 6b, respectively). For the results of measurement of preferences for competition, Figures 5 and 6 show the distribution of ω_i by size, for both orders. Figures 7 and 8 show the intensity of these preferences (i.e. whether they are consistently positive, negative or not defined) by size, for both orders.

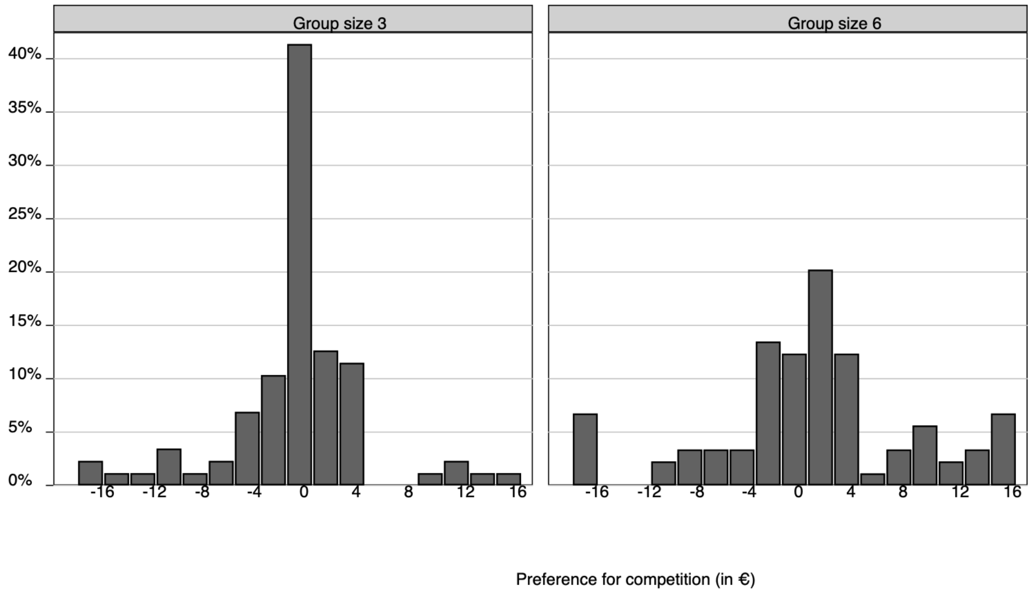


Figure 5. Preferences for Competition by size for Order 1, ω_i

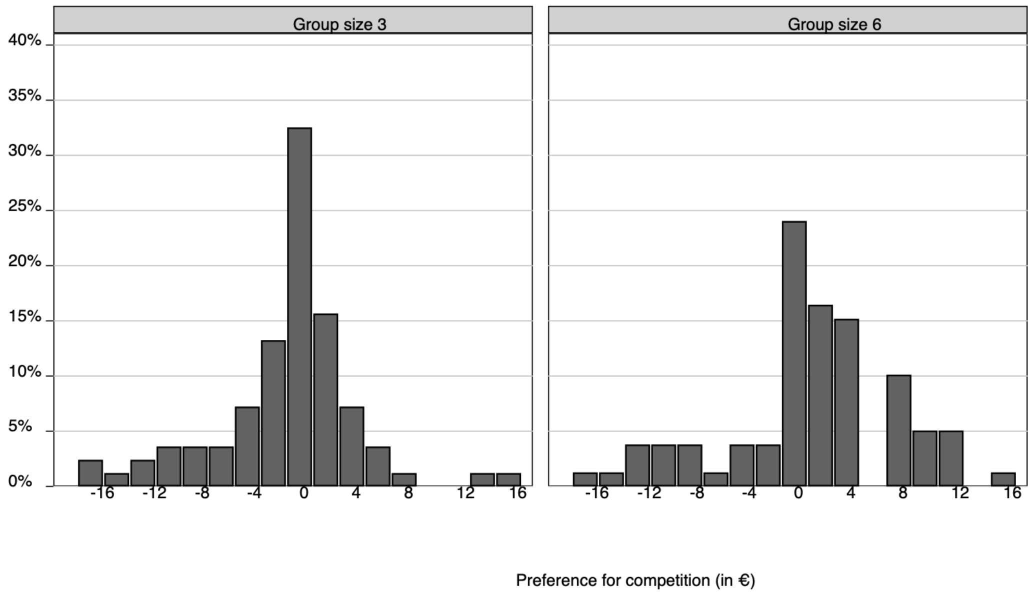


Figure 6. Preferences for Competition by size for Order 2, ω_i

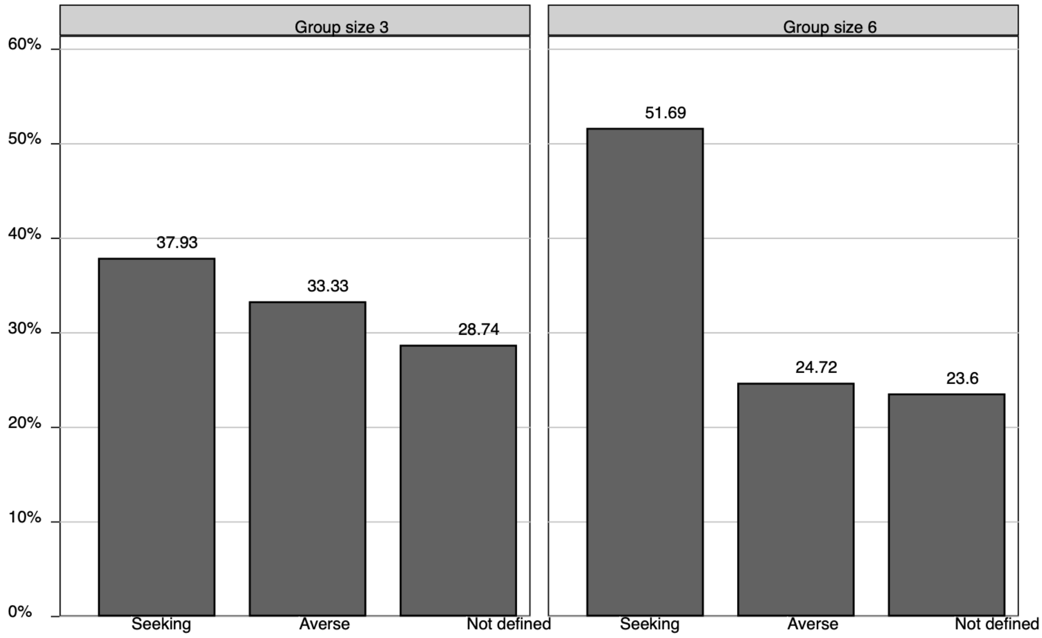


Figure 7. Intensity of Preferences for Competition by size for Order 1, ω_i

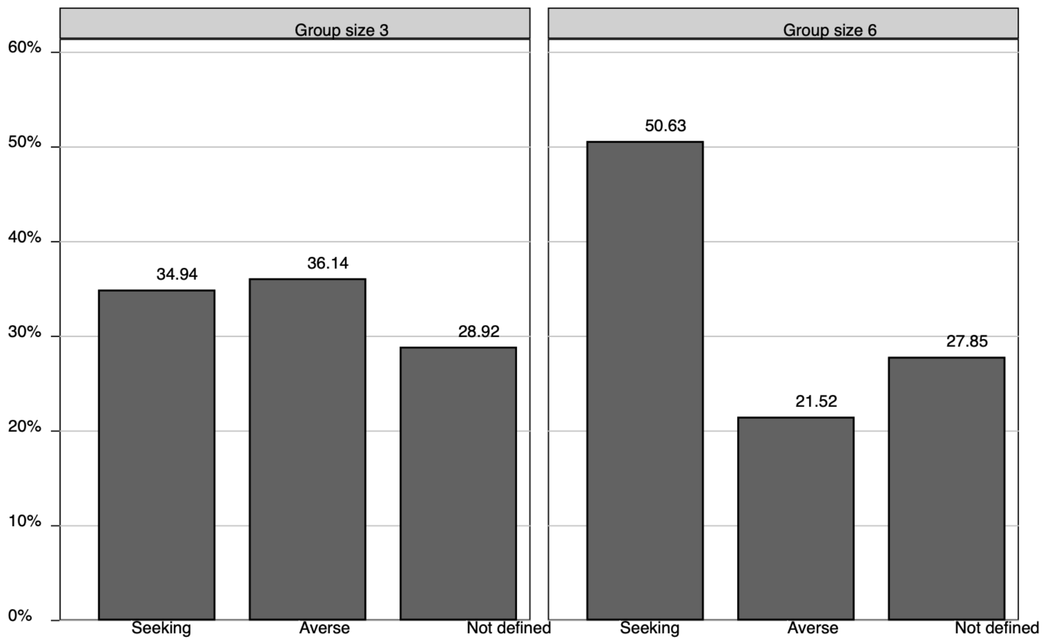


Figure 8. Intensity of Preferences for Competition by size for Order 2, ω_i

A.6 Analysis whole sample - Including inconsistent ones

In this subsection we present the results measurement of preferences for competition without removing the participants that have inconsistent switching behavior or have less than three decision sets with a rational switch.

Figure 9 shows the distribution of ω_i for both group sizes and Figure 10 show the intensity of these preferences (i.e. whether they are consistently positive or negative in three or more decision sets).

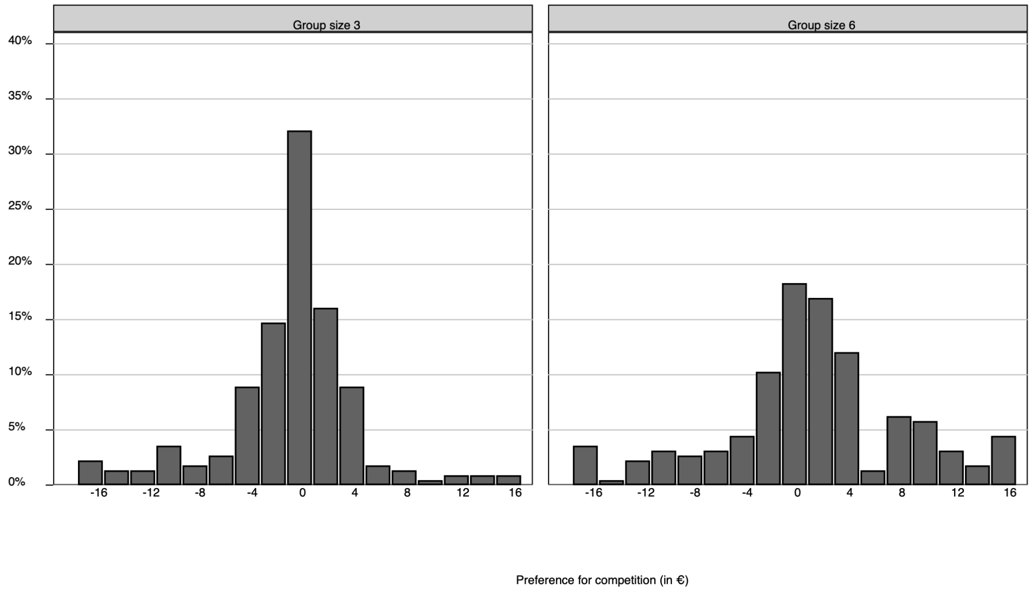


Figure 9. Distribution of ω_i by group size

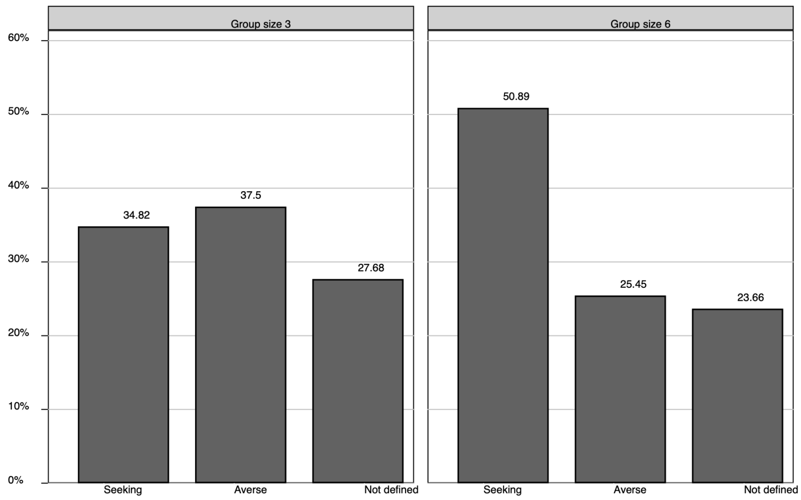


Figure 10. Interquartile ranges distribution of ω_i by group size

A.7 Analysis consistent ones including corner solutions

In this subsection we present the results measurement of preferences for competition without removing the participants that have more than two decision sets with corner solutions.

Figure 11 shows the distribution of ω_i for both group sizes and Figure 12 show the intensity of these preferences (i.e. whether they are consistently positive or negative in three or more decision sets).

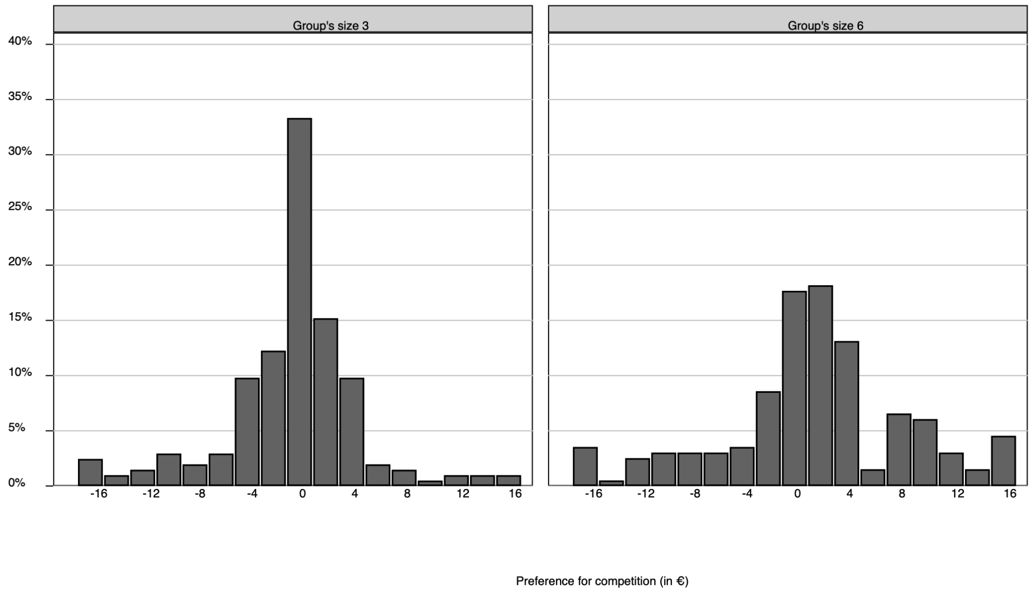


Figure 11. Distribution of ω_i by group size

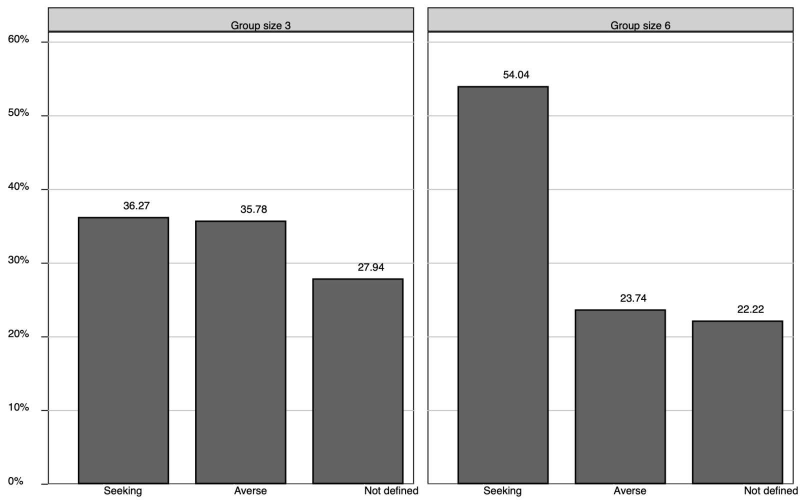


Figure 12. Interquartile ranges distribution of ω_i by group size

A.8 Analysis by gender

In this subsection we present the results for consistency and measurement of preferences for competition separate for men and women. Table 7 displays the average switching behavior at set level and individual level by gender.

For the results of measurement of preferences for competition, Figure 13 shows the intensity of these preferences (i.e. whether they are consistently positive, negative in three or more decision sets, or not defined).

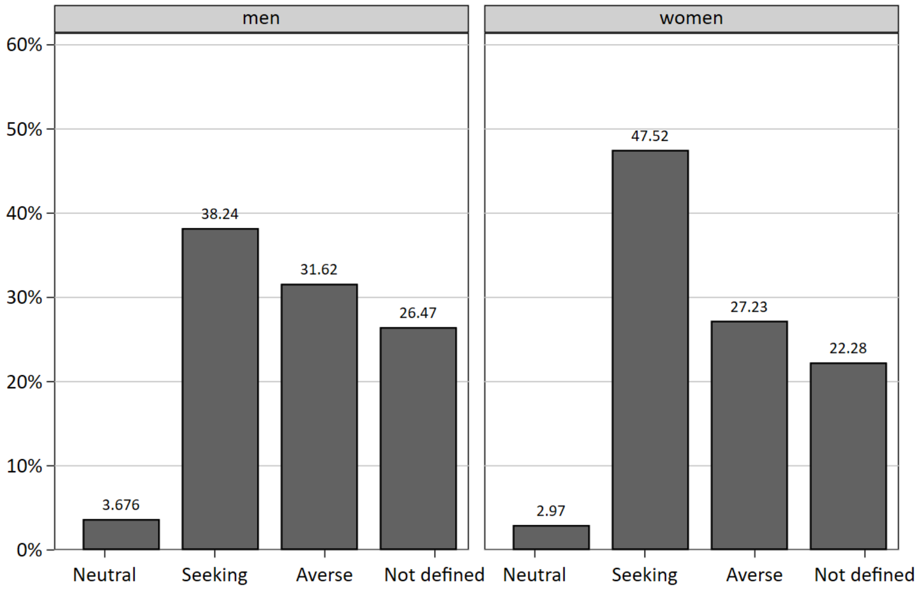


Figure 13. Intensity of Preferences for Competition

Table 7. Consistency behavior within decision sets and individual level

a. Switching behavior *within decision sets*

	Men [n=455]		**Women [n=655]**	
	Size 3	Size 6	Size 3	Size 6
Inconsistent behavior				
Multiple switch	1.32%	1.76%	2.86%	3.01%
Irrational switch	1.32%	2.20%	2.26%	2.11%
Consistent behavior				
Single rational switch	74.73%	75.16%	78.50%	76.54%
No switch	22.64%	20.88%	16.39%	18.35%

Note: percentage of decision sets with a rational and irrational switching behavior. For the decision sets with consistent behavior, there are two possibilities: single rational switch (i.e., from competitive pay to individual pay) or no switch at all. For the decision sets with irrational behavior, there are two possibilities as well: switch more than once or switch irrationally (i.e., from individual pay to competitive pay).

b. Switching behavior *within individuals*

	Men [n=91]		**Women [n=133]**	
	Size 3	Size 6	Size 3	Size 6
Inconsistent behavior				
At least one mult. or irrat. switch	6.59%	9.89%	10.53%	12.78%
Consistent behavior				
No multiple or irrational switch	93.41%	90.11%	89.47%	87.22%
Rational switch in three or more sets	73.63%	75.82%	77.44%	74.44%
Rational switch in all five sets	49.45%	46.15%	57.89%	45.22%

Note: percentage of individuals with a consistent and inconsistent switching behavior for both group sizes and the corresponding number of individuals [n]. Individuals with inconsistent behavior are those that have at least one decision set with multiple switches or with an irrational switch. For the participants with consistent behavior, we display three categories: individuals that have no sets at all with multiple switches or with an irrational switch; individuals that have a rational switch in three or more decision sets (i.e., switched rationally in a majority of sets), and no switch in the other sets; or individuals with a rational switch in all five decision sets (i.e., switched rationally in all sets).

A.9 Instructions

General Instructions - both group sizes

Welcome to the experiment. In the experiment today, you will be asked to complete five tasks. Before each task, you will receive detailed instructions and description of how your earnings in that task are determined.

Your total earnings at the end of the experiment are the sum of the following two components:

1. A €10 show-up fee;
2. Your earnings in one of the five tasks.

Specifically, at the end of the experiment, one of the five tasks you will complete during the experiment will be randomly chosen for payment purposes.

During the experiment, the use of cell phones is prohibited. All your information, decisions, and performance during this experiment are anonymous.

If you have a question, please raise your hand. An experimenter will come and answer your question in private.

Now you will start Task 1, please read the instructions of Task 1 carefully.

[new page]

Task 1

In Task 1, you will be randomly assigned to a group of three[six] participants. In other words, you will be matched with two[five] other participants in the room.

In Task 1 you will be given four minutes to calculate a series of sums of four two-digit numbers (see Figure 1). You cannot use a calculator, but you are welcome to use the provided scratch paper. You submit an answer by clicking the button "Next". When you submit an answer, the computer will immediately tell you whether the answer is correct or incorrect and a new sum is generated.

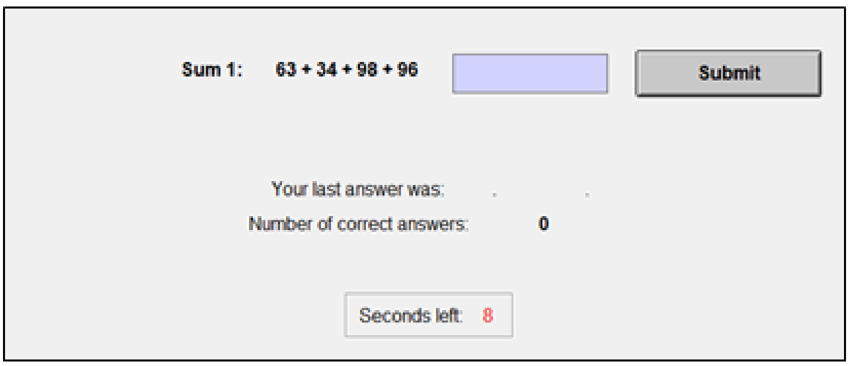


Figure 1

Your earnings in Task 1 depend on your number of correct sums. Specifically, you can earn either a high amount or a low amount per correct sum. The high amount will vary between €1.5 and €6 per correct sum, and the low amount will vary between €0 and €1. You will be given the precise values before you perform the task. Whether you are paid a high amount or a low amount depends on your choices. Before you perform the task, you will choose between **Individual Pay** and **Competitive Pay**. The two payments schemes are as follows:

Individual Pay: if you choose Individual Pay, whether you receive a high or low amount per correct sum depends on chance. With Individual Pay your earnings do NOT depend on the performance of others in your group.

Competitive Pay: if you choose Competitive Pay, whether you receive a high or low amount per correct sum depends on your performance and the performance of the other two[five] members of your group.

Specifically, you will be your group's winner if you solve more sums in Task 1 than all others in your group in Task 1. If there are ties, the winner will be randomly determined among the tied group members. If you are your group's winner, you will receive the high amount per correct sum.

If you are NOT your group's winner, then you are one of the two losers in the group. If you are one of the group's losers, you will receive the low amount per correct sum.

PRACTICE ROUND: Before Task 1 starts, you will have two minutes to get familiar with the screen and to practice the calculation of series of sums of four two-digit numbers. Please notice that your answers in this practice round will not be considered for your earnings in this experiment.

Once you are done reading, click on the "NEXT" button on your screen.

TASK 2 - Group of three

In this task, you can earn money by answering the following question:

How likely do you think it is that you are the winner of your group in Task 1?

Your answer can go from 0 (meaning you are completely certain that you are not the winner of your group) to 100 (meaning you are completely certain that you are the winner of your group). Your earnings in Task 2 can be either **€0 or €20**. The probability of earning €20 depends on two things:

1. The actual outcome (whether you are the winner or a loser in your group).
2. The likelihood you selected as the answer to the question above.

The closer the likelihood you choose is to your actual outcome in Task 1, the higher the probability you have of earning €20. This probability is based on the formulas you see in the footnote.[37] It is not necessary for you to understand precisely the formulas, but it's important that you know that these formulas have been designed so that **your expected earnings are higher the closer your answer is to your actual likelihood of being your group's winner**.

To help you to think about your likelihood of being your group's winner, it is useful to think **how your performance in Task 1 ranks compared to the performance of all participants.** The table provided in the next page displays this information. In the table you can see for each possible rank (from being on the top 0% to being on the top 100%) the likelihood that someone with that rank is the winner of a group of three.

The numbers on the table are calculated based on you being randomly assigned to a group of three people.

For example, imagine that your performance in Task 1 puts you in the Top 10%. This means that you performed better than 90% of all participants in the study and you performed worse than around 10% of all participants in the study. Then for you to be the winner it must be the case that ALL TWO of the other members of your group have a worse rank than you. In other words,

- You have been randomly matched ONLY with participants who ALL come from the 90% of participants who performed worse than you, and

- You have NOT been randomly matched with ANY of the 10% of participants who performed better than you. The table shows that, for someone in the Top 10%, the likelihood that this happens is 81.00%.

[37]Probability of earning €20 if you are the winner $= 1 - (1 - Yourselectedlikelihood/100)^2$ Probability of earning €20 if you are one of the losers $= 1 - (Yourselectedlikelihood/100)^2$

Your performance is in the Top ...	The likelihood that you are your group's winner is...
0%	100.00%
1%	98.01%
2%	96.04%
3%	94.09%
4%	92.16%
5%	90.25%
6%	88.36%
7%	86.49%
8%	84.64%
9%	82.81%
10%	81.00%
11%	79.21%
12%	77.44%
13%	75.69%
14%	73.96%
15%	72.25%
16%	70.56%
17%	68.89%
18%	67.24%
19%	65.61%
20%	64.00%
21%	62.41%
22%	60.84%
23%	59.29%
24%	57.76%
25%	56.25%
26%	54.76%
27%	53.29%
28%	51.84%
29%	50.41%
30%	49.00%
31%	47.61%
32%	46.24%
33%	44.89%
34%	43.56%
35%	42.25%
36%	40.96%
37%	39.69%
38%	38.44%
39%	37.21%
40%	36.00%
41%	34.81%
42%	33.64%
43%	32.49%
44%	31.36%
45%	30.25%
46%	29.16%
47%	28.09%
48%	27.04%
49%	26.01%
	continues →

Group size 3

Your performance is in the Top ...	The likelihood that you are your group's winner is...
50%	25.00%
51%	24.01%
52%	23.04%
53%	22.09%
54%	21.16%
55%	20.25%
56%	19.36%
57%	18.49%
58%	17.64%
59%	16.81%
60%	16.00%
61%	15.21%
62%	14.44%
63%	13.69%
64%	12.96%
65%	12.25%
66%	11.56%
67%	10.89%
68%	10.24%
69%	9.61%
70%	9.00%
71%	8.41%
72%	7.84%
73%	7.29%
74%	6.76%
75%	6.25%
76%	5.76%
77%	5.29%
78%	4.84%
79%	4.41%
80%	4.00%
81%	3.61%
82%	3.24%
83%	2.89%
84%	2.56%
85%	2.25%
86%	1.96%
87%	1.69%
88%	1.44%
89%	1.21%
90%	1.00%
91%	0.81%
92%	0.64%
93%	0.49%
94%	0.36%
95%	0.25%
96%	0.16%
97%	0.09%
98%	0.04%
99%	0.01%
100%	0.00%

Figure 14. Ranking table

You will indicate your likelihood of being your group's winner in a screen like the one below. As you can see, there are two sliders in the top part of the screen. You can select your answer by moving the cursors in these two different sliders:

- **In the black slider**, you can select your likelihood of being the winner of your group. Your answer can go from 0% (meaning you are completely certain that you are not the winner of your group) to 100% (meaning you are completely certain that you are the winner of your group).
- **In the green slider**, you can select how your performance in task 1 ranks compared to the performance of all participants.
  Your answer can go from Top 100% (you performed worse than ALL other participants of the study) to Top 0% (you performed better than ALL other participants in the study).

Please notice that the information displayed in both sliders is always consistent with each other. In other words, when you select a likelihood on the black slider, the cursor on the green slider will automatically mark the rank associated with your selected likelihood. Similarly, when you select a rank on the green slider, the cursor on the black slider will automatically mark the likelihood associated with your selected rank. The values of the sliders are based on the numbers you can see in the table of the previous page.

The cursors will appear on the sliders only after you have clicked on one of the sliders for the first time.

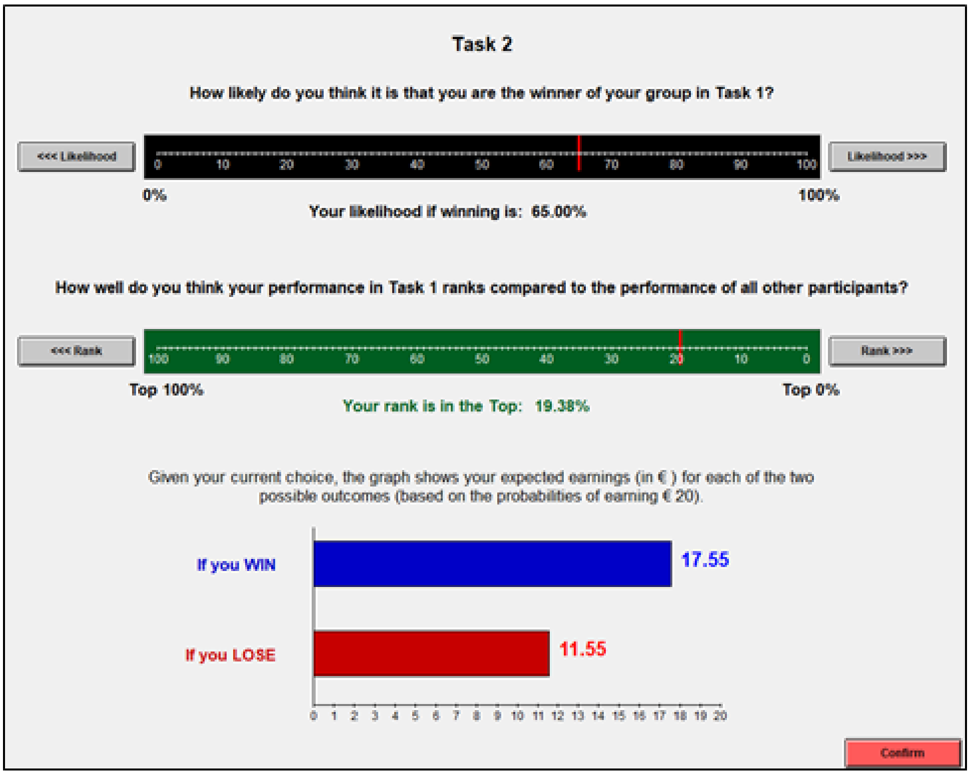


Figure 15. Task 2 - Screen example

To help you to understand the consequences of your choice, below the sliders, you will also see the **expected earnings** associated to your choice in the two possible outcomes: in case **you are the winner**, and in case **you are one of the losers** of your group. You will obtain the highest expected earnings if **your answer equals the actual likelihood of you being the winner**.

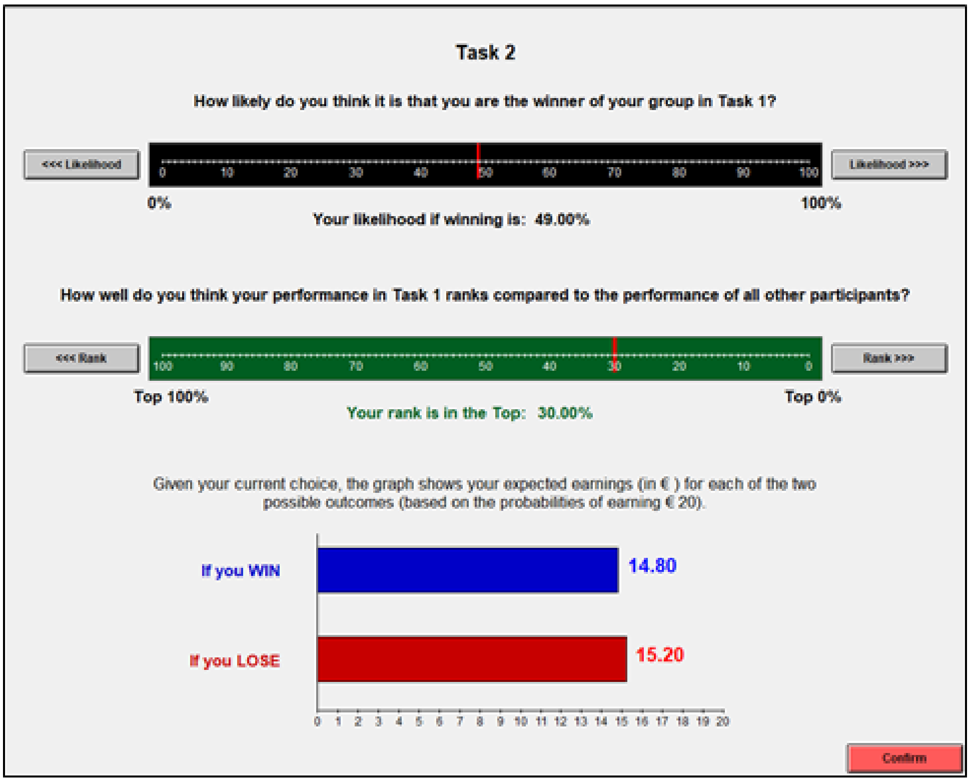
Please remember that your earnings in Task 2 are either **€0 or €20**, therefore, your expected earnings are equal to €20 multiplied by the probability of earning the €20 (which is calculated with the formulas in footnote 1).

We provide an example below to illustrate how your earnings depend on your answers (note that the numbers used in this example are not indicative of what constitutes a good or bad answer in this task).

Example

Imagine that among the students taking part in this study, your performance in Task 1 puts you in the **Top 30%**. In other words, 70% of the study participants performed worse than you did and 30% performed better than you did. Recall that, for you to be the group's winner, it must be the case that ALL TWO of the other members of your group come from the 70% of participants who performed worse than you did. In this example, the probability that this occurs is 49.00% (see the table).

Suppose that your answer is 49.00% in the black slider and Top 30% in the green slider, as shown in the screen below.



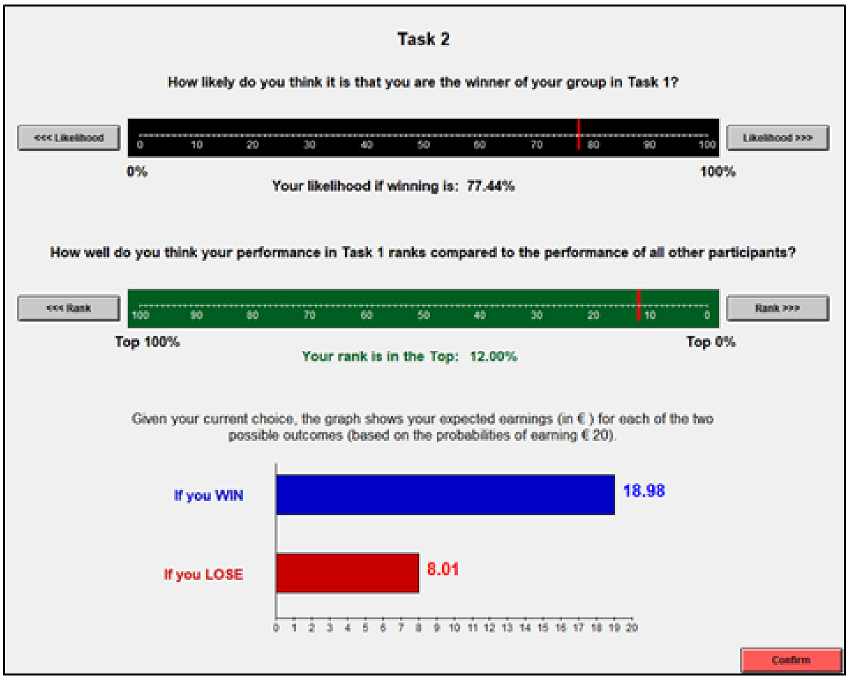
Then, as you can see with the bar graph in the screenshot:

- If you turn out to be the winner of your group, you can expect to earn in Task 2 **€14.80** on average (= €20 × probability of earning €20 if you are the winner).
- If you turn out to be one of the losers of your group, you can expect to earn in Task 2 **€15.20** on average (= €20 × probability of earning €20 if you are one of the losers).

Since the actual likelihood that you are the winner of your group is **49.00%**, this means that **49.00%** of the time you are the group's winner and **51.00%** of the time you are one of the losers. Overall, this means that you can expect to earn in Task 2 **€15.00 on average** (€15.00 = 0.49 × €14.80 + 0.51 × €15.20).

Now let's see what happens if you answer differently.

Continue to suppose that your performance places you in the **Top 30%**. However, imagine that this time your answer is 77.44% in the black slider and Top 12% in the green slider, as shown in the screen below.



Then, as you can see with the bar graph in the screenshot:

- If you turn out to be the winner of your group, you can expect to earn in Task 2 **€18.98** on average (€20 × probability of earning €20 if you are the winner).
- If you turn out to be one of the losers of your group, you can expect to earn in Task 2 **€8.01** on average (€20 × probability of earning €20 if you are one of the losers).

Since the actual likelihood that you are the winner of your group is still **49.00%** (remember that you actually are in the Top 30%), this means you can expect to earn in Task 2 **€13.39 on average** (€13.39 = **0.49** × **€18.98** + **0.51** × **€8.01**).

Note that **€13.39** is lower than **€15.00**, which are the expected earnings from reporting 49.00% in the black slider and Top 30% in the green slider.

In conclusion and to reiterate, you will obtain the highest expected earnings in Task 2 if **your answer equals your actual likelihood of being the group's winner in Task 1**.

Once you are done reading, click on the "Next" button on your screen.

TASK 2 - Group of six

In this task, you can earn money by answering the following question:

How likely do you think it is that you are the winner of your group in Task 1?

Your answer can go from 0 (meaning you are completely certain that you are not the winner of your group) to 100 (meaning you are completely certain that you are the winner of your group). Your earnings in Task 2 can be either **€0 or €20**. The probability of earning €20 depends on two things:

1. The actual outcome (whether you are the winner or a loser in your group).
2. The likelihood you selected as the answer to the question above.

The closer the likelihood you choose is to your actual outcome in Task 1, the higher the probability you have of earning €20. This probability is based on the formulas you see in the footnote.[38] It is not necessary for you to understand precisely the formulas, but it's important that you know that these formulas have been designed so that **your expected earnings are higher the closer your answer is to your actual likelihood of being your group's winner**.

To help you to think about your likelihood of being your group's winner, it is useful to think **how your performance in Task 1 ranks compared to the performance of all participants.** The table provided in the next page displays this information. In the table you can see for each possible rank (from being on the top 0% to being on the top 100%) the likelihood that someone with that rank is the winner of a group of three.

The numbers on the table are calculated based on you being randomly assigned to a group of six people.

For example, imagine that your performance in Task 1 puts you in the Top 10%. This means that you performed better than 90% of all participants in the study and you performed worse than around 10% of all participants in the study. Then for you to be the winner it must be the case that ALL FIVE of the other members of your group have a worse rank than you. In other words,

- You have been randomly matched ONLY with participants who ALL come from the 90% of participants who performed worse than you, and

- You have NOT been randomly matched with ANY of the 10% of participants who performed better than you. The table shows that, for someone in the Top 10%, the likelihood that this happens is 81.00%.

[38] Probability of earning €20 if you are the winner = $1 - (1 - Yourselectedlikelihood/100)^2$ Probability of earning €20 if you are one of the losers = $1 - (Yourselectedlikelihood/100)^2$

Group of 6

Your performance is in the Top ...	The likelihood that you are your group's winner is...
0%	100.00%
1%	95.10%
2%	90.39%
3%	85.87%
4%	81.54%
5%	77.38%
6%	73.39%
7%	69.57%
8%	65.91%
9%	62.40%
10%	59.05%
11%	55.84%
12%	52.77%
13%	49.84%
14%	47.04%
15%	44.37%
16%	41.82%
17%	39.39%
18%	37.07%
19%	34.87%
20%	32.77%
21%	30.77%
22%	28.87%
23%	27.07%
24%	25.36%
25%	23.73%
26%	22.19%
27%	20.73%
28%	19.35%
29%	18.04%
30%	16.81%
31%	15.64%
32%	14.54%
33%	13.50%
34%	12.52%
35%	11.60%
36%	10.74%
37%	9.92%
38%	9.16%
39%	8.45%
40%	7.78%
41%	7.15%
42%	6.56%
43%	6.02%
44%	5.51%
45%	5.03%
46%	4.59%
47%	4.18%
48%	3.80%
49%	3.45%
	continues →

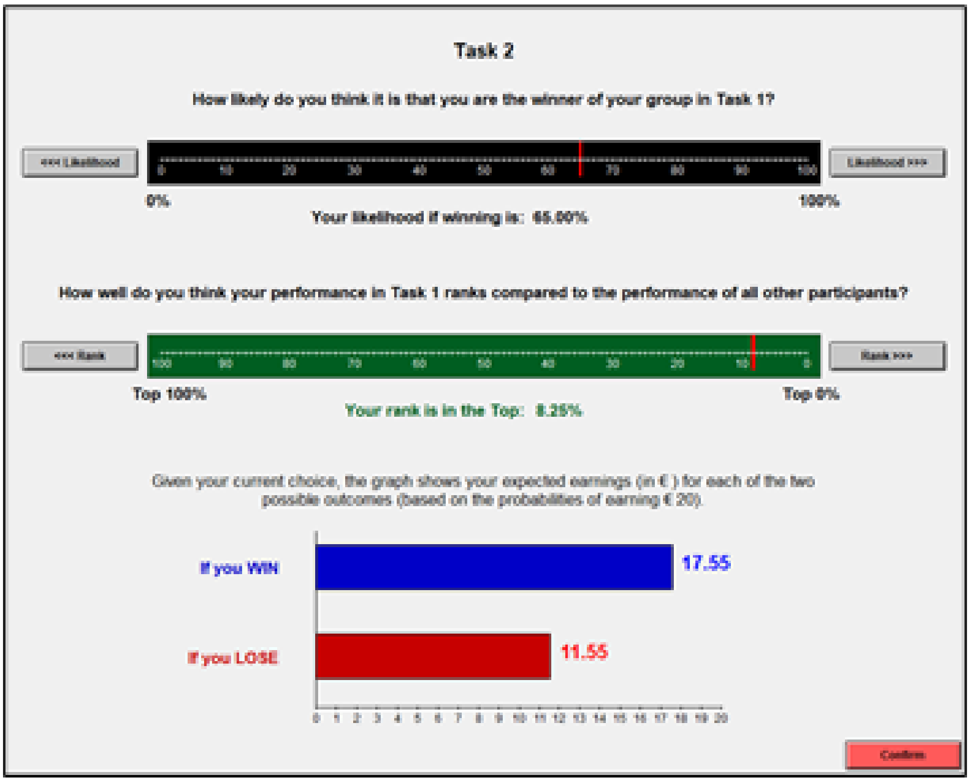
Your performance is in the Top ...	The likelihood that you are your group's winner is...
50%	3.13%
51%	2.82%
52%	2.55%
53%	2.29%
54%	2.06%
55%	1.85%
56%	1.65%
57%	1.47%
58%	1.31%
59%	1.16%
60%	1.02%
61%	0.90%
62%	0.79%
63%	0.69%
64%	0.60%
65%	0.53%
66%	0.45%
67%	0.39%
68%	0.34%
69%	0.29%
70%	0.24%
71%	0.21%
72%	0.17%
73%	0.14%
74%	0.12%
75%	0.10%
76%	0.08%
77%	0.06%
78%	0.05%
79%	0.04%
80%	0.03%
81%	0.02%
82%	0.02%
83%	0.01%
84%	0.01%
85%	0.01%
86%	0.01%
87%	0.00%
88%	0.00%
89%	0.00%
90%	0.00%
91%	0.00%
92%	0.00%
93%	0.00%
94%	0.00%
95%	0.00%
96%	0.00%
97%	0.00%
98%	0.00%
99%	0.00%
100%	0.00%

You will indicate your likelihood of being your group's winner in a screen like the one below. As you can see, there are two sliders in the top part of the screen. You can select your answer by moving the cursors in these two different sliders:

- **In the black slider**, you can select your likelihood of being the winner of your group. Your answer can go from 0% (meaning you are completely certain that you are not the winner of your group) to 100% (meaning you are completely certain that you are the winner of your group).
- **In the green slider**, you can select how your performance in task 1 ranks compared to the performance of all participants.
  Your answer can go from Top 100% (you performed worse than ALL other participants of the study) to Top 0% (you performed better than ALL other participants in the study).

Please notice that the information displayed in both sliders is always consistent with each other. In other words, when you select a likelihood on the black slider, the cursor on the green slider will automatically mark the rank associated with your selected likelihood. Similarly, when you select a rank on the green slider, the cursor on the black slider will automatically mark the likelihood associated with your selected rank. The values of the sliders are based on the numbers you can see in the table of the previous page.

The cursors will appear on the sliders only after you have clicked on one of the sliders for the first time.



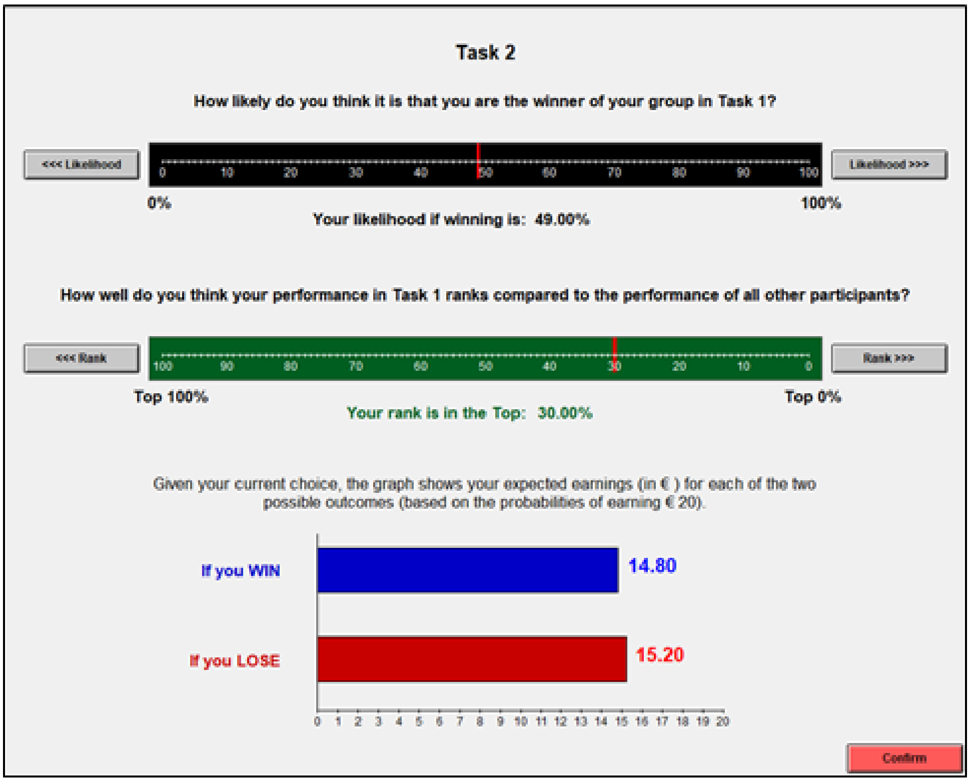
To help you to understand the consequences of your choice, below the sliders, you will also see the **expected earnings** associated to your choice in the two possible outcomes: in case **you are the winner**, and in case **you are one of the losers** of your group. You will obtain the highest expected earnings if **your answer equals the actual likelihood of you being the winner**.

Please remember that your earnings in Task 2 are either **€0 or €20**, therefore, your expected earnings are equal to €20 multiplied by the probability of earning the €20 (which is calculated with the formulas in footnote 1).

We provide an example below to illustrate how your earnings depend on your answers (note that the numbers used in this example are not indicative of what constitutes a good or bad answer in this task).

Example
Imagine that among the students taking part in this study, your performance in Task 1 puts you in the **Top 30%**. In other words, 70% of the study participants performed worse than you did and 30% performed better than you did. Recall that, for you to be the group's winner, it must be the case that ALL FIVE of the other members of your group come from the 70% of participants who performed worse than you did. In this example, the probability that this occurs is **16.81%** (see the table).

Suppose that your answer is 16.81S% in the black slider and Top 30% in the green slider, as shown in the screen below.



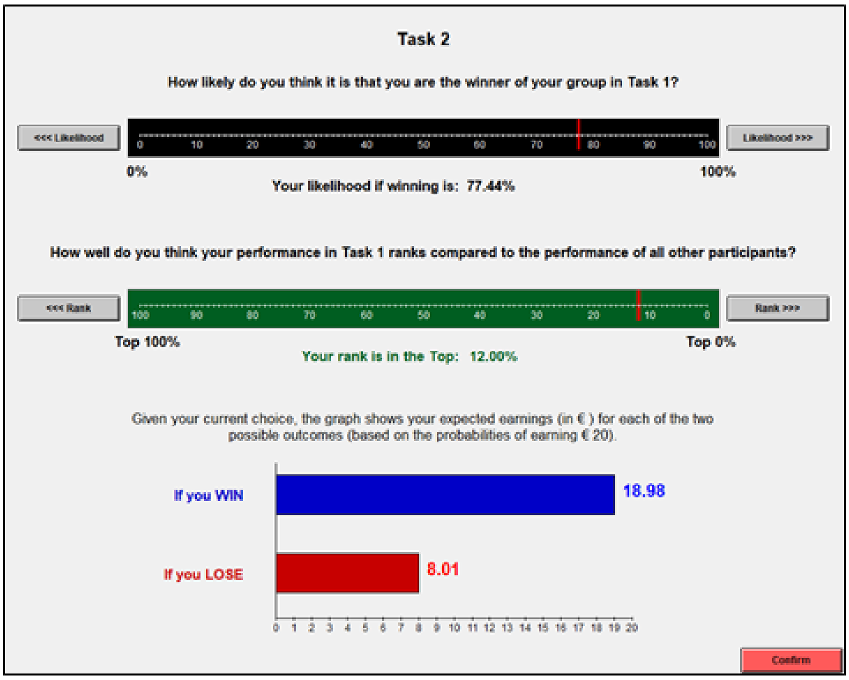
Then, as you can see with the bar graph in the screenshot:

- If you turn out to be the winner of your group, you can expect to earn in Task 2 **€6.16** on average (= €20 × probability of earning €20 if you are the winner).
- If you turn out to be one of the losers of your group, you can expect to earn in Task 2 **€19.43** on average (= €20 × probability of earning €20 if you are one of the losers).

Since the actual likelihood that you are the winner of your group is **16.81%**, this means that **16.81%** of the time you are the group's winner and **83.19%** of the time you are one of the losers. Overall, this means that you can expect to earn in Task 2 **€17.20 on average** (€15.00 = 0.1681 × €6.16 + 0.8319 × €19.43).

Now let's see what happens if you answer differently.

Continue to suppose that your performance places you in the **Top 30%**. However, imagine that this time your answer is 52.77% in the black slider and Top 12% in the green slider, as shown in the screen below.



Then, as you can see with the bar graph in the screenshot:

- If you turn out to be the winner of your group, you can expect to earn in Task 2 **€15.54** on average (€20 × probability of earning €20 if you are the winner).
- If you turn out to be one of the losers of your group, you can expect to earn in Task 2 **€€14.43** on average (€20 × probability of earning €20 if you are one of the losers).

Since the actual likelihood that you are the winner of your group is still **16.81%** (remember that you actually are in the Top 30%), this means you can expect to earn in Task 2 **€15.02 on average** (€15.02 = **0.1681** × **€15.54** + **0.8319** × **€14.43**).

Note that **€15.02** is lower than **€17.20**, which are the expected earnings from reporting 16.81% in the black slider and Top 30% in the green slider.

In conclusion and to reiterate, you will obtain the highest expected earnings in Task 2 if **your answer equals your actual likelihood of being the group's winner in Task 1**.

Once you are done reading, click on the "Next" button on your screen.

YOUR PAYMENT CHOICE IN TASK 1 - both group sizes

Next you are going to perform Task 1, but before performing the task, you must choose how you want to be paid for each correct sum in Task 1. Recall that you can choose between **Individual Pay** and **Competitive Pay**.

You will be asked to make choices in 5 **different decision sets**. All these decision sets are completely independent of each other. An example of one decision set is displayed in the screenshot below.

	Competitive Pay		Individual Pay
1.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **17%** chance and € 1.00 with **83%** chance
2.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **20%** chance and € 1.00 with **80%** chance
3.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **23%** chance and € 1.00 with **77%** chance
4.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **26%** chance and € 1.00 with **74%** chance
5.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **29%** chance and € 1.00 with **71%** chance
6.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **32%** chance and € 1.00 with **68%** chance
7.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **35%** chance and € 1.00 with **65%** chance
8.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **38%** chance and € 1.00 with **62%** chance
9.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **41%** chance and € 1.00 with **59%** chance
10.	€ 4.00 if you win and € 1.00 if you lose		€ 4.00 with **44%** chance and € 1.00 with **56%** chance

Each decision set consists of a table with a series of choices:

- The left-choices correspond to **Competitive Pay**. Under Competitive Pay your earnings in Task 1 depend on your performance and the performance of others in your group. Specifically, if are the winner of your group then you earn the high amount per correct sum, otherwise you earn the low amount per correct sum.
- The right choices correspond to **Individual Pay**. Under Individual Pay your earnings in Task 1 depend on your performance and on chance. Specifically, you earn the high amount per correct sum with some probability X [a number between 1 and 100]. To determine your earnings, you will throw two ten-sided dice to randomly generate a number between 1 and 100. If the number you generate is lower than the probability X then you earn the high amount per correct sum, otherwise you earn the low amount per correct sum.

You must decide in every row whether you prefer **Individual Pay** or **Competitive Pay**.

Notice that in a decision set, the high and low amounts for Competitive Pay are the same in all rows. In some decision sets, what varies from row to row is the probability of getting the high amount in Individual Pay. In other decision sets, what varies from row to row is the high amount in Individual Pay.

At the end of the experiment, one of the 8 decision sets will be randomly selected. Within the selected decision set, one of the 10 rows will be randomly selected. The type of payment you chose in the selected row will be used to determine how much you will receive per correct sum in Task 1.

Example 1

Take a look at the choices in the screenshot below. Now, imagine that this decision set is randomly selected for payment and within this decision set, row number 4 is randomly selected. Given that **Individual Pay** was chosen instead of a **Competitive Pay** in this row, then:

- With 27% of chance, you will earn €5 per correct sum in Task 1 [the high amount].
- With 73% of chance, you will earn €0 per correct sum in Task 1 [the low amount].

	Competitive Pay		Individual Pay
1.	**€ 6.00 if you win and € 0.00 if you lose**	◉ ○	€ 6.00 with **21%** chance and € 0.00 with **79%** chance
2.	**€ 6.00 if you win and € 0.00 if you lose**	◉ ○	€ 6.00 with **23%** chance and € 0.00 with **77%** chance
3.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 25% chance and € 0.00 with 75% chance**
4.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 27% chance and € 0.00 with 73% chance**
5.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 29% chance and € 0.00 with 71% chance**
6.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 31% chance and € 0.00 with 69% chance**
7.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 33% chance and € 0.00 with 67% chance**
8.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 35% chance and € 0.00 with 65% chance**
9.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 37% chance and € 0.00 with 63% chance**
10.	€ 6.00 if you win and € 0.00 if you lose	○ ◉	**€ 6.00 with 39% chance and € 0.00 with 61% chance**

Now, imagine that instead of row number 4, the row randomly selected for payment is row number 2. Given that **Competitive Pay** was chosen instead of **Individual Pay** in this row, then:

- If you are the group's winner in Task 1, you earn €6 per correct sum [the high amount].
- If you are one of the group's losers in Task 1, you earn €0 per correct sum [the low amount].

TASK 3 - both group sizes

In Task 3 you will be perform again the same summation task you performed in Task 1. The main difference is that you will be randomly assigned to a group of six[three] participants instead of three.

TASK 4

Task 4 is like Task 2. In Task 4 you can earn money by answering the following question:

How likely do you think it is that you are the winner of your group in Task 3?

Again, your will be able to select your answer by moving the cursors in two different sliders:

- In the black slider, you can select your likelihood of being the winner of your group. Your answer can go from 0% (meaning you are completely certain that you are not the winner of your group) to 100% (meaning you are completely certain that you are the winner of your group).
- In the green slider, you can select how your performance in task 3 ranks compared to the performance of all participants.
  Your answer can go from Top 100% (you performed worse than ALL other participants of the study) to Top 0% (you performed better than ALL other participants in the study).

Your earnings in Task 4 will be calculated using the same formulas as in Task 2. Recall that you will obtain the highest expected earnings if your answer equals the actual likelihood of you being the winner in Task 3.

One important consideration for Task 4, is that to be the winner in Task 3, you need to be the best in a group of SIX[THREE]. The table provided in the next page displays the likelihood of being your group's winner in Task 3 depending on each possible rank. Logically, it is easier[harder] to be the winner in a group of three[six] than in a group of six[three]. This is why the percentages in the table for Task 4 are lower[higher] than the percentages in the table for Task 2.

[Ranking table for the corresponding group size - see page ** for a group size of 3 and page ** for a group size of 6]

TASK 5 - both group sizes

This is Task 5 of the experiment. The earnings from this part of the experiment are completely independent from the other tasks. The amount you earn depends **solely on your decisions and on chance**. Moreover, you will not perform further summation tasks.

You will be asked to make choices in **4 different decision tables**. All these decision tables are completely independent of each other. An example of one decision table is displayed in the screenshot below.

	Option A		Option B
1.	€ 28.80 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
2.	€ 30.24 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
3.	€ 31.68 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
4.	€ 33.12 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
5.	€ 34.56 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
6.	€ 36.00 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
7.	€ 37.44 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
8.	€ 38.88 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
9.	€ 40.32 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance
10.	€ 41.76 with certainty	○ ○	€ 72.00 with 50% chance and € 0.00 with 50% chance

Each table has 10 different decisions, each in a different row. Each decision has two options:

- **Option A**, where you can earn a different certain amount in each of the 8 rows.
- **Option B**, where you can earn a high amount with some probability and a low amount with some other probability. Specifically, you earn the high amount with some probability X [a number between 1 and 100]. To determine your earnings, you will throw two ten-sided dice to randomly generate a number between 1 and 100. If the number you generate is lower than the probability X then you earn the high amount, otherwise you earn the low amount.

You can decide for every row whether you prefer **Option A** or **option B**. Option A is the same for every row, while option B takes 8 different amounts, one for each row.

At the end of the experiment, one of the 4 decision tables will be randomly selected. Within the selected table, one of the 10 rows will be randomly selected. The choice you made in that row will determine your earnings of Task 5.