Measuring preferences for competition with experimentally-validated survey questions

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Abstract

We validate experimentally a new survey item to measure the preference for competition. The item, which measures participants' agreement with the statement "Competition brings the best out of me", predicts individuals' willingness to compete in the laboratory after controlling for their ability, beliefs, and risk attitude (Niederle and Vesterlund, 2007). We further validate the explanatory power of our survey item outside of the laboratory, by comparing responses across two samples with predicted differences in their preference for competition: professional athletes and non-athletes. As predicted, we find that athletes score higher on the item than non-athletes.

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1 Introduction

In recent years, economists have grown increasingly interested in non-cognitive factors to explain economic behavior. Heckman et al. (2019) review the economics literature and conclude that factors such as personality traits and preferences can explain and predict important life outcomes across a variety of social and economic domains, including labor market outcomes and health. If non-cognitive factors are an important source of behavior, it is essential to develop precise empirical tools to measure them accurately. Among such tools, economics experiments offer a number of clear advantages, since they allow the measurement of preferences and traits in an incentive-compatible way and controlling for the influence of confounding factors (Roth, 1995; Erkut and Reuben, 2019). One limitation of this approach, however, is that incentivized experiments may be less practical when conducting large-scale field studies with non-convenience samples (e.g., with members of the general population). In these studies incentivization is not always feasible (e.g., due to difficulties in paying participants, or because it would be prohibitively expensive), interaction between participants may not be easily organized, and there might be too little time to go through a lengthy experiment. For this reason, experimental and behavioral economists have started developing more portable tools that can be deployed quickly in field settings without incentives, while at the same time retaining the predictive power of incentive-compatible experimental measurements (e.g., Dohmen et al., 2011; Falk et al., 2018). The aim of this paper is to develop one such tool, designed to measure individuals' *preferences for competition*.

Preferences for competition have recently attracted substantial interest among economists. Studies have shown that laboratory measures of these preferences can explain important educational choices and labor market outcomes (e.g., Buser et al., 2014; Berge et al., 2015; Buser et al., 2017a,b; Reuben et al., 2017; Kamas and Preston, 2018; Reuben et al., 2019; Zhang, 2019). The preference for competition is measured through the experimental paradigm introduced by Niederle and Vesterlund (2007). Given that this paradigm, which consists of a sequence of interconnected tasks, may be difficult to implement outside of the laboratory, in this paper we develop a more flexible, experimentally-validated survey question to measure preferences for competition in settings that do not allow the high degree of implementation control of the lab.

Our approach to developing a survey item that captures preferences for competition is two-fold. First, we follow the methodology introduced by Falk et al. (2016) and Falk et al. (2018) to select and validate our question with observed behavior. We start with a list of eight candidate questions designed to capture either direct or indirect aspects of an individual's preference for competition. We administer these questions in a survey that participants completed online about two weeks before taking part in a laboratory experiment. In the laboratory experiment, we use a variation of the paradigm of Niederle and Vesterlund (2007) to measure participants'

preference for competition in an incentive-compatible way. We then run an econometric horse-race between our eight survey questions to identify the question that best explains behavior in the laboratory experiment. This exercise reveals that the survey item that best predicts the participants' preference component of their willingness to perform in a competitive environment is the statement: *"Competition brings the best out of me"* as an answer to a question asking participants to indicate the extent to which the statement describes them (answers ranging from "*Not at all like me*" to "*Exactly like me*").

In a second step, we corroborate the validity of our question by performing an additional validation exercise. This exercise consists in testing whether our question can predict behavior observed *outside of the lab*. We take an individual's decision to practice sports at a professional level as an indication of the person's preference for competition (Barron et al., 2000). We administer our survey question, under identical experimental conditions, to a group of professional athletes aged 18-30 and to a group of students, who do not practice sports professionally but are of comparable age. We corroborate the predictive power of our question by showing that professional athletes' agreement with the statement "Competition brings the best out of me" is much higher than among non-athletes.

This paper is related to work in social psychology on developing psychometric scales to capture the taste for competition (e.g., Smither and Houston, 1992; Newby and Klein, 2014). Our approach offers a number of advantages relative to these scales. First, our approach offers higher portability: the psychometric scales developed in the social psychology literature typically consist of multiple interrelated questionnaire items that cannot be deployed individually and therefore require considerable time to be administered. In contrast, we aim to develop a single question that can broadly capture people's preference for competition to facilitate its implementation in surveys and field applications. Second, our measure is experimentally-validated, as it predicts incentivized behavior in a controlled laboratory environment.[1]

Our paper is also related to concurrent work by Buser et al. (2020) who develop an unincentivized survey question to measure the preference for competition using a representative sample of the population in the Netherlands. They show that their question (which asks participants: "How competitive do you consider yourself to be?") is associated with the same educational and career outcomes as an experimental measure of the willingness to compete. We became aware of Buser et al. (2020)'s study only after we had designed our survey items and so we could not include their question in the battery of candidate questions that we tested in our experimental validation. Nevertheless, one of the questions we designed is coincidentally similar to the one used by Buser et al. (2020) (we ask participants whether the following statement

[1] An exception is the work of Bönte et al. (2017), who test the association between a psychometric scale designed to measure competitiveness and behavior in an incentivized experiment à la Niederle and Vesterlund (2007). They find a statistically significant correlation between the two.

describes them: "I see myself as a competitive person"). Hence, we can indirectly test how our preferred question compares with theirs. With our sample, our question has greater predictive power than the alternative question. Although this result suggests it is better to use our question, it would nevertheless be important to compare directly the predictive power of the two independently-developed survey items, which is a task that we leave to further research. Also related is Gill et al. (2019) who ask participants at the end of a rank-order tournament experiment to self-report their degree of competitiveness across four discrete categories. They find that participants in the most competitive category are more willing to work hard in the experiment.

The remainder of the paper is organized as follows. In Section 2, we describe our methodology to validate the survey questions using a laboratory experiment. In Section 3, we describe the validation exercise outside of the lab. Section 4 concludes.

2 Experimental validation

The main objective of our investigation is to identify a survey measure that captures the preference component of an individual's willingness to compete. We base our analysis on two sequential empirical strategies. The first strategy consists in finding, among a set of candidate survey items, the question that best correlates with having a preference for competition as identified in a *laboratory* environment. The second strategy probes the external validity of the first empirical analysis, by exploring whether the survey item that best explains preferences for competition in the laboratory can also explain the willingness of individuals to compete *outside of the lab*. In this section, we describe the design and results of the experimental validation of the survey questions, which constitutes our first strategy. We describe our strategy to examine the external validity of results in the next section.

2.1 Design and procedures

We conduct the experimental validation of the survey items in two steps. First, we elicit the participants' responses to a set of survey questions. Second, we invite participants to take part in a laboratory experiment designed to observe their competitive behavior and measure the extent to which it is due to a preference for competition.

We recruited 96 students from the University of Luxembourg through ORSEE (Greiner, 2015) to participate in a survey and a laboratory experiment (in English) at LISER-LAB between fall 2018 and spring 2019. Participants were invited to sign up for a laboratory session 14 days in advance. Immediately after registering, they received an invitation to take part in an online survey containing 38 questions. Among these questions, we included eight questions related to competition. The remaining questions consisted of standard questionnaires used to

Table 1. Candidate survey questions

Choose the scale to which the following statements describe you [7-point Likert scale labeled from 'Not at all like me' to 'Exactly like me']
Q1. I see myself as someone who enjoys winning and hates losing
Q2. I see myself as someone who enjoys competing, regardless of whether I win or lose
Q3. I see myself as a competitive person
Q4. Competition brings the best out of me
You and your friends are playing your favorite game. Does it make the game more fun if . . . [7-point Likert scale labeled from 'Not at all' to 'Extremely more fun']
Q5. Everyone puts in money for a prize for the winner
Please indicate the importance of each aspect below for accepting a job offer [7-point Likert scale labeled from 'Not important at all' to 'Essential']
Q6. Work environment is not too competitive [reverse coded]
Q7. Working for a prestigious organization
On a scale from 1 to 7 where 1 means you agree completely with the statement on the left and 7 means you agree completely with the statement on the right; how would you rate your views for the following statements?
Q8. [left] Competition is good. It stimulates people to work hard and develop new ideas. [right] Competition is harmful. It brings the worst in people.

measure personality traits, general values towards society, and demographic characteristics. We use a broad set of questions to avoid alerting participants that we are particularly interested in preferences for competition and thus limit any spillovers from the survey to the experiment. We provide the complete survey in Appendix A. On average, participants earned €19.82 for their participation in the survey and experiment.

We report the eight competition questions in Table 1.[2] We designed the first four questions with a preference for competition in mind. These questions use the well-tested structure of questionnaires designed to measure the big five personality traits (Goldberg, 1992). The four questions ask respondents directly whether they describe themselves as competitive. However, the questions emphasize different aspects of competition. Q1 focuses on the outcome of competition, namely, winning and losing (in line with the literature on the joy of winning in contests; Sheremeta, 2010); Q2 highlights enjoyment with the process of competing whilst deemphasizing the outcome; Q3 frames competition as a personal trait, and Q4 focuses on competition as motivating one's best qualities. We designed the next three questions to be context-specific. Q5 refers to competition in a social context, whereas Q6 and Q7 refer to it in a work context. Q7, in

[2]Some of the survey items are better described as statements instead of questions. However, for simplicity, we refer to them as questions throughout the paper.

particular, focuses on prestige because status-seeking is discussed as a plausible non-pecuniary motivation for competing in the field (see e.g., Buser et al., 2014). Finally, while these seven questions are designed by us, question Q8 is taken from the widely-used World Values Survey (Inglehart et al., 2014). All questions measure responses on a 7-point Likert scale.

To avoid alerting participants about the fact that we are studying preferences for competition and minimize spillovers to the lab experiment, in the survey the competition questions are embedded with other questions. Q1 through Q4 are part of a short version of the big-five questionnaire (Lang et al., 2011). Q5 is part of a three-item questionnaire, while Q6 and Q7 are part of a five-item questionnaire. In all questionnaires with multiple items, the order of the items is randomized to avoid order effects.

To further minimize spillovers between the survey and the experiment, participants are asked to complete the survey at least ten days before participating in the laboratory session. Of all participants who were invited, 90 (94%) completed the survey. This is the subset of participants we will use in the analysis.

Participants then take part in a laboratory experiment designed to measure preferences for competition (Niederle and Vesterlund, 2007). The experiment is computerized and programmed in zTree (Fischbacher, 2007). In the laboratory, we inform participants that the experiment consists of five parts, all of them incentivized, one of which will be randomly chosen for payment at the end of the experiment. Participants read the instructions for each part before the start of the respective part. Importantly, participants do not receive any information about the performance or choices of others until the end of experiment. We provide the instructions and screenshots of the experiment in Appendix B.

In parts one, two, and four, participants perform a real-effort task for four minutes. The task consists of finding the two highest numbers in two 4x4 matrices and add them up (for more details see, Weber and Schram, 2017). In part one, participants first perform the real-effort task for one minute as an unpaid trial run and then for four minutes for a piece-rate payment of €1.00 per correct answer. In part two, participants are assigned to groups of four and compete in a tournament that pays €4.40 per correct answer if they have the highest number of correct answers in their group (ties are broken randomly) and €0 otherwise.[3] In part three, we elicit the participants' belief about their relative performance by asking them to tell us their expected probability of being the tournament winner in part two. We incentivize their response using

[3]The majority of papers measuring preferences for competition equalize the expected payoff of the piece-rate and tournament payment schemes assuming that each participant has a $1/N$ chance of winning the tournament. In these papers, most subjects choose the piece-rate scheme. In order to achieve a better balance between subjects choosing the tournament vs. piece-rate scheme, we follow Saccardo et al. (2018) and calibrate the tournament incentives so that in expectation the tournament pays more than the piece-rate. In Saccardo et al. (2018) the tournament pays 50% more than the piece-rate while in our experiment it pays 10% more.

the scoring rule proposed by Wilson and Vespa (2018), which is robust to varying degrees of risk aversion.

We observe the participants' willingness to compete in part four. In this part, we inform participants that they will perform the real-effort task once again and ask them to choose how they want to be paid. We follow Saccardo et al. (2018) and allow participants to choose a combination of piece-rate pay and tournament pay. Specifically, participants choose $x \in [0, 1]$ knowing that their payment per correct sum is given by $(1 - x)\pi^P + xI^W\pi^T$, where π^P is the piece-rate of €1.00, π^T is the tournament-rate of €4.40, and I^W is an indicator function that equals one if the participant is the tournament winner in part four and zero otherwise.

To determine the tournament winners in part four, the performance of participants is compared to the performance of their group members in part two. There are three clear advantages of having participants compete against the past performance of others. First, winning the tournament does not imply that someone else loses and vice versa, which means that the choice between piece-rate and tournament pay ought to be unaffected by an aversion to impose a negative externality on others (e.g., as predicted by models of other-regarding preferences; Fehr and Schmidt, 2006). Second, this method ensures that, irrespective of the participants' payment-scheme choice, their performance is compared to a setting where the incentives to perform are fixed and equal for all. Third, the participants' payment-scheme choice will not be influenced by their expectations concerning the payment-scheme choice of others.

Finally, in part five, we measure the participants' risk preferences. To do so, we use a variant of the risk elicitation game of Gneezy and Potters (1997). Specifically, we give participants six choices. In each choice, participants choose an $x \in [0, 1]$ knowing that their payment is given by $(1-x)\pi^C + xI^p\pi^R$, where π^C is a certain payment equal to €1.00 multiplied by their number of correct answers in part two, π^R is a risky payment of €R multiplied by their number of correct answers in part two, and I^p is an indicator function that equals one with probability p and zero otherwise. Across their six choices, we vary the value of R and the probability p. The precise combinations (R, p) were: (4.40, 0.25), (2.75, 0.40), (11.00, 0.10), (4.84, 0.25), (2.00, 0.55), and (5.28, 0.25).

Note that in our risk-elicitation task we scale the risk game payments according to each participant's performance in part two to give them risky choices that mirror their choice between piece-rate and tournament pay in part four. Most papers that measure preferences for competition by controlling for risk preferences use the same payments for all participants in the risk elicitation task (e.g., by eliciting risk preferences using the lottery choices used in Holt and Laury, 2002). Scaling payments according to performance in a real-effort task might not be the best way to obtain a measure of risk preferences that is comparable between individuals. However, we think it is well suited as a measure meant to control for risk preferences when measuring preferences for competition *within* individuals. The reason is that it ensures that the

preferences for risk and competition of each individual are both measured in the same payoff domain.

Overall, our experimental design differs from Niederle and Vesterlund (2007) in three ways:

1. We record the participants' willingness to compete as a continuous measure instead of a binary choice between piece-rate and tournament. As discussed by Saccardo et al. (2018), this gives us a more precise individual measure of the intensity of the participants' preferences for competition.
2. Instead of asking participants for their expected rank in the group, we elicit their belief of winning the tournament. We see three advantages in this method. First, it gives us an exact estimate of the participants' expected earnings. Second, it is less ambiguous in that it specifies the statistic of the belief distribution participants should report (Manski, 2004). Third, it allows us to incentivize the participants' answers with a robust elicitation mechanism (Karni, 2009).
3. We elicit risk preferences using six choices between a certain outcome and a lottery with known probabilities. We use multiple measures of the participants' risk preferences to reduce the potential impact of measurement error in the measure of risk preferences on the regression we will use to measure preferences for competition (for a detailed discussion see van Veldhuizen, 2018; Gillen et al., 2019).

2.2 Descriptive statistics

In Table 2, we report summary statistics of the participants' behavior and beliefs in the experiment (panel a), their demographic characteristics (panel b), and their answers to the survey questions (panel c). In Appendix C, we report further descriptive statistics (Table C1) and the Pearson correlation coefficients between the survey questions (Table C2).

As we can see in Table 2a, on average, participants assign 0.399 of their payment to the tournament payment scheme. This fraction is quite similar to the fraction of participants who choose the tournament payment scheme in experiments that use a binary choice between tournament and piece-rate (as in Niederle and Vesterlund, 2007). For example, in the 25 experiments using students reported in the survey of Dariel et al. (2017) the average percentage of participants choosing the tournament is 0.421. The fraction of the payment assigned to the tournament in our experiment is also not too different from the fraction reported by Saccardo et al. (2018), which is 0.501. Hence, our results in this part of the experiment are comparable to the existing literature. Moreover, as in many experiments with student populations, we find gender differences in the willingness to compete. On average, men assign a higher fraction of their payment to the tournament payment scheme than women (0.483 vs. 0.334, Mann-Whitney U test $p = 0.015$). We observe a similar pattern for the survey questions. On average, men

Table 2. Descriptive statistics of the survey questions and behavior in the experiment

Note: Descriptive statistics of the participants' behavior in the experiment (panel I), their demographic characteristics (panel II), and the eight survey questions designed to capture a preference for competition (panel III). Data corresponds to the 90 participants who participated in the survey and experiment.

a. Experimental variables

	Mean	Std. dev.
Fraction assigned to tournament pay	0.399	0.292
Average number of correct sums per try	8.959	2.546
Belief of winning the tournament	0.513	0.265
Fraction assigned to the uncertain amount	0.390	0.239

b. Demographic variables

	Mean	Std. dev.
Fraction of women	0.567	1.562
Age	24.800	4.874

c. Survey questions

	Mean	Std. dev.
Q1	4.256	1.562
Q2	4.800	1.545
Q3	4.544	1.470
Q4	4.022	1.499
Q5	3.378	1.911
Q6	3.833	1.351
Q7	4.211	1.590
Q8	4.189	1.483

self-report as being more competitive than women in all questions (the difference is significant in Q2, Q5, and Q8).

2.3 Results

The first part of the analysis consists of identifying the survey question, among the eight we have, that can best explain participants' preference to perform in a competitive environment (the tournament). To do so, we follow a two-step procedure.

In a first step, as Niederle and Vesterlund (2007) and Buser et al. (2014), we interpret the participants' payment-scheme choice as their preference for competition once we control for other reasons they may have for choosing tournament pay. Specifically, we run an OLS regression with the fraction of the payment participants assign to the tournament scheme as the dependent variable. As independent variables, we use the participants' individual ability in the task (measured by their average performance in parts one and two), their tolerance towards risk (the average fraction of payment they assigned to the risky lottery in the six choices of part five), and their expected likelihood of winning the tournament (elicited in part three). We report in Table 3 the regression results. As typically found in the literature, the coefficients of both incentivized measures of beliefs and risk attitudes are positive and statistically significant. The residuals obtained from this initial regression represent the "unexplained" preference component of the participants' competitive behavior, their so-called preference for competition.[4] We depict

[4]We use the residual of the regression as our main measure of preferences for competition because we think it is the most parsimonious in that it distinguishes preferences for competition from risk preferences and beliefs (see

Table 3. Determinants of the fraction of payment assigned to tournament pay

Note: OLS regression with robust standard errors of the fraction of compensation assigned to the tournament payment scheme in part four of the experiment as the dependent variable. The number of observations is 90 and the resulting R^2 is 0.266.

Variable	**Coefficient**	**Std. err.**	***p*-value**
Average performance	0.002	0.012	0.899
Average risk tolerance	0.397	0.142	0.006
Expected likelihood of winning	0.424	0.137	0.006
Constant	0.013	0.109	0.904

the distribution of the participants' preference for competition in Figure 1. It is interesting to note that there are gender differences in our measure of participants' preferences for competition: in line with previous results, we find that the residual measure of preferences for competition is higher for men than women (Mann-Whitney U test, $p = 0.030$).

The second step consists of estimating the predictive power of our eight survey questions to explain this preference. More specifically, we run eight separate OLS regressions with the first-step regression residuals as dependent variable and each of the survey questions as independent variable. In Table 4, we report the estimated coefficient of each regression along with its standard error and p-value, and the regression's R-squared as an estimate of goodness-of-fit. In order to make the coefficients easy to interpret, we standardized both the dependent and the independent variables to have a mean of zero and a standard deviation of one. By doing this, the dependent and independent variable in each regression have the same standard deviation, and therefore, the coefficients reported in Table 4 are equal to the Pearson correlation coefficient between the participants' preference for competition and the respective survey question.

The best fit is given by question Q4, which asks the degree to which participants think the following statement describes them: *"Competition brings the best out of me"*. An increase of one standard deviation in the answer to this survey question is associated with an increase of 0.261 standard deviations in the participants' preference for competition.[5] This correlation is moderate but well within the range of other validated survey items. For example, the Pearson correlation coefficients of individual survey items reported in Falk et al. (2016) vary between

Niederle and Vesterlund, 2007). Moreover, this measure has been often used to study the association between preferences for competition and field behavior (e.g., Buser et al., 2014, 2020; Reuben et al., 2017, 2019). However, since there are other approaches in the literature, later on, we consider alternative measures of preferences for competition as robustness checks.

[5]We obtain similar results with Spearman's rank correlation coefficients. The highest Spearman correlation coefficient is 0.277 for Q4, followed by 0.163 (Q8), 0.140 (Q6), 0.105 (Q2), 0.075 (Q5), 0.074 (Q7), 0.069 (Q3), and −0.126 (Q1). Likewise, we also ran univariate ordered probit regressions with each question as the dependent variable and the preference for competition as the independent variable. The regression for Q4 has the largest coefficient and the highest log likelihood.

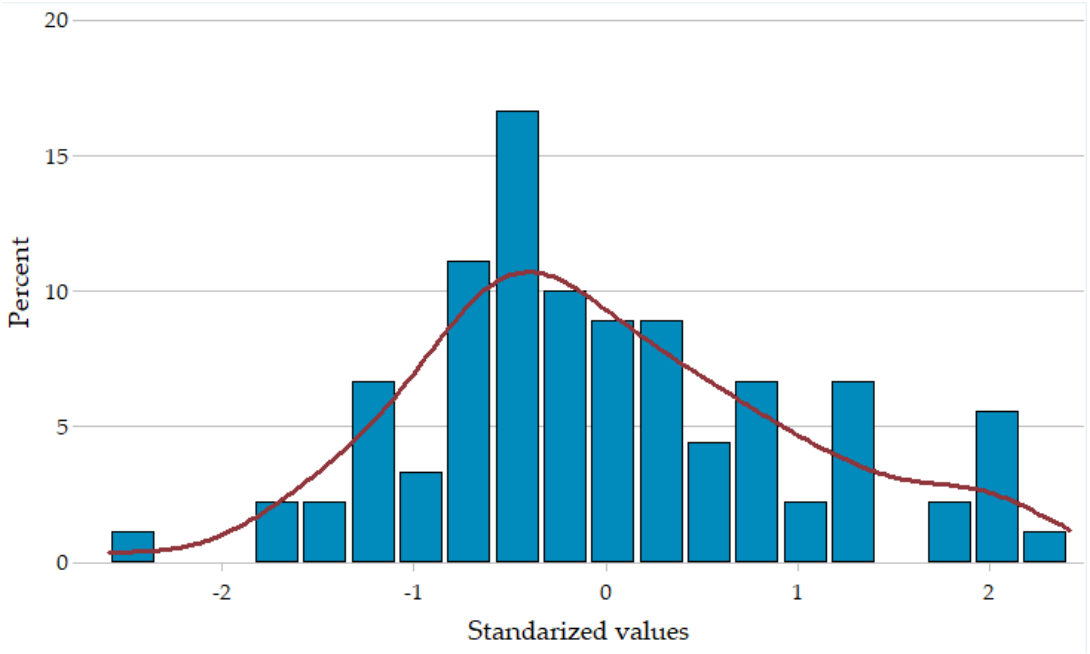

Figure 1. Distribution of the residual measure of preference for competition

Note: Distribution of the participants' preference for competition, measured as the residuals of the regression of the fraction of compensation assigned to the tournament payment scheme in part four of the experiment on the participants' performance, beliefs, and risk preferences (see Table 3). To facilitate interpretation, the variable has been standardized.

0.148 (for negative reciprocity) and 0.629 (for trust), with a mean of 0.294 and a median of 0.240.

To check the robustness of this result, we performed a few additional exercises. As our first robustness exercise, we check whether aggregating survey questions into a common competition scale gives a better predictor of the participants' behavior. To perform this check, we use principal component analysis to create a common factor from the survey questions and then regress the participants' preference for competition on this common factor.[6] The resulting coefficient is 0.225 with a standard error of 0.089 ($p = 0.013$). Given that the coefficient of the common factor is of similar magnitude and statistical significance as the coefficient of question Q4, this analysis suggests that there is not much to gain in terms of additional explanatory power from taking into account the other survey questions.

As a second robustness check, we consider combinations of up to three survey questions to check weather a linear combination of multiple survey questions is a better predictor than the single question we identified. In other words, we run a separate regression for each combination of three questions.[7] To select the best set of questions, we follow Falk et al. (2016) and use

[6]We used questions Q2 through Q8 to create the common factor because Q1 displays a negative association with the participants' preference for competition. Including Q1 gives the common factor a worse fit.

[7]Once again, we restrict this analysis to questions Q2 through Q8 because Q1 shows a negative relationship with preferences for competition.

Table 4. Using the survey questions to predict the participants' preferences for competition

Note: OLS regressions with robust standard errors. In all cases, the dependent variable is the participants' preference for competition, which corresponds to the residuals of an initial regression of the fraction of compensation assigned to the tournament in part four of the experiment on the participants' expected likelihood of winning the tournament, their average performance, and their average risk tolerance (see Table 3). Both dependent and independent variables have been standardized.

Question	Coefficient	Std. err.	p-value	R-squared
Q1	−0.141	0.123	0.253	0.020
Q2	0.179	0.108	0.099	0.032
Q3	0.077	0.101	0.449	0.006
Q4	0.261	0.093	0.006	0.068
Q5	0.064	0.103	0.532	0.004
Q6	0.103	0.108	0.341	0.011
Q7	0.071	0.099	0.475	0.005
Q8	0.163	0.095	0.090	0.026

the Bayesian Information Criterion (BIC). We report the results in Table C3 in Appendix C. The BIC suggests that the one-question regression using Q4 as the independent variable is better than the other specifications. As above, this analysis suggests that including more survey questions does not add significant explanatory power.[8]

Lastly, since there is no consensus in the literature on the precise way to measure the preference for competition, our third robustness check consists of rerunning the analysis in Table 4 as well as the first two robustness checks using two alternative measures of preferences for competition. As our first alternative dependent variable, we use the fraction of the payment participants assign to the tournament scheme. The results are presented in Table C4. We find, once again, that the regression with only Q4 as the independent variable has the best BIC score (255.803) and displays the highest correlation coefficient (0.285, $p = 0.003$), even when compared to the coefficient of the common factor of survey questions (0.215, $p = 0.014$). It is interesting to note that the coefficient for Q4 changes very little between the regression of Table 4 and the alternative regression of Table C4. The difference between the two coefficients indicates the extent to which our survey question captures tournament entry due to the participants' ability, beliefs, or risk preferences. The fact that the coefficient for Q4 decreases very little, from 0.285 in Table C4 to 0.261 in Table 4, suggests that Q4 captures preferences for competition but it

[8] As an alternative criterion to select the best combination of survey questions, we evaluated the predictive power of each model based on cross-validation. As Falk et al. (2016), we use k-fold cross-validation, which entails splitting the data randomly into K partitions and then predicting the outcomes in each partition k using a model fitted with the data from the other $K - 1$ partitions. To be specific, we use n-fold cross-validation and the root of mean squared errors as the measure of predictive power. Although the ranking of models based on cross-validation is not exactly the same as with BIC, the two measures of fit are highly correlated ($r = 0.836$) and both select the regression with Q4 as the sole independent variable as the best specification.

does not capture ability, beliefs, and risk preferences.

As our second measure of preferences for competition, we once again use the residuals of an OLS regression with the fraction assigned to tournament pay as the dependent variable. As before, we control for the participants' individual ability, tolerance towards risk, and expected likelihood of winning. However, unlike in the regression of Table 3, in this case we control for the participants' ability by adding separately their performance in parts one and two, and we control for their tolerance towards risk by adding separately the amount participants assigned to the risky lottery in each of the six choices of part five. The idea is that, by including more variables measuring ability and risk tolerance, we reduce the impact of measurement error in these variables on the measure of preferences for competition (as suggested by Gillen et al., 2019). The results are presented in Table C5. We obtain very similar results in that the regression with only Q4 has the best BIC score (256.928) and displays the highest correlation coefficient (0.263, $p = 0.005$), comparable in size with the correlation coefficient of the common factor of survey questions (0.264, $p = 0.004$).

Result 1 *The question "Competition brings the best out of me" has the highest explanatory power for the preference for competition.*

3 Predicting competitive behavior in the field

With the first part of the analysis, we have identified the survey question that best explains the desire to perform in a competitive environment inside the laboratory. A natural follow-up question is whether this survey question can also explain competitive behavior *outside* the laboratory. To answer this question, we survey a group of individuals that previous research has identified as being especially competitive, namely, professional athletes (Barron et al., 2000). If our survey question is capturing a preference for competition, then it should classify professional athletes as more competitive than non-athletes.

3.1 Design and procedures

We ask our survey question (Q4) to 90 young athletes recruited from professional sports associations to participate in an experiment (in French) at LISER-LAB in spring 2019. The athletes are all from Luxembourg and practice a variety sports, the most common being cycling (20%), swimming (15%), judo (13%) and gymnastics (12%). As a control group, we also asked our survey question to 78 students of the University of Luxembourg who are of similar age as the professional athletes (between 18 and 30 years old) and who were recruited to participate in the same experiment together with the athletes in mixed sessions.[9]

[9]The experiment was designed and conducted by a group of researchers from the University of Montpellier (Bravaccini et al., 2019), who kindly agreed to include our survey question in their post-experimental question-

Table 5. Preferences for competition among professional athletes and non-athletes

Note: Summary statistics of the answer to question Q4, which asks the degree to which individuals think the following statement describes them: *"Competition brings the best out of me"*. Responses collected using a 10-point Likert scale.

	Athletes	**Non-athletes**
Mean	8.100	5.731
Standard deviation	1.861	2.795
# observations	90	78
	Men	
Mean	8.197	6.472
Standard deviation	1.691	2.501
# observations	61	36
	Women	
Mean	7.897	5.095
Standard deviation	2.193	2.903
# observations	29	42

3.2 Results

In Table 5, we show the summary statistics of the answer to the survey question Q4 comparing professional athletes and non-athletes. On average, the answer to Q4 is clearly lower for non-athletes (5.731 out of 10) than for athletes (8.100 out of 10). An average athlete is 0.848 standard deviations more competitive than the average non-athlete. The large gap in preferences for competition between the two populations is also evident in Figure 2, which plots the cumulative distribution of the answer to Q4 for athletes and non-athletes. We can see that the median athlete is more competitive than 71% of the non-athletes. The two distributions are significantly different (Mann-Whitney U test, $p < 0.001$).

As a robustness check, we compare athletes and non-athletes separately by gender. Since men have been found to be more competitive than women in many student populations (for a review, see Dariel et al., 2017), the difference in preferences for competition reported above could be driven by differences in the fraction of men and women in the two populations (32% of the athletes are women while 54% of the non-athletes are women). In the lower part of Table 5, we show the summary statistics of the answer to Q4 for men and women. We find that both male and female athletes are significantly more competitive than their non-athlete counterparts (Mann-Whitney U tests, $p < 0.001$ for both).[10]

naire. Since their experiment was conducted in French, Q4 was translated as "Sur une échelle de 0 (pas du tout comme moi) à 10 (exactement comme moi), à quel point êtes-vous décrit par la déclaration suivante: La compétition me fait donner le meilleur de moi-même?" Responses were recorded using an 10-point Likert scale ranging from 1 to 10 in order to match the scales used in other unrelated questions present in their questionnaire.

[10]In line with previous literature, we find a significant difference in preferences for competition between men and

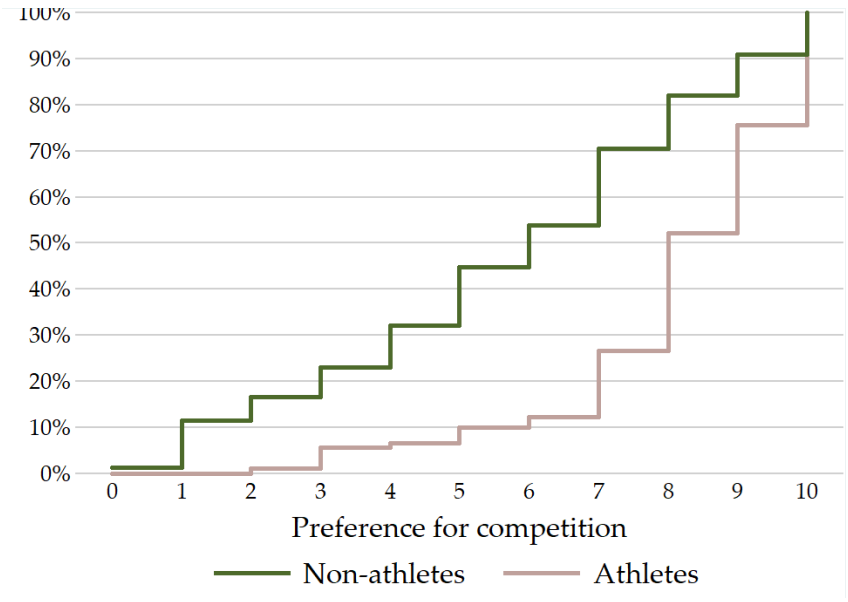

Figure 2. Cumulative distributions of the preference for competition

Note: Cumulative distributions for athletes and non-athletes of the answer to question Q4, which asks the degree to which individuals think the following statement describes them: *"Competition brings the best out of me"*. Responses collected using a 10-point Likert scale.

Result 2 *The question "Competition brings the best out of me" captures differences in competitiveness between professional athletes and others.*

4 Discussion

The preference for competition has attracted considerable interest among economists in recent years. Laboratory measurements of this preference have been shown to predict and explain a series of important educational and labor market outcomes. Moreover, Buser et al. (2020) show that educational and career outcomes in a representative sample of the population in the Netherlands can also be predicted using an unincentivized survey question to measure the preference for competition. This result chimes in with findings from other recent studies showing the potential of using unincentivized survey questions in lieu of laboratory experiments as a way to measure individual preferences (e.g., Dohmen et al., 2011; Falk et al., 2018).

Inspired by this literature, in this paper we validated a self-reported, unincentivized survey measure of preference for competition using the validation methodology introduced by Falk et al. (2016). To do so, we compared the explanatory power of eight candidate questions in predicting individuals' preference for competition as measured by people's behavior in the laboratory Niederle and Vesterlund (2007). We then further explored the validity of the best

women among non-athlete students (Mann-Whitney U test, $p = 0.031$). Moreover, consistent with there being a strong positive selection for competitive individuals to become a professional athlete, we do not find that male athletes are significantly more competitive than female athletes (Mann-Whitney U test, $p = 0.727$).

survey question by testing whether it predicts competitive behavior in the field: namely, whether an individual is a professional athlete. The question captures differences between professional athletes and non-athletes, confirming its reliable predictive power. Based on this evidence, we suggest the use of this tool to measure individual's preference for competition in large-scale surveys.

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Appendix A Survey questionnaire

Below are the survey questions given to the participants before they participated in the experiment. Participants had to answer these questions at least ten days before the experiment took place. Within each set of questions, the order of the questions was randomized to avoid order effects.

Choose the scale to which the following statements describe you

	1 = Not at all like me	2	3	4	5	6	7 = Exactly like me
I see myself as someone who is reserved, quiet	○	○	○	○	○	○	○
I see myself as someone who is talkative	○	○	○	○	○	○	○
I see myself as someone who tends to be lazy	○	○	○	○	○	○	○
I see myself as someone who is outgoing, sociable	○	○	○	○	○	○	○
Competition brings the best out of me	○	○	○	○	○	○	○
I see myself as someone who does a thorough job	○	○	○	○	○	○	○
I see myself as a competitive person	○	○	○	○	○	○	○
I see myself as someone who does things efficiently	○	○	○	○	○	○	○
I see myself as someone who worries a lot	○	○	○	○	○	○	○
I see myself as someone who gets nervous easily	○	○	○	○	○	○	○
I see myself as someone who has a forgiving nature	○	○	○	○	○	○	○
I see myself as someone who has an active imagination	○	○	○	○	○	○	○
I see myself as someone who is sometimes rude to others	○	○	○	○	○	○	○
I see myself as someone who enjoys winning and hates losing	○	○	○	○	○	○	○
I see myself as someone who is relaxed, handles stress well	○	○	○	○	○	○	○
I see myself as someone who values artistic, aesthetic experiences	○	○	○	○	○	○	○
I see myself as someone who is original, comes up with new ideas	○	○	○	○	○	○	○
I see myself as someone who enjoys competing, regardless of whether I win or lose	○	○	○	○	○	○	○
I see myself as someone who is considerate and kind to almost everyone	○	○	○	○	○	○	○

You and your friends are playing your favorite game. Does it make the game more fun if...

	1 = Not at all	2	3	4	5	6	7 = Extremely more fun
... everyone puts in money for a prize for the winner?	◯	◯	◯	◯	◯	◯	◯
... a stranger joins?	◯	◯	◯	◯	◯	◯	◯
... you play in teams rather than individually?	◯	◯	◯	◯	◯	◯	◯

On a scale from 1 to 7 where 1 means you agree completely with the statement on the left and 7 means you agree completely with the statement on the right; how would you rate your views for the following statements?

	1	2	3	4	5	6	7	
Competition is good. It stimulates people to work hard and develop new ideas	◯	◯	◯	◯	◯	◯	◯	Competition is harmful. It brings the worst in people
Incomes should be made more equal	◯	◯	◯	◯	◯	◯	◯	We need larger income differences as incentives
In the long run, hard work usually brings a better life	◯	◯	◯	◯	◯	◯	◯	Hard work doesn't generally bring success, it's more a matter of luck and connections
One should be cautious about making major changes in life	◯	◯	◯	◯	◯	◯	◯	You will never achieve much unless you act boldly

Please indicate the importance of each aspect below for accepting a job offer.

	1 = Not important at all	2	3	4	5	6	7 = Essential
Good financial compensation	◯	◯	◯	◯	◯	◯	◯
Work environment is not too competitive	◯	◯	◯	◯	◯	◯	◯
The potential to contribute to society	◯	◯	◯	◯	◯	◯	◯
Working for a prestigious organization	◯	◯	◯	◯	◯	◯	◯
Job security and reasonable working hours	◯	◯	◯	◯	◯	◯	◯

What is your age?

What is your nationality?

- Luxembourger
- German
- French
- Belgian
- Dutch
- Portuguese
- Other

What is your field of study?

- Computer Science
- Engineering
- Life Sciences
- Mathematics
- Physics
- Psychology
- Law
- Humanities
- Economics and Management
- Social Sciences and Education
- Teaching and Education
- Other

What is your biological gender?

- Male
- Female

Are you vegan / vegetarian?

- Yes
- No
- Other:

Do you have siblings (including half/step/adoptive)?

- Yes
- No

Please describe the birth order of siblings (including half/step/adoptive) in your family. In the case of twins, please select "twins" & "sister" if the pair includes two female siblings but not you, "twins" & "brother" if the pair includes two male siblings and not you, "twins" & "brother" & "sister" if the pair includes a sibling from each gender but not you, "twins" & "me" & "sister" if the pair includes you and a female sibling, and "twins" & "me" & "brother" if the pair includes you and a male sibling

	Me	Brother	Sister	Twins
First child	☐	☐	☐	☐
Second child	☐	☐	☐	☐
Third child	☐	☐	☐	☐
Fourth child	☐	☐	☐	☐
Fifth child	☐	☐	☐	☐

Appendix B Instructions

Below are the instructions of the experiment, including the control questions seen by the participants and examples of the screens where they made their decisions.

Welcome

In this study, you will be asked to complete five different tasks. They will take at most around twelve minutes each.

At the end of the study, you will receive €10 for your participation. In addition, we will randomly select **one** of the five tasks and pay you your earnings in that task. Hence, your total earnings at the end of the study will be your payment for the randomly selected task plus €10. You will be paid your earnings in cash.

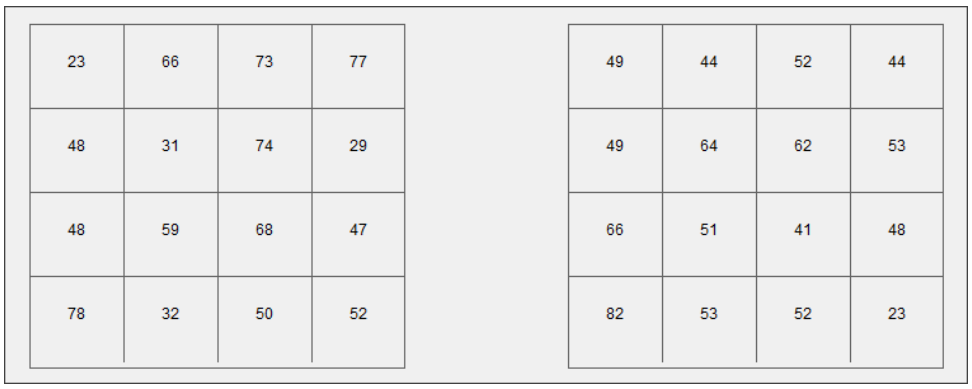
You will receive the instructions for each task right before you start the task. These instructions include a clear description of how your earnings for that task are calculated.

Please do not communicate with other people while you are taking part in this study. If you have any questions, please raise your hand. We will come to your desk to answer your questions. All your information, decisions, and performance during this study are anonymous.

You will start with Task 1. Please read the instructions of Task 1 carefully.

Instructions for Task 1

In Task 1 you will be given **240 seconds** to answer a series of **math questions**. You are not allowed to use any kind of calculator. When you start, you will see matrices on the screen. Each matrix has 4 rows and 4 columns and is filled with randomly-generated numbers. Below is an example.



Your task is to find the highest number in each matrix and them sum the two numbers up. After submitting your answer, you will be able to see whether your answer was correct. Subsequently, irrespective of whether your answer was correct or incorrect, a new pair of matrices will appear.

Your earnings for Task 1 depend on your performance. Specifically, your earnings for Task 1 equal **€1.00 per correct sum.**

Practice round: before Task 1 starts, you will have a practice round of 60 seconds to familiarize yourself with the screen. Answers during practice round do not count toward your earnings.

Understanding check: To ensure you correctly understood how the earnings for Task 1 are calculated, please answer the following question. Note that the numbers used in this question are not indicative of what constitutes good performance in this task.

1. Suppose you solved 10 sums correctly and 2 sums incorrectly. What are your earnings in Task 1?

Instructions for Task 2

As in Task 1, you will be given 240 seconds to calculate sums of the two highest numbers from pairs of matrices.

The difference with Task 1 is that, in Task 2, your earnings depend on your performance and the performance of three other participants. Specifically, you will be randomly assigned to a group of four participants. The individual who correctly solves the highest number of sums in the groups will be the tournament winner. If there are ties, the tournament winner will be determined randomly among the tied group members.

The earnings for Task 2 are calculated as follows: the tournament winner receives **€4.40 per correct sum** while everyone else in the group receives **€0**. You will not be informed of how you did in the tournament until you have completed all five tasks.

Understanding check: To ensure you correctly understood how the earnings for Task 2 are calculated, please answer the following questions. Note that the numbers used in these questions are not indicative of what constitutes good performance in this task.

1. Suppose you solved 10 sums correctly and 2 sums incorrectly, and everybody else in your group solved less sums than you. What are your earnings in Task 2?
2. Suppose you solved 10 sums correctly and 2 sums incorrectly, and at least one person in your group solved more sums correctly than you. What are your earnings for Task 2?

Instructions for Task 3

In Task 3, you can earn money by answering the following question:

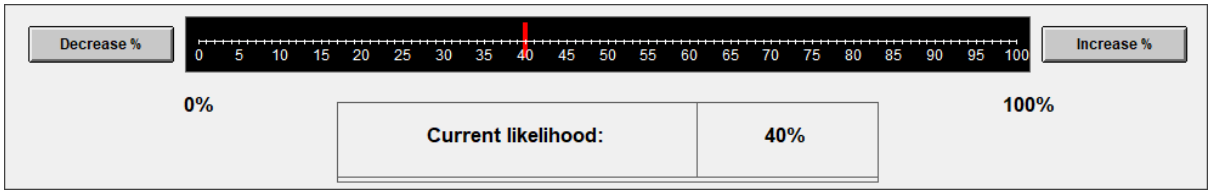
How likely do you think it is that you are the tournament winner in Task 2?

Your answer can go from 0% (meaning you are completely certain that you are not the tournament winner) to 100% (meaning that you are completely certain that you are the tournament winner). Your earnings in Task 3 can be either **€0** or **€20**. The probability of earning €20 depends on two things:

1. The actual outcome (whether you are the tournament winner or not)
2. The likelihood you selected as the answer to the question above.

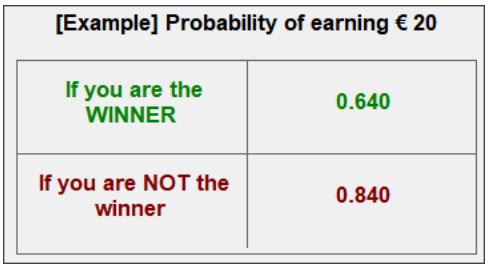
The closer the likelihood you selected is to the actual outcome in Task 2, the higher the probability that you earn €20. In other words, if turns out that you are the tournament winner in Task 2, then the probability that you earn €20 increases the closer you selected the likelihood is to 100%. Conversely, if it turns out that you are not the tournament winner in Task 2, then the probability that you earn €20 increases the closer you selected likelihood is to 0%.

You will select your likelihood of being the tournament winner picking a point on a line. You will be able to select any number between 0% and 100%. We provide an example below to illustrate how the line will look (note that the number used in the example is not indicative of what constitutes a good or a bad answer in this task).

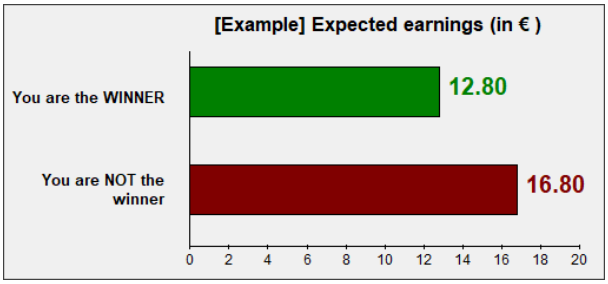


To help you to understand the consequences of your answer, you will see the following information below the line.

On the left part of the screen, there is a table that shows the probability of earning €20 in the two possible outcomes: in case you are the tournament winner and in case you are not the tournament winner. As you can see in the example, if you select 40% on the line, the table on the left lets you know that your probability of earning €20 is **0.640 if you are the tournament winner** and **0.840 if you are not the tournament winner**.

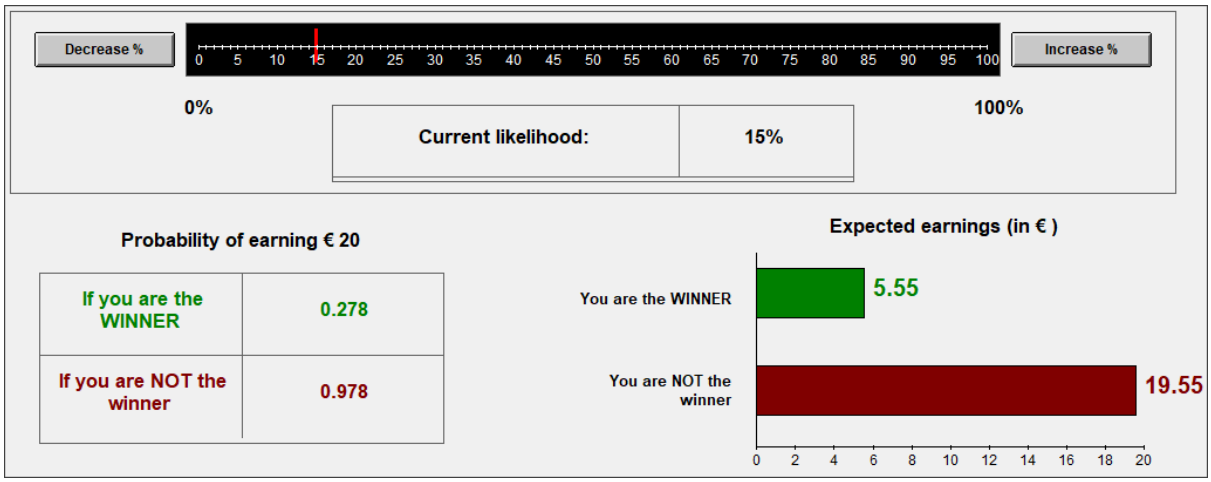


On the right part of the screen, a graph shows the corresponding **expected** earnings for both outcomes. In the example, the bar graph on the right shows you the corresponding expected earnings: €12.80 if you are the tournament winner and €16.80 if you are not the tournament winner.



Understanding check: To ensure you correctly understood how the earnings for Task 3 are calculated, please answer the following questions. Note that the numbers used in these questions are not indicative of what constitutes a good answer in this task.

Suppose that you think there is 15% chance that you are the tournament winner, and therefore, you use the slider to select 15% as your likelihood of being the tournament winner. **According to the information in the table and graph below**:



1. What is your probability of winning €20 if you turn out not to be the tournament winner?
2. What are your expected earnings if you turn out not to be the tournament winner?
3. What is your probability of winning €20 if you turn out to be the tournament winner?
4. What are your expected earnings if you turn out to be the tournament winner?

Instructions for Task 4

As in Task 1 and 2, you will have once again 240 seconds to calculate sums of the two highest numbers from pairs of matrices. The difference between previous tasks and Task 4 is that you **choose how you want to be paid** for each correct sum in Task 4. You choose a combination of an **individual rate** and **tournament rate** by assigning euros to each rate. The two payments schemes are as follows:

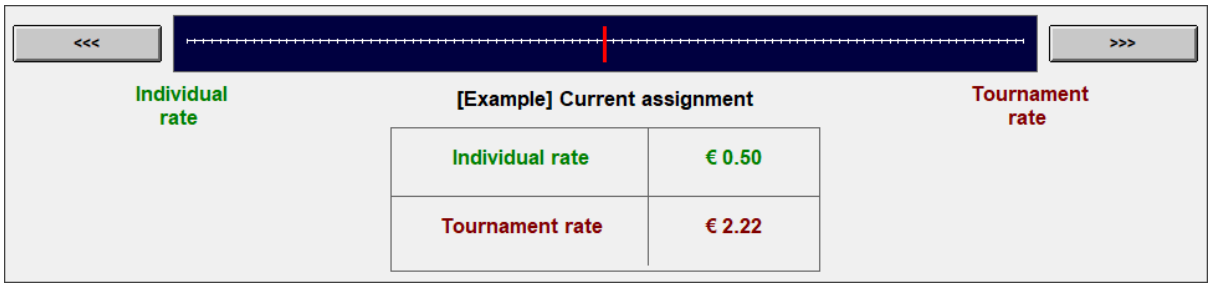
- **Individual rate:** For each correct sum, the individual rate pays the amount of euros you assign to this rate. For example, if you assign **€1.00** per correctly answered sum in Task 4. Your earnings from the individual rate do not depend on the performance of other participants.
- **Tournament rate:** For each correct sum, the tournament rate pays the amount of euros you assign to this rate if you are the winner in Task 4. Specifically, your performance in Task 4 will be compared with the performance of the other members of your group in Task 2. You are the tournament winner if you solved more sums in Task 4 than all other group members in Task 2. If there are ties, the winner will be randomly determined among the

tied group members. If you are not the tournament winner, then you earn **€0**.

In summary, your earnings in Task 4 are:

- If you are not the tournament winner in Task 4: (individual rate) × (correct sums in Task 4)
- If you are the tournament winner in Task 4: (individual rate + tournament rate) × (correct sums in Task 4)

To assign euros to the individual and tournament rates, you will pick a point on a line like the one below.

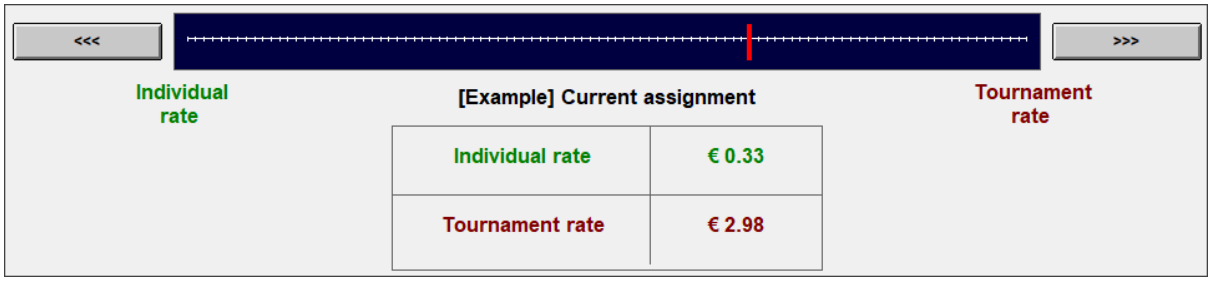


Every point on the line corresponds to a combination of individual rate and tournament rate. Points closer to the left assign more euros to the individual rate and less euros to the tournament rate while points closer to the right assign more euros to the tournament rate and less euros to the individual rate.

To make a choice, use your mouse to click on a point on the line. Once you click, you will see the selected individual rate and tournament rate on the table below the line. You can adjust your choice by clicking a different point on the line or with the buttons labelled with the left and right arrows. To confirm your final assignment, click the 'Confirm' button on the bottom right part of your screen.

We provide a few examples next. Note that the numbers used in these examples are for illustration purposes only and do not convey what a good or a bad choice is in this task.

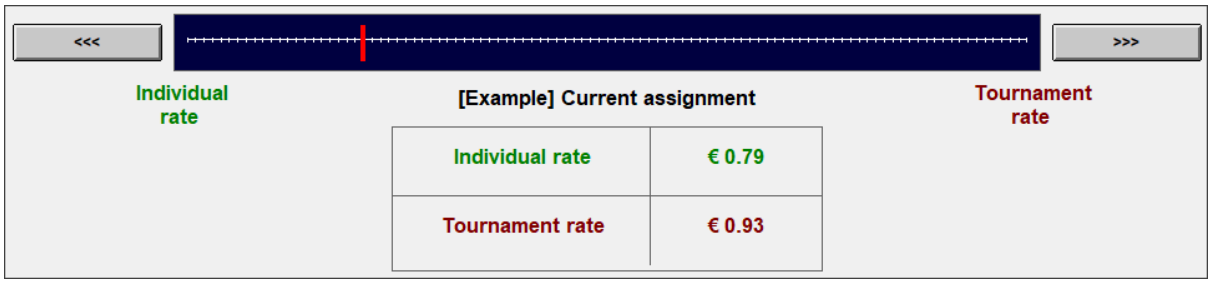
Example 1: Imagine you chose the point below.



At this point, you have an individual rate of €0.33 per correct sum and a tournament rate of €2.98 per correct sum. This means that:

- If you are not the tournament winner in Task 4, you earn €0.33 per correct sum: €0.33 from your individual rate choice plus €0 from your tournament rate choice.
- If you are the tournament winner in Task 4, you earn €3.31 per correct sum: €0.33 from your individual rate choice plus €2.98 from your tournament rate choice.

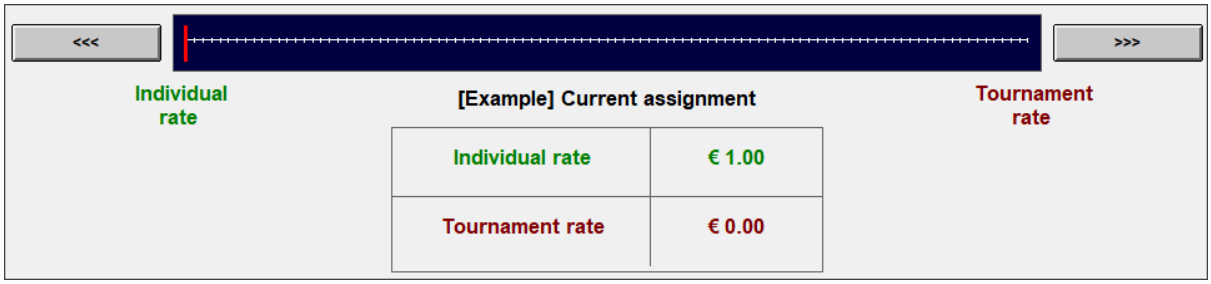
Example 2: Imagine you chose the point below.



At this point, you have an individual rate of €0.79 per correct sum and a tournament rate of €0.93 per correct sum. This means that:

- If you are not the tournament winner in Task 4, you earn €0.79 per correct sum: €0.79 from your individual rate choice plus €0 from your tournament rate choice.
- If you are the tournament winner in Task 4, you earn €1.72 per correct sum: €0.79 from your individual rate choice plus €0.93 from your tournament rate choice.

Example 3: Imagine you chose the point below.



At this point, you have an individual rate of €1.00 per correct sum and a tournament rate of €0.00 per correct sum. This means that:

- If you are not the tournament winner in Task 4, you earn €1.00 per correct sum: €1.00 from your individual rate choice plus €0 from your tournament rate choice.
- If you are the tournament winner in Task 4, you earn €1.00 per correct sum: €1.00 from your individual rate choice plus €0.00 from your tournament rate choice.

Understanding check: To ensure you correctly understood how the earnings for Task 4 are calculated, please answer the following questions. Note that the numbers used in these questions are not indicative of what constitutes good performance in this task.

1. For the tournament rate, your performance in Task 4 will be compared to:

- Your group members' past performance in Task 2
- Your group members' future performance in Task 4
- Your group members' average performance in Task 1 and Task 2
- Your own past performance in Task 2

2. Suppose you solved 10 sums correctly in task 4 and everybody else in your group solved less than 10 sums correctly in Task 2. What are your earnings for Task 4 if you assigned:
   - €1.00 to the individual rate and €0.00 to the tournament rate?
   - €0.00 to the individual rate and €4.40 to the tournament rate?
   - €0.25 to the individual rate and €3.30 to the tournament rate?
   - €0.75 to the individual rate and €1.10 to the tournament rate?
3. Suppose you solved 10 sums correctly in task 4 and at least one person in your group solved more than 10 sums correctly in Task 2. What are your earnings for Task 4 if you assigned:
   - €1.00 to the individual rate and €0.00 to the tournament rate?
   - €0.00 to the individual rate and €4.40 to the tournament rate?
   - €0.25 to the individual rate and €3.30 to the tournament rate?
   - €0.75 to the individual rate and €1.10 to the tournament rate?

Instructions for Task 5

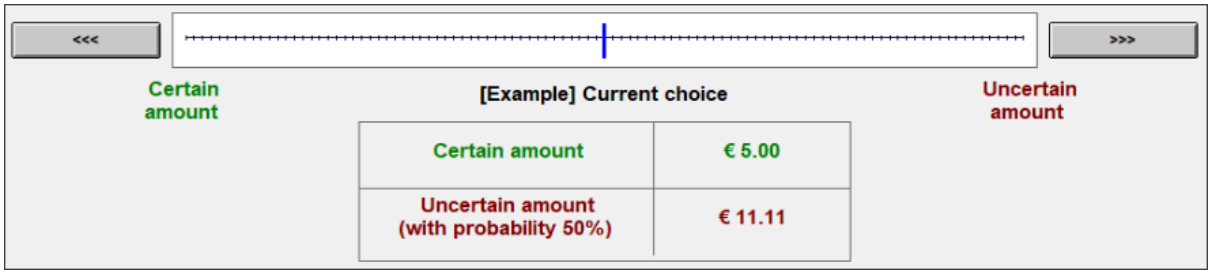
Task 5 consists of **6 rounds**. Your earnings in this task correspond to your earnings in one randomly-selected round. In each round, you decide how you want to be paid by choosing a combination of a certain amount and an uncertain amount. The two options are:

- **Certain amount**: You always earn the amount of money you assign to the certain amount
- **Uncertain amount**: You earn the amount of money you assign to the uncertain amount only with a given probability. For example, if the given probability is 50%, then you earn the amount you assign to the uncertain amount half the time and earn €0 otherwise. You will be told the probability of winning the uncertain amount before you make your choice.

In summary, your earnings in a round of Task 5 are:

- If you win the uncertain amount: Certain amount + Uncertain amount
- If you do not win the uncertain amount: Certain amount

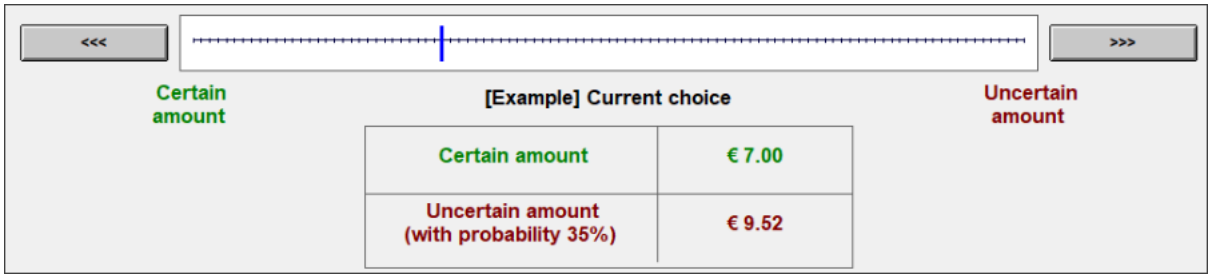
To assign euros to the certain and uncertain amounts, you will pick a point on line like the one below.



Every point on the line correspond to a combination of certain and uncertain amounts. Points closer to the left assign more euros to the certain amount and less to the uncertain amount while points closer to the right assign more euros to the uncertain amount and less euros to the certain amount. To make a choice, use your mouse to click on a point on the line. Once you click, you will see the selected certain and uncertain amount on the table below the line.

We provide one example below. Note that the numbers used in this example are for illustration purposes only and do not convey what a good or a bad choice is in this task.

Example: Imagine that the probability of winning the uncertain amount is **35%** and you choose the point below.

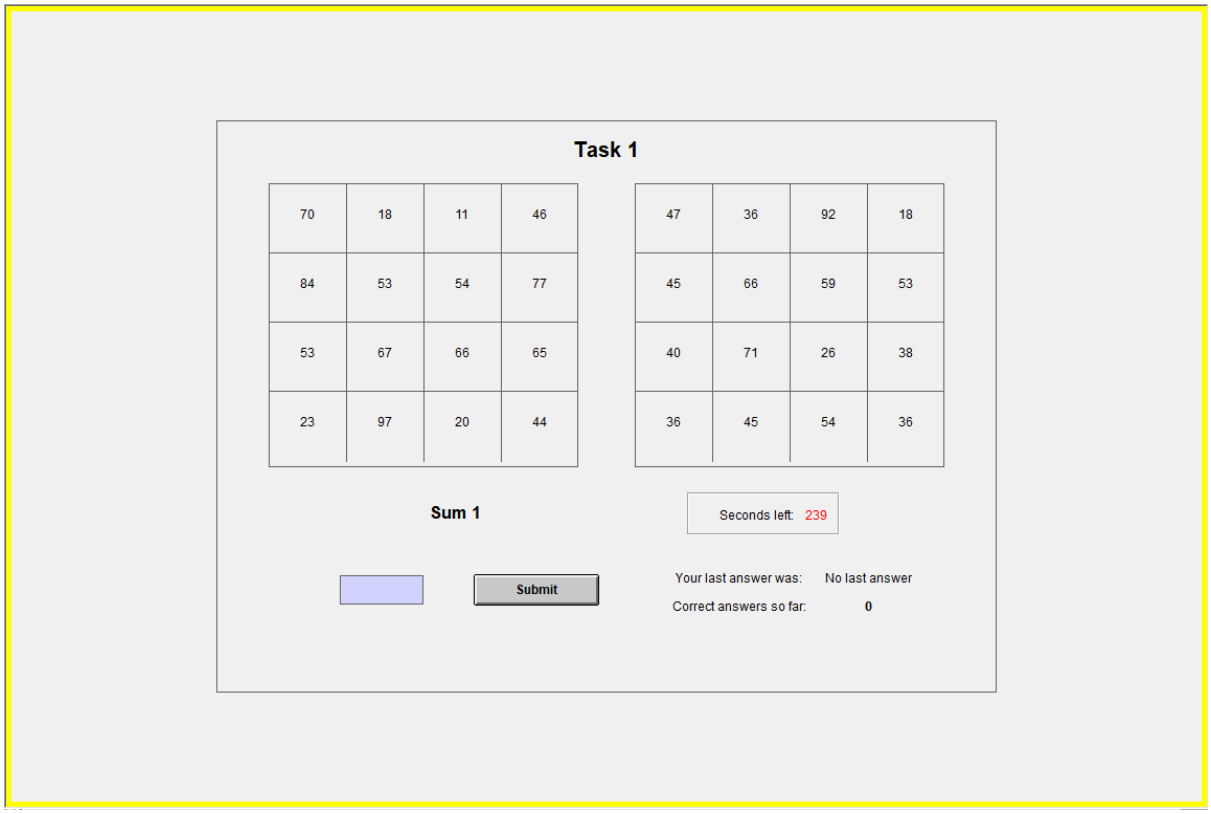


At this point, you have a certain amount of €7.00 and an uncertain amount of €9.52. This means that:

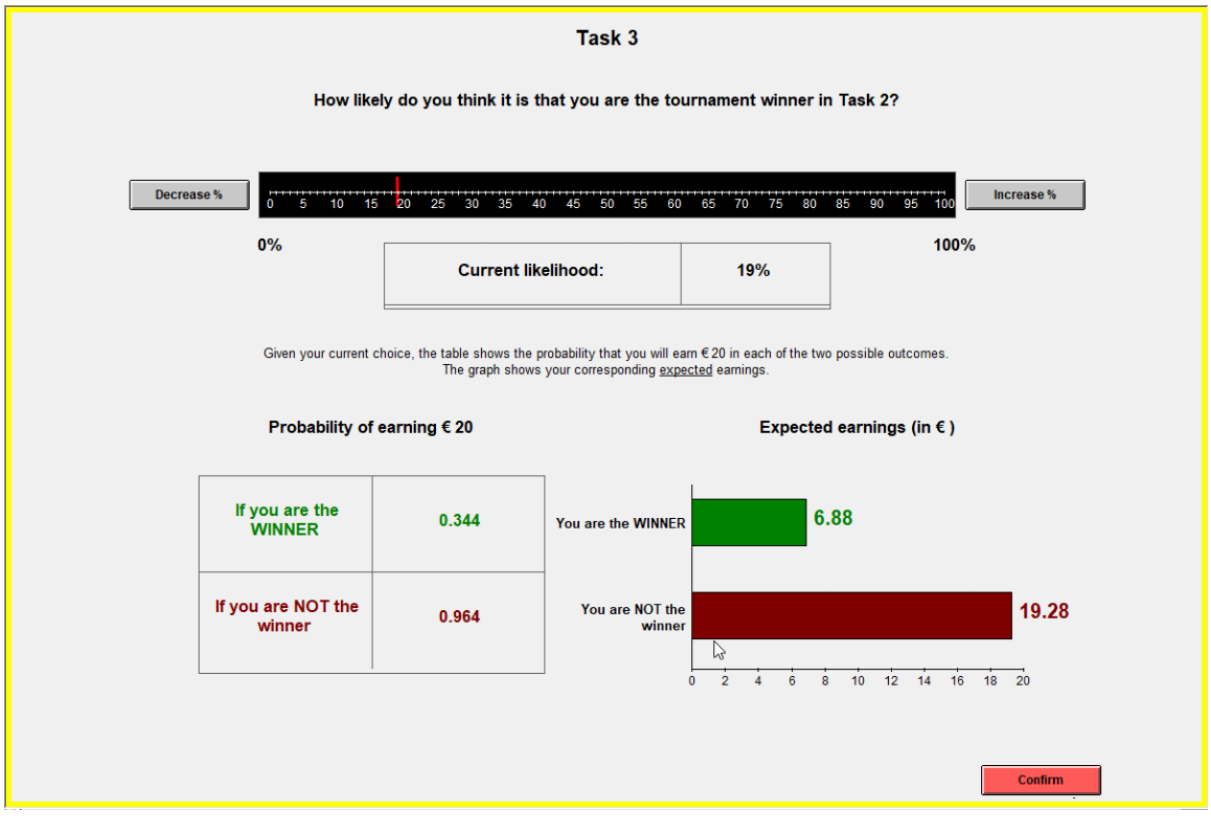
- If you win the uncertain amount, which happens with a 35% probability, then you earn €18.52, €7.00 from the certain amount plus €9.52 from the uncertain amount.
- If you do not win the uncertain amount, which happens with a 65% probability, then you earn €7.00, €7.00 from the certain amount plus €0 form the uncertain amount.

Examples of screenshots of the decision screens

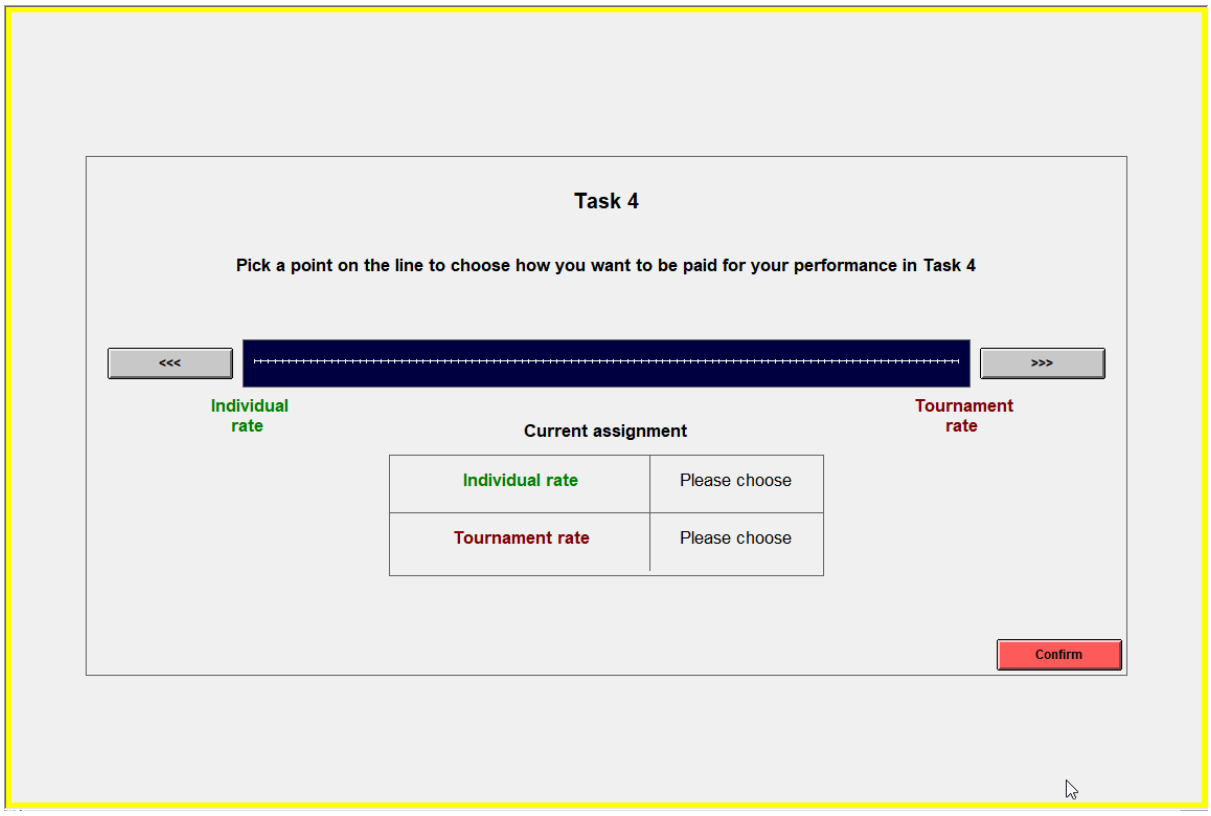
The math task



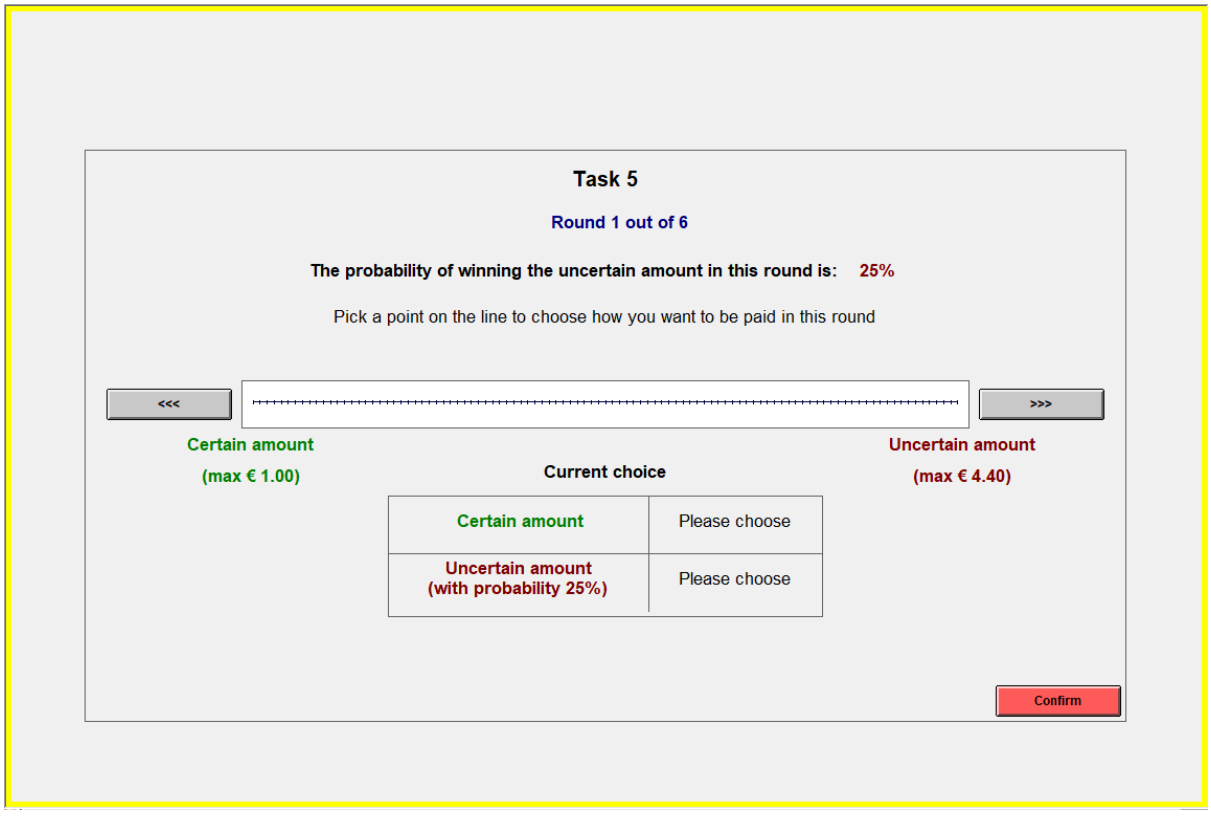
The belief elicitation screen



The payment scheme choice screen



The risk attitude elicitation screen



Appendix C Descriptive statistics

Table C1. Additional descriptive statistics of behavior in the experiment

Note: Descriptive statistics of the participants' performance in the real-effort task in each part and the fraction assigned to the uncertain amount in the six questions of part five.

	Mean	**Std. dev.**
Number of correct sums		
Part one: forced piece-rate pay	7.689	3.172
Part two: forced tournament pay	9.100	2.793
Part four: choice of piece-rate and tournament pay	10.089	2.959
Fraction assigned to the uncertain amount		
Choice 1: €1.00 vs. 0.25 probability of €4.40	0.335	0.317
Choice 2: €1.00 vs. 0.40 probability of €2.75	0.430	0.266
Choice 3: €1.00 vs. 0.10 probability of €11.00	0.296	0.356
Choice 4: €1.00 vs. 0.25 probability of €4.84	0.362	0.307
Choice 5: €1.00 vs. 0.55 probability of €9.68	0.493	0.268
Choice 6: €1.00 vs. 0.25 probability of €5.28	0.423	0.323

Table C2. Correlations between the survey questions

Note: Pairwise Pearson correlation coefficients between the eight survey questions designed to capture a preference for competition.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Q1	1.0000							
Q2	0.0307	1.0000						
Q3	0.1785	0.4394	1.0000					
Q4	0.2039	0.3416	0.4228	1.0000				
Q5	0.1894	0.2199	0.1459	0.2323	1.0000			
Q6	−0.0382	0.2799	0.4139	0.1461	0.0856	1.0000		
Q7	0.1047	0.1089	0.1137	0.1159	0.1620	−0.0253	1.0000	
Q8	0.0953	0.4139	0.3337	0.2912	0.3312	0.2457	0.1973	1.000

Table C3. Predicting preferences for competition with survey questions

Note: Results from OLS regressions with robust standard errors where the dependent variable is the participants' preference for competition (i.e., the residuals of regressing the fraction of compensation assigned to the tournament in part four of the experiment on the participants' performance, beliefs, and risk preferences, see Table 3). Each row of the table shows the regression coefficients of a combination of survey questions. The survey questions used as independent variables in each regression are listed under 'Variables,' followed by their respective coefficients, and Schwarz's Bayesian information criteria (BIC). The rows are sorted according to regressions' BIC. ***, **, and * denote statistical significance at 1%, 5%, and 10%.

Variables			Coefficients			BIC
1st	2nd	3rd	1st	2nd	3rd	
Q4			0.261***			257.033
Q2			0.179*			260.463
Q2	Q4		0.102	0.227**		260.642
Q4	Q8		0.234**	0.094		260.740
Q8			0.163*			260.992
Q4	Q6		0.252**	0.066		261.116
Q4	Q7		0.257***	0.041		261.368
Q3	Q4		−0.041	0.279***		261.398
Q4	Q5		0.261***	0.004		261.531
Q6			0.103			262.442
Q3			0.077			262.871
Q7			0.071			262.945
Q5			0.064			263.029
Q2	Q8		0.135	0.107		264.082
Q2	Q3	Q4	0.131	−0.088	0.254**	264.591
Q2	Q6		0.163	0.057		264.680
Q2	Q7		0.174	0.052		264.711
Q2	Q4	Q8	0.078	0.215**	0.068	264.782
Q3	Q4	Q8	−0.069	0.259**	0.11	264.876
Q2	Q5		0.174	0.026		264.902
Q2	Q4	Q6	0.090	0.224**	0.045	264.96
Q2	Q3		0.180	−0.002		264.962
Q4	Q6	Q8	0.230**	0.049	0.084	265.022
Q2	Q4	Q7	0.099	0.224**	0.035	265.028
Q6	Q8		0.067	0.146		265.099
Q2	Q4	Q5	0.104	0.229**	−0.012	265.130
Q3	Q4	Q6	−0.082	0.282***	0.096	265.159
Q4	Q7	Q8	0.232**	0.027	0.09	265.174
Q4	Q5	Q8	0.238**	−0.024	0.101	265.189
Q7	Q8		0.041	0.155		265.344
Q4	Q6	Q7	0.246**	0.068	0.044	265.427
Q3	Q8		0.025	0.154		265.439

Variables			Coefficients			BIC
1st	2nd	3rd	1st	2nd	3rd	
Q5	Q8		0.012	0.159*		265.480
Q4	Q5	Q6	0.252**	0.000	0.066	265.616
Q3	Q4	Q7	−0.045	0.275***	0.044	265.710
Q4	Q5	Q7	0.257**	−0.002	0.042	265.868
Q3	Q4	Q5	−0.041	0.278***	0.006	265.895
Q6	Q7		0.105	0.074		266.444
Q5	Q6		0.056	0.098		266.659
Q3	Q6		0.041	0.086		266.814
Q3	Q7		0.070	0.063		267.012
Q3	Q5		0.069	0.054		267.109
Q5	Q7		0.054	0.062		267.185
Q2	Q6	Q8	0.126	0.043	0.100	268.423
Q2	Q7	Q8	0.134	0.037	0.100	268.459
Q2	Q3	Q8	0.144	−0.023	0.111	268.542
Q2	Q5	Q8	0.135	−0.001	0.107	268.582
Q2	Q6	Q7	0.156	0.061	0.056	268.894
Q2	Q5	Q6	0.158	0.025	0.057	269.125
Q2	Q3	Q6	0.172	−0.026	0.066	269.134
Q2	Q5	Q7	0.170	0.019	0.050	269.179
Q2	Q3	Q7	0.177	−0.007	0.053	269.207
Q2	Q3	Q5	0.175	−0.004	0.026	269.400
Q6	Q7	Q8	0.071	0.046	0.136	269.410
Q5	Q6	Q8	0.011	0.067	0.142	269.588
Q3	Q6	Q8	0.000	0.067	0.146	269.599
Q3	Q7	Q8	0.023	0.040	0.147	269.800
Q5	Q7	Q8	0.007	0.040	0.152	269.840
Q3	Q5	Q8	0.025	0.011	0.151	269.929
Q5	Q6	Q7	0.045	0.101	0.066	270.765
Q3	Q6	Q7	0.031	0.092	0.070	270.874
Q3	Q5	Q6	0.034	0.052	0.084	271.071
Q3	Q5	Q7	0.064	0.046	0.057	271.328

Table C4. Using survey questions to predict the first alternative measure of preferences for competition

Note: OLS regressions using the survey questions to predict the participants' preference for competition, measured as the fraction of their payment participants assign to the tournament payment scheme (i.e., their willingness to compete). All regressions use standardized dependent and independent variables and report robust standard errors.

Question	Coefficient	Std. err.	p-value	R-squared
Q1	−0.072	0.116	0.538	0.005
Q2	0.138	0.092	0.137	0.019
Q3	0.044	0.094	0.638	0.002
Q4	0.285	0.094	0.003	0.081
Q5	0.102	0.101	0.318	0.010
Q6	0.201	0.101	0.049	0.040
Q7	0.006	0.100	0.949	0.000
Q8	0.113	0.089	0.207	0.013

Table C5. Using survey questions to predict the second alternative measure of preferences for competition

Note: OLS regressions using the survey questions to predict the participants' preference for competition, measured as the residuals of an initial regression of the fraction of compensation assigned to the tournament in part four of the experiment on the participants' expected likelihood of winning the tournament, their performance in parts one and two, and the amount they assigned to the risky lottery in each of the six choices of part five. All regressions use standardized dependent and independent variables and report robust standard errors.

Question	Coefficient	Std. err.	p-value	R-squared
Q1	−0.119	0.123	0.337	0.014
Q2	0.188	0.107	0.081	0.035
Q3	0.116	0.101	0.252	0.014
Q4	0.263	0.092	0.005	0.069
Q5	0.060	0.100	0.551	0.004
Q6	0.119	0.114	0.299	0.014
Q7	0.125	0.103	0.229	0.016
Q8	0.221	0.097	0.026	0.049