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Motivated Beliefs in Auctions

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Abstract

In auctions bidders are usually assumed to have rational expectations with regards to their winning probability. However, experimental and empirical evidence suggests that agent's expectations depend on direct utility stemming from expectations, resulting in optimism or pessimism. Optimism increases ex ante savoring, while pessimism leads to less disappointment ex post. Hence, optimal expectations depend on the time left until the uncertainty is resolved, i.e. the time one can savor ex ante by being (too) optimistic. Applying the decision theory model of Gollier and Muermann (2010) to first price auctions, I show that by decreasing the time between bids and revelation of results, the auctioneer can induce bidders to forego optimism, leading to more aggressive bids and thereby higher revenues for the auctioneer. Finally I test these predictions experimentally, finding no evidence for my theoretical predictions.

JEL Classification: D44, C91.

Keywords: Auctions; Experiment; Motivated Beliefs.

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Contents

1 Introduction

When analyzing games with uncertainty, economists usually assume that agents have rational expectations, i.e. correctly infer the probability of all potential outcomes given their actions. In particular, this implies that expectations stay constant over time if agents do not receive new information.

That does not allow for systematic errors of agents confronted with uncertainty, which are however observed in many environments. A large strand of psychological literature finds evidence for an optimism bias, meaning that agents systematically overestimate probabilities of good outcomes and underestimate probabilities of bad outcomes. Interestingly, this bias seems to disappear (or even turn into a pessimism bias) as the moment of truth, i.e. when the uncertainty is resolved, arrives.

This observation is in line with the predictions of motivated beliefs that are caused by ex ante savoring and ex post disappointment: Optimism comes with the benefit of utility gains during the time of optimism. [1] Yet, at the moment of truth agents can insure themselves against their own disappointment aversion by decreasing their expectations. As a result, the closer the temporal distance to the revelation of an uncertainty is, the less optimistic (or more pessimistic) agents tend to be. Or, in other words, when an agent expects the immediate resolution of an uncertainty, he tends to be less optimistic as compared to a situation where the resolution lies in a distant future.

The theoretical and empirical analysis of this behavioral pattern is so far limited to choice models. Clearly systematic errors in probability assessments influence decisions on investments, health outcomes or exam preparations.

However, to the best of my knowledge it has not yet been investigated (i) whether endogenous expectations[2] play a role in strategic games and (ii) what the consequences of this would be. This paper is a first attempt to close this gap by applying endogenous expectations to strategic games with uncertainty. As

[1] It is well documented that optimism increases outcomes such as health or general well-being, see e.g. Andersson (1996).

[2] As it is standard in the literature, endogeneous expectations and motivated beliefs are used as synonyms in this work.

I will show in the next chapters, an analysis based on endogenous expectations can provide important insights to strategic games. When agents can strategically manipulate the perceived probabilities of good or bad outcomes, their optimization problem will change, leading to different equilibria in a certain game (as compared to agents with rational expectations).

A natural choice of a strategic game to apply this framework to are static auctions. On the one hand due to the sheer size of auctions, especially in procurement, where static first-price auctions are the main tool to award suppliers. [3]. On the other hand, in static auctions the auction designer can usually influence the time between bidding and revelation of results. Since, as argued above, this has an influence on bidder´s expectations to win (and thereby on their bidding strategy), the auctioneer has an additional lever to increase or decrease revenue.

In procurement practice, the temporal distance between supplier´s bids and the revelation of the winner of the auction varies by multiple weeks to months. In some procurement projects, suppliers first hand in their final commercial and technical offers, and then the procuring organization analyses the offers in all dimensions. After this elaborate and lengthy analysis, the winning supplier is awarded the business. In other procurement projects, suppliers first hand in their technical offers, then the procuring organization monetarily evaluates all non-commercial differences between suppliers, and then an auction with immediate feedback is conducted.

To summarize, in first price auctions in procurement the time between the final submission of a (commercial) offer and the awarding of the business varies, which, under the assumption of motivated beliefs of bidders, has an effect on the bidding strategies. [4]

In this paper I analyze the consequences of a decrease in this temporal distance on estimated winning probabilities and revenues in first-price auctions. Applying a simple framework based on Gollier and Muermann (2010), I show that a low

[3]Note that procurement makes up 17% of European GDP, see e.g. Internal Market Scoreboard, no19, July 2009 and is even more important in many industries, see https://www.oliverwyman.com/our-expertise/industries/automotive/procurement.html

[4]Note that this is even the case if we assume that the shift in expected winning probabilities is exogenous instead of endogenous, since pessimism per se leads to overbidding in auctions, see e.g. Armantier and Treich (2009)

temporal distance between bid and revelation of results leads to more pessimism and thereby to more aggressive bidding. The rationale behind this finding is the following: The longer the time between bidding and revelation of results, the more subjects benefit from being optimistic. When subjects are optimistic, they benefit more from marginally decreasing their bid, as this increases their expected payoff (valuation minus bid multiplied by the expected winning probability) more than that of pessimistic bidders.

In addition to the theoretical analysis I test my main hypothesis experimentally. In two different induced values frameworks I vary the time between bidding and revelation of results. In these experiments I cannot find any effect of an increase in this time on either expected winning probabilities or bidding strategies.

2 Related Literature

When it comes to uncertain outcomes, systematic errors in the assessment of probabilities have been well documented. In an extensive study, Weinstein (1980) argues that people are unrealistically optimistic with respect to future life events. While participants correctly estimated probabilities of their peers, they significantly overestimated the chances for own good outcomes (and vice versa underestimated chances for own bad outcomes). Similar patterns have been found for estimates on task completion times (Buehler, Griffin, and Ross (1994)), student debt (Seaward and Kemp (2000)) or success of startups (Baker, Ruback, and Wurgler (2007)).

The economic interpretation behind this is that utility is not only realized at the moment of truth, but also continuously during the time of uncertainty. Being optimistic increases current felicity during this time. The temporal element of utility stemming from anticipation has first been introduced by Loewenstein (1987). Caplin and Leahy (2001) incorporate this formally into an economic model, where anticipatory feelings are caused by exogenous expectations.

The first researchers that modeled agents that can manipulate their expectations were Brunnermeier and Parker (2005). In a portfolio choice model they account for endogenous expectations and current felicity flows and show that in this case investors tend to overestimate their return and have an irrational preference for assets with high variance.

While it seems intuitive that being optimistic has benefits if the revelation of the uncertainty is in the distant future, it becomes less clear as the moment of truth approaches. As introduced by Bell (1985), agents tend to be disappointment averse, i.e. compare outcomes to expected outcomes[5]. With respect to uncertain outcomes, this means that the higher the estimated probability of a good event, the higher the disappointment if the good event does not realize. Hence being pessimistic comes with the benefit of insuring oneself against disappointment. Closing the gap between these two strands of literature, Gollier and Muermann (2010) introduce a choice model that accounts for both ex ante savoring and ex post disappointment.

In line with their model, multiple psychological researchers find that agents have the tendency to abandon optimism (and even become pessimistic) as the moment of truth approaches. In a study by Shepperd, Ouellette, and Fernandez (1996) college sophomors, juniors and seniors estimated their starting salary in their first post-graduate job at the beginning and end of the semester. As the researchers show, only the seniors significantly decreased their expectations over time. They furthermore argue that the decrease was solely driven by those seniors that were actually about to look for a job. Similarly, when estimating their exam scores multiple times after the exam was written, students abandon their initial optimism in favor of pessimism right before the grades are published (Van Dijk, Zeelenberg, and Van der Pligt (2003)). As Taylor and Shepperd (1998) show, the same logic applies to estimates on health.

Additionally Drobner (2022) conducts a literature review arguing that in experiments subjects update their beliefs optimistically if and only if they expect no immediate resolution of the uncertainty. He confirms this finding in the lab, showing that subjects update their beliefs about an IQ test optimistically if they expect no resolution of the uncertainty, and neutrally if they expect immediate resolution.

[5]Disappointment aversion is conceptually very similar to expectations based loss aversion as in Kőszegi and Rabin (2006). The only difference is that here the reference point corresponds to the lottery´s certainty equivalent, while in Kőszegi and Rabin (2006) the reference point is stochastic, i.e. corresponds to the distribution of the lottery.

In this paper I apply the model of Gollier and Muermann (2010) on first price auctions and show that immediate feedback is favorable for the auctioneer. To the best of my knowledge, this is the first paper to apply a model of endogenous expectations to a settinng that includes strategic interaction. Finally I test my predictions experimentally.

3 Model

One indivisible item is to be awarded. There are two bidders with independent private values drawn from a uniform distribution function $U[0,1]$.

3.1 Preferences

I model agent´s preferences based on Gollier and Muermann (2010). There are two dates: At date 1, bidders submit bids. At the same time, they form subjective beliefs about their winning probability. The subjective beliefs can be different from the objective winning probability based on own bid and strategies of competitors. At date 2, i.e. the moment of truth, the winner of the auction is announced. Each bidder generates welfare from anticipatory feelings and the utility generated by the final outcome of the auction. Welfare from anticipatory feelings is weighted with the temporal distance k between now and the moment of revelation. For consumption c_s, subjective probabilities p_s and objective probabilities q_s for different states of the world s, welfare then becomes

$$W = k * \sum_{s=1}^{S} p_s U(c_s, y) + \sum_{s=1}^{S} q_s U(c_s, y) \tag{1}$$

where reference consumption y is defined as expected value given subjective probabilities.

The utility generated by the final outcome of the auction depends on actual consumption x and reference consumption y and is given by[6]

$$U(x, y) = x - \alpha(y - x) \tag{2}$$

where α represents the weight of the utitlity derived from reference depence compared to standard consumption utility.

[6]To make the analysis tractable, I assume linear utility, resulting in 'no kink' at the point of the reference consumption. Intuitively this means that an agent does not suffer more from a negative surprise than he gains from a positive surprise. The introduction of a kink would however not change the main results, as I will argue in the discussion section.

In first price auctions, welfare then becomes

$$
\begin{aligned}
W = kpU(v-b,y) &+ k(1-p)U(0,y) \\
&+ qU(v-b,y) + (1-q)U(0,y); \\
&\qquad\qquad y = p(v-b) \qquad (3)
\end{aligned}
$$

with p being the subjective winning probability.

The anticipatory utility is represented in the first line of the equation. With subjective probability p the agent expects to win the auction, and receives a utility that accounts for the fact that he expected to receive y. With subjective probability $1-p$ he will not win the auction and will hence receive a (negative) utility that again accounts for the fact that he expected to receive y. All expressions in the first line are of course multiplied by the temporal distance k. Actual consumption utilities are then represented in the second line. These depend on the objective winning probability q and also take into account potential deviations from expected utlity y.

Plugging in $y = p(v-b)$ and the linear utility function from above, this becomes

$$W = p(k-\alpha)(v-b) + q(1+\alpha)(v-b) \qquad (4)$$

4 Analysis

In contrast to most standard auction models, in this model bidders optimize over 2 variables: Subjective winning probability p and bid b. I begin the analysis with the observation that for all $k < \alpha$, W is strictly decreasing in p, while for all $k > \alpha$, W is strictly increasing in p.[7] As a result, bidders will choose $p = 0$ in the former case, and $p = 1$ in the latter, hence I can make a distinction between these two cases, and the problem becomes a one-dimensional optimization problem in each of the cases.[8]

4.1 Small temporal distance: $k < \alpha$

In the case of small temporal distance between bids and publication of results, the welfare of a bidder becomes

$$W_{small} = q(1 + \alpha)(v - b) \tag{5}$$

Assume both bidders bid according to the strictly increasing and differentiable equilibrium bidding strategy $\beta(v)$. The welfare of bidder i bidding b is given by

$$\begin{aligned} W_{small} &= q(1 + \alpha)(v - b) \\ &= Pr\left(b > \beta\left(v\right)\right)(1 + \alpha)(v - b) \\ &= Pr\left(\beta^{-1}\left(b\right) > v\right)(1 + \alpha)(v - b) \\ &= \beta^{-1}\left(b\right)(1 + \alpha)(v - b) \end{aligned} \tag{6}$$

Optimize via b:

$$\frac{\partial}{\partial b} W_{small} = \left(\frac{v - b}{\beta'\left(\beta^{-1}\left(b\right)\right)} - \beta^{-1}\left(b\right)\right)(1 + \alpha) \tag{7}$$

[7] The intuition behind that is the following: When the temporal distance k is high and the weight on reference dependence α is low a bidder benefits from being optimistic, and does not suffer from over-optimism at the time of the revelation. The same logic applies vice versa for low temporal distance k and high weight on reference dependence α.

[8] The fact that agents always choose one of the extremes is caused by the linear utility functions. In the case of non-linear utility functions we would not observe these extremes, but the main results still hold, with the downside that closed-form solutions do not exist. Since the main purpose of the theory in this paper is to motivate my experiments, I decided to take the 'simple' model which however nicely shows the intuition.

$$\left(\frac{v-b}{\beta'\left(\beta^{-1}\left(b\right)\right)}-\beta^{-1}\left(b\right)\right)(1+\alpha)\overset{!}{=}0 \tag{8}$$

In equilibrium, $\beta^{-1}(b)=v$.

$$\frac{v-\beta(v)}{\beta'(v)}-v\overset{!}{=}0 \tag{9}$$

$$\frac{\partial}{\partial v}[v\beta(v)]\overset{!}{=}v \tag{10}$$

$$\int_0^v \frac{\partial}{\partial y}\left[y\beta(y)\right]dy\overset{!}{=}\int_0^v ydy \tag{11}$$

$$v\beta(v)\overset{!}{=}\frac{v^2}{2} \tag{12}$$

Hence, in equilibrium

$$\beta_{small}(v)=\frac{v}{2} \tag{13}$$

Evidently, in the case of a small temporal distance, the equilibrium bidding function corresponds to the bidding function in standard theory. This is due to the fact that ex-ante savoring does not play a role here, since subjects choose a subjective winning probability of zero.

4.2 Large temporal distance: $k > \alpha$

In the case of large temporal distance between bids and publication of results, the welfare of a bidder becomes

$$W_{large}=(k-\alpha)(v-b)+q(1+\alpha)(v-b) \tag{14}$$

Assume both bidders bid according to the strictly increasing and differentiable equilibrium bidding strategy $\beta(v)$. The welfare of bidder i bidding b is given by

$$\begin{aligned} W_{large} &= (k-\alpha)(v-b) + q(1+\alpha)(v-b) \\ &= (k-\alpha)(v-b) + Pr\left(b > \beta\left(v\right)\right)(1+\alpha)(v-b) \\ &= (k-\alpha)(v-b) + Pr\left(\beta^{-1}\left(b\right) > v\right)(1+\alpha)(v-b) \\ &= (k-\alpha)(v-b) + \beta^{-1}\left(b\right)(1+\alpha)(v-b) \end{aligned} \tag{15}$$

Optimize via b:

$$\frac{\partial}{\partial b}W_{large} = (\alpha-k) + \Big(\frac{v-b}{\beta'\left(\beta^{-1}\left(b\right)\right)} - \beta^{-1}\left(b\right)\Big)(1+\alpha) \tag{16}$$

$$\Big(\frac{v-b}{\beta'\left(\beta^{-1}\left(b\right)\right)} - \beta^{-1}\left(b\right)\Big)(1+\alpha) \stackrel{!}{=} (k-\alpha) \tag{17}$$

In equilibrium, $\beta^{-1}(b) = v$.

$$\frac{v-\beta(v)}{\beta'(v)} - v \stackrel{!}{=} \frac{k-\alpha}{1+\alpha} \tag{18}$$

$$v + \frac{\alpha-k}{1+\alpha} * \beta'(v) \stackrel{!}{=} v * \beta'(v) + \beta(v) \tag{19}$$

$$\frac{\partial}{\partial v}[v\beta(v)] \stackrel{!}{=} v + \frac{\alpha-k}{1+\alpha}\beta'(v) \tag{20}$$

$$\int_0^v \frac{\partial}{\partial y}\left[y\beta(y)\right]dy \stackrel{!}{=} \int_0^v (y + \frac{\alpha-k}{1+\alpha}\beta'(y))dy \tag{21}$$

$$v\beta(v) \stackrel{!}{=} \frac{v^2}{2} + \frac{\alpha-k}{1+\alpha}\int_0^v (\beta'(y))dy \tag{22}$$

$$v\beta(v) \stackrel{!}{=} \frac{v^2}{2} + \frac{\alpha-k}{1+\alpha}\beta(v) \tag{23}$$

$$\beta(v)(v + \frac{k-\alpha}{1+\alpha}) \stackrel{!}{=} \frac{v^2}{2} \tag{24}$$

Hence, in equilibrium

$$\beta_{large}(v) = \frac{v^2}{2 * (v + \frac{k-\alpha}{1+\alpha})} \tag{25}$$

As we can see, β is increasing in k and decreasing in α, with the following intution: When the temporal distance k is high and the weight on reference dependence α is low, it becomes attractive to (i) be very optimistic and (ii) bid very low, since the bidder benefits strongly from the higher expected gain associated with a high bid and high sibjective winning probability.

4.3 Results

Having derived the bidding functions for small and large temporal distances, I can show that the former is always larger than the latter:

Proposition 1. *For all v, bids are strictly higher in the case of small temporal distance than in the case of large temporal distance:*

$$\beta_{small}(v) > \beta_{large}(v) \forall v \tag{26}$$

Proof.

$$\beta_{small}(v) = \frac{v}{2} = \frac{v^2}{2 * v} > \frac{v^2}{2 * (v + \frac{k-\alpha}{1+\alpha})} = \beta_{large}(v) \tag{27}$$

□

As intuition suggests, a larger temporal distance leads to more optimism. When slightly decreasing a certain bid, bidders face a tradeoff between higher ex ante savoring (i.e. expecting to win $v - b$) and a lower chance of actually winning the auction. Since for a high temporal distance the bidder benefits from a lower bid longer and with a higher perceived probability, the incentive to slightly decrease the bid is higher than for a short temporal distance, driving my main result.

To test whether the behavioral mechanisms described in the previous chapters are actually relevant for human behavior in auctions, I conducted an experiment.

5 Experiment

5.1 Experimental Design

The experiment consisted of five bidding rounds. Participants were matched into cohorts of four bidders, that were randomly matched in groups of two in each round.

Auction. Participants were bidding on a coupon, that each participant had a certain valuation for. This valuation was drawn independently from {0; 2; 4; 6; 8; 11}USD, with each value being equally likely. [9] The bidder submitting the highest bid received the coupon, accordingly his payoff from the auction was valuation minus his bid. The bidder submitting the lower bid received a payoff of zero.

Probability Estimate. In addition to bidding, participants had to provide an estimate on their winning probability given their bid. To do so, they could choose from a set of 'confidence levels', i.e. $\{0\% - 20\%; 20\% - 40\%; 40\% - 60\%; 60\% - 80\%; 80\% - 100\%\}$ that they estimated their winning probability to be within. This estimate was incentivized in the following way: After a cohort finished all 5 rounds, I counted the number of bids (of all other bidders) lower or equal to the respective bid. This number was then divided by 20, i.e. the number of all bids of all other players in this cohort. If the estimate in a given round was corresponding to this probability, the participant received an additional $0.50USD$.

Timing. The timing of the experiment was the following: Participants entered the submission screen, where they were told their valuation for the coupon. On the same screen, participants had to post their offer and their estimate of winning given this offer. To do so, they had 2 minutes. After the 2 minutes, participants in CLOSE were immediately told wether they won the auction and then had to wait 5 minutes for the next round to start. Participants in FAR had to wait 5 minutes for the revelation of the result, and then the next round immediately started. [10]

[9] This distribution function was chosen due to its clear theoretical prediction: In the unique RNNE, bidders bid {0; 1; 2; 3; 4; 5}USD respectively.

[10] When designing the experiment, I faced a tradeoff between the amount of data I can collect (i.e. the number of rounds) and the length of the waiting time. In an ideal world, participants would wait for multiple weeks between bidding and revelation, and play the experiment multiple times. This however was not possible due to technical and financial constraints. So I decided to take an approach with a relatively low waiting time in order to let subjects play multiple rounds, since I was not fully convinced that the mechanism I describe also works in a one-shot game.

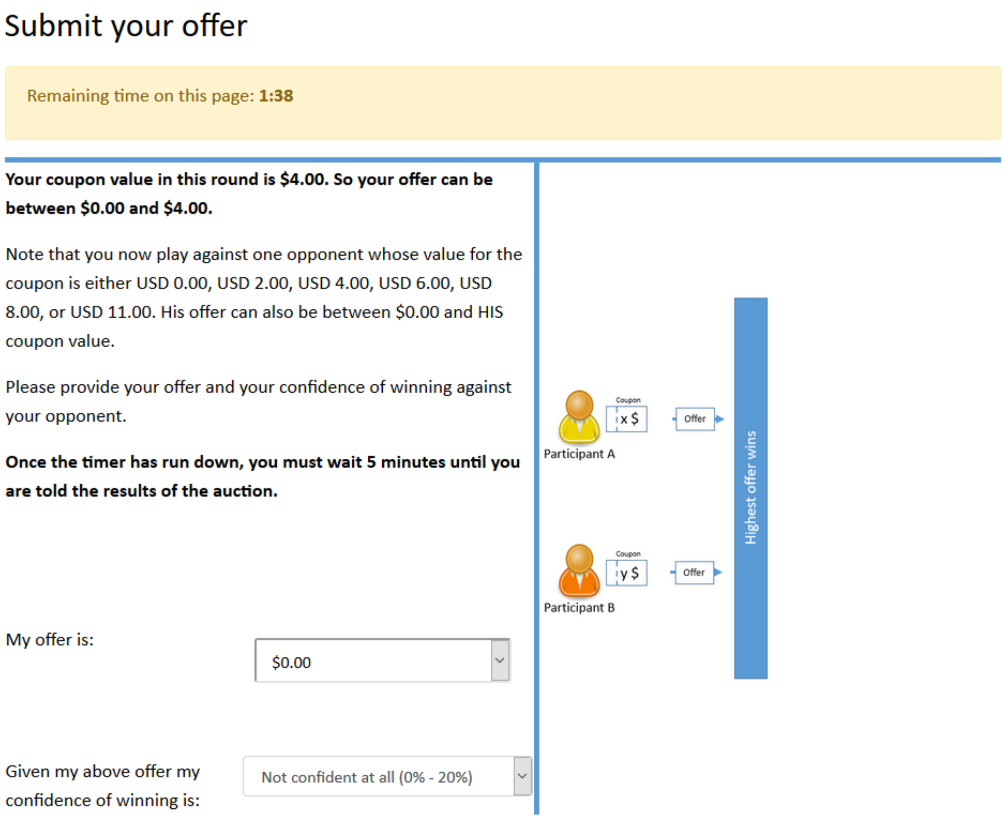


Figure 1: Screenshot of decision situation in FAR

Figure 1 displays a screenshot of the decision situation that participants were facing in the treatment FAR. Moreover, the full set of screenshots can be found in the appendix.

5.2 Hypotheses derived from the model

As shown in the model, bidders choose to be optimistic for high k, and pessimistic for low k. Since the experimental treatments only differ in k[11], I can extract following hypothesis from the model:

Hypothesis 1. *With an increase in temporal distance between bidding and revelation of bids subjects become more optimistic. Hence subjects tend to be more optimistic in FAR than in CLOSE.*

Furthermore, in accordance with Proposition 1 I expect subjects to bid less aggressively when k is high:

Hypothesis 2. *With an increase in temporal distance between bidding and revelation of bids subjects bid less aggressively. Hence subjects tend to bid less aggressively in FAR than in CLOSE.*

5.3 Experimental procedures and data sample

The experiments were conducted online and took place on the 14th and 22nd of July 2020. All participants were recruited via Amazon Mechanical Turk, where I published my task at around 4 pm CEST on both days. After choosing my experiment, subjects first received some general information, i.e. on data protection, duration and expected earnings of my experiment. By accepting my terms and conditions, subjects were redirect to the ZEW server, where the actual experiment took place. The whole experiment was computerized using the programming environment oTree (Chen, Schonger, and Wickens, 2016).

[11]The hypothesis are based on the assumption that the difference in k between treatments is sufficiently large.

Table 1: Descriptive Statistics

	FAR	CLOSE
Age [Avg]	33.29	33.17
Share of females	0.33	0.35
Share of US citizens	0.65	0.53
Share of College graduates	0.83	0.87
Observations	60	60

To sort out bots and participants with a low level of understanding subjects had to answer 4 comprehension questions after reading the instructions. If a participant answered one of the questions wrongly three times, they got excluded from the experiment.[12] Subjects were then matched into cohorts the following way: On the first day, the first 4 subjects answering the control questions correctly constituted the first cohort in treatment FAR. The next 4 subjects answering the control questions correctly constituted the first cohort in treatment CLOSE etc. On the second day of the experiment I changed this order accordingly.[13]

In total, 120 subjects participated in the experiment, with 60 subjects participating in each treatment. An overview of participant´s characteristics can be found in Table 1.

Payoffs were stated in USD. Participants were paid out by Amazon Mechanical Turk. The average payoff for the entire experiment was 8.33 USD, including a fixed payment of 0.50 USD and an additional 0.50 USD per control question answered correctly at the first try. The experiment lasted around 45 minutes on average.

I preregistered the experiment via aspredicted.org, where I stated my research question, the treatments of the experiment and the hypothesis as above. I furthermore predefined the key dependent variables of my analyses: Average estimated winning probability and average bid over the 5 rounds (per cohort and per sub-

[12]I hence had to invite a sufficiently large number of subjects. In my case, I invited 400 subjects in order to get 120 participants that answered all control questions correctly.

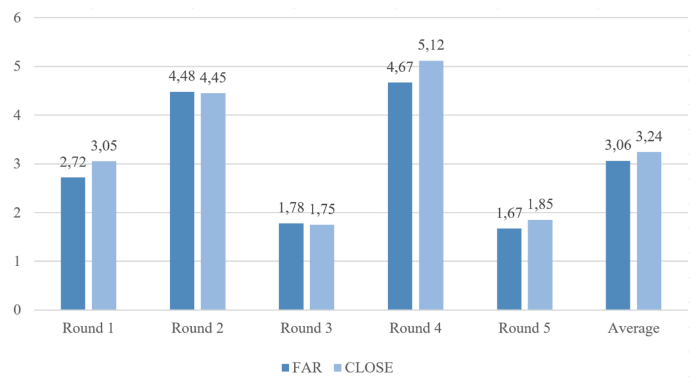
[13]At Amazon Mechanical Turk workers do not enter an experiment simultaneously. This kind of matching was hence implemented due to practicial reasons: To avoid long waiting times, that would in turn lead to high drop-out rates.

ject).

5.4 Results

In the experiment, behavior does not significantly differ between treatments. Figure 2 and Figure 3 display average values of bids and assessment per round. [14] As can be seen in the figures, average values over all 5 rounds are not substantially different, both for bids and probability assessments. Conducting two-sided Mann-Whitney U-tests of average values per subject, I find no significant difference for either bids or probability assessment between the treatments (the p-values are 0.53 and 0.56 respectively).

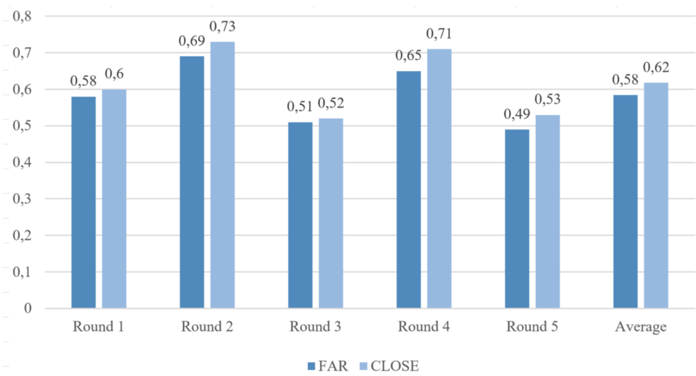
Figure 2: Average bids per treatment and round



This figure displays the average bid per round submitted by the participants in both treatments, as well as the average over all rounds and subjects.

[14] The large variation in average bids over the rounds are due to us drawing valuations upfront and then using the same sets of valuations per cohort.

Figure 3: Average Assessment per treatment and round



This figure displays the average probability assessment per round submitted by the participants in both treatments, as well as the average over all rounds and subjects.

The same is true for parametric analysis of the data taking into account valuations and demographic variables. Table 2 and Table 3 display OLS regressions of average bids and average assessment. As can be seen in the tables, treatment (FAR) is not significant, which does not change with independent variables I add to the model.

Table 2: Regressions: Determinants for bids

Model No.	1	2	3
Dependent Variable	Average Bid	Average Bid	Average Bid
FAR	0.18	0.18	0.115
	[1,02]	[1,02]	[0.73]
Average Valuation		-0,622	-1,161
		[-0,61]	[-1,26]
Male			0,237
			[1,44]
Unknown gender			0,282
			[0,46]
Education			0,0166
			[0,13]
Age (in years)			0,00655
			[0.65]
Constant	3,063**	6,392	9,003
	[24,65]	[1,17]	[1,84]
Model	OLS	OLS	OLS
Observations	120	120	114
Adjusted R-squared	0	-0,005	-0,017

Standard errors in brackets
*** p<0.01, ** p<0.05, * p<0.1

Table 3: Regressions: Determinants for assessment

Model No.	1	2	3
Dependent Variable	Average Assessment	Average Assessment	Average Assessment
FAR	0.0353	0.0353	0.0270
	[0.96]	[0.96]	[0.76]
Average Valuation		-0,242	-0,28
		[-1,14]	[-1,35]
Male			0,0385
			[1,04]
Unknown gender			-0,131
			[-0,95]
Education			-0,00821
			[-0,4]
Age (in years)			-0,00219
			[0.97]
Constant	0.583***	1,879	2,183*
	[22,46]	[1,66]	[1,99]
Model	OLS	OLS	OLS
Observations	120	120	114
Adjusted R-squared	-0,001	0,002	-0,005

Standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

5.5 Discussion of results

In the experiment I do not observe any effect of temporal distance on the expected winning probability (and, potentially as a result, also no effect on bidding behavior). This is in stark contrast to the existing literature on endogenous expectations where an increase in the temporal distance to the revelation of an uncertainty usually leads to an increase in optimism.

Importantly, this is the first paper to explore this behavioral mechanism in games with strategic interactions. Hence, an interpretation of the 'zero results' of experiment 1 could be that the behavioral mechanisms described above simply do not play a role in these games.

As a robustness check of this interpretation, and to rule out that the 'zero results' were driven by the low variance in temporal distance (which was only 5 minutes), I conducted a second experiment. This second experiment varies in two main dimensions from the first one: (i) It is a within subject design experiment, where all participants bid exactly twice: Once with immediate feedback and once with delayed feedback. (ii) The variance in the temporal distance is increased to 4 weeks.

In line with the results from experiment 1, I observe no effect of an increase in temporal distance on expectations to win, which gives further evidence for the interpretation that the behavioral mechanisms described above seem to play no role in auctions, even when the time until the resolution of the auction winner is increased to 4 weeks.[15] Furthermore, given that the estimated winning probability does not change, I neither expect nor observe any difference in bidding behavior between treatments.

As a next step it would be interesting to find out if these 'zero results' also hold in other environments. Firstly, researchers should explore if the pattern plays a role for outcomes that are not ego-relevant [16]. If that is positive, it should be examined if the 'zero result' is robust to other strategic games than (first price) auctions.

The detailed description and results of the second experiment are delegated to the appendix.

[15]Alternatively it is possible that the mechanisms do play a role, but only if stakes are 'high'. So far the effect has only been observed in environments where the outcome is of high relevance for the subjects.

[16]One can argue that experimental evidence so far only exists for outcomes that are relevant for ones self-image, since they are all correlated with either health or intelligence.

6 Conclusion

There is ample evidence that agents have systematic biases in their expectations. When the resolution of an uncertainty lies in the distant future, agents can benefit from high subjective winning probabilities, and hence tend to be overly optimistic. When the resolution is imminent, agents want to insure themselves against their own disappointment aversion and therefore forego optimism in favor of a pessimistic bias. In this paper I theoretically analyse the consequences of this pattern in first-price auctions: When the time until the revelation is long, the incentive to increase ones subjective probability is higher (given a fixed bid). Hence, compared to an imminent revelation, agents increase their subjective probability of winning, which in turn leads to higher marginal utility of a decrease in the bid (again given a fixed bid). [17] Based on this theory I hence advise auction designers to minimize the time between bidding and revelation of the winner of the auction.

Finally I test these findings experimentally. In two different standard induced values frameworks I vary the time between bid and revelation of results. This has however no effect on estimated winning probability, and hence also no effect on bidding behavior.

[17] Note that this logic applies independent of a kink in the utility funtion, hence the results will also hold for agents that suffer more from disappointment than they benefit from a positive surprise.

7 Appendix

7.1 Experimental Instructions

Instructions

Time left to complete this page: **1:53**

Thank you very much for participating in this social science experiment. 4 people participate in today´s experiment. Before the actual experiment starts, all participants must answer questions to show that they understood how the experiment works. For every question that you answer correctly at the first try you will receive an additional USD 0.50. If you answer one of the questions wrongly three times, you get excluded from the experiment. The experiment itself commences only once 4 participants have answered these questions correctly.

The experiment consists of 5 rounds.
In each round you get randomly matched with ONE other participant. You both will have the chance to buy a coupon that will be traded for money after the experiment. The coupon has a certain value for you that we will tell you in each round. You and the other potential buyer have to make an offer on how much you are willing to pay for the coupon. The coupon will be received by the participant who makes the highest offer. This participant then receives the value of the coupon minus the price he offered.

Additionally you have to tell us how confident you are to receive the coupon in each round. If your level of confidence is realistic, you will receive an additional amount of money.

All 5 rounds are relevant for your final payoff.

Summary of a round:

1. **You get matched with ONE other participant**
2. **You get to know the value of YOUR coupon**
3. **You make an offer for the coupon**
4. **You tell us how confident you are to receive the coupon**
5. **You receive the coupon if your offer was higher than the offer of the other participant**

Next

Figure 4: Experimental Instructions

Procedures (1/2): Coupons

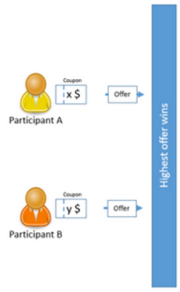
Time left to complete this page: **1:57**

In each round you have 2 minutes to make an offer in USD and provide your level of confidence to receive the coupon given your offer. Should you not specify an offer or not provide information on how confident you are that you receive the coupon, we will regard this as an input of 0 USD (offer) and 0%-20% (confidence level), respectively.

In each round a regular (virtual) dice is tossed independently for each participant to determine that player´s value for the coupon. If the dice shows a 1, the value of your coupon is 0 USD. If the dice shows a 2 (3; 4; 5; 6), the value of your coupon is 2 (4; 6; 8; 11) USD. **Note that the value of your competitor's coupon can be different from the value of your coupon.** The offers are allowed to be between 0 USD and 11 USD in increments of 1 USD, but cannot be higher than the value of your coupon.
The participant making the highest offer receives the coupon. Should both participants offer the same amount of money, a coin flip will determine who receives the coupon.

The payoff of a participant then equals the value of his coupon minus his offer if he receives the coupon, and 0 if he does not receive the coupon.

	Payoff of a participant (Coupon)
Highest offer:	Coupon Value - Offer
Non-highest offer:	0



Next

Figure 5: Experimental Instructions

Procedures (2/2): Estimation

Time left to complete this page: **1:58**

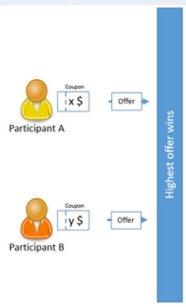
In addition to making an offer each participant has to tell us how confident they are that they made the higher offer. The participant must specify this by telling us if he is "very confident" (80% - 100%), "quite confident" (60% - 80%), "medium confident" (40% - 60%), "not very confident" (20% - 40%) or "not confident at all" (0%-20%) that his offer is higher than the offer of his competitor in this round.

If the participant gives us a realistic level of confidence in a certain round, he receives an additional USD 0.50.

To determine if a level of confidence in a certain round is realistic, we proceed the following way: After the experiment we take all offers from the other participants in this experiment. Then we simply check what share of these offers is lower than (or equal to) your offer in this round.

Example: Assume you make an offer of USD 5.00 in a certain round. During the entire experiment, 70% of the offers of the other participants are lower than USD 5.00, and 30% are higher than USD 5.00. In this case, it would have been realistic if you had been "quite confident", and therefore estimated your confidence to win between 60% and 80%. In this case you would receive the additional USD 0.50.

	Payoff of a participant (estimation)
Realistic level of confidence	USD 0.50
Unrealistic level of confidence	0



Next

Figure 6: Experimental Instructions

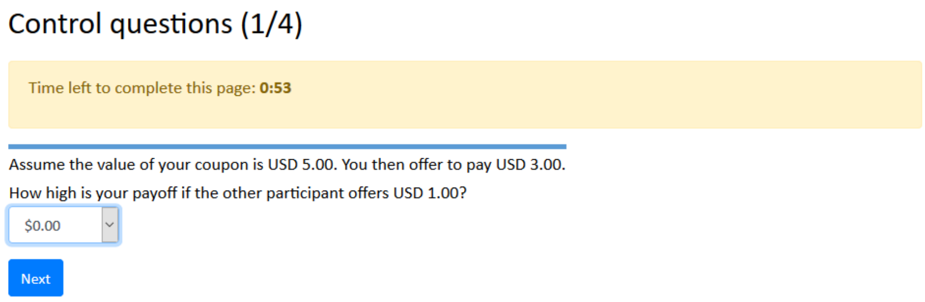


Figure 7: Experimental Instructions

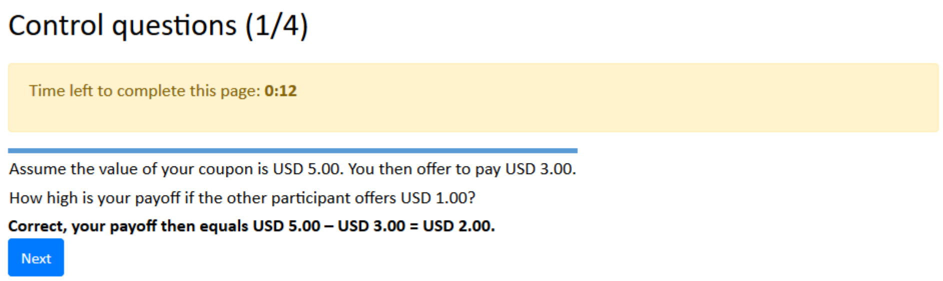


Figure 8: Experimental Instructions

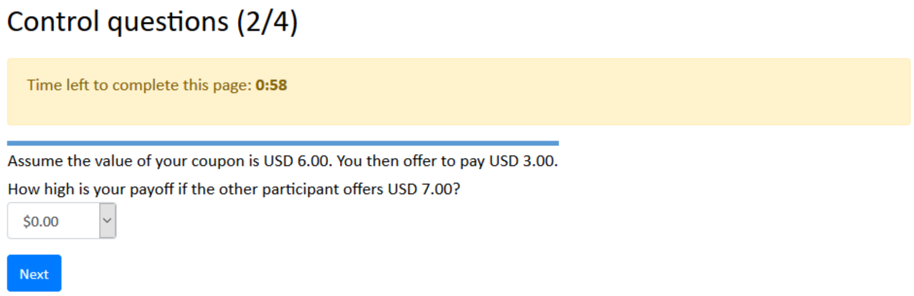
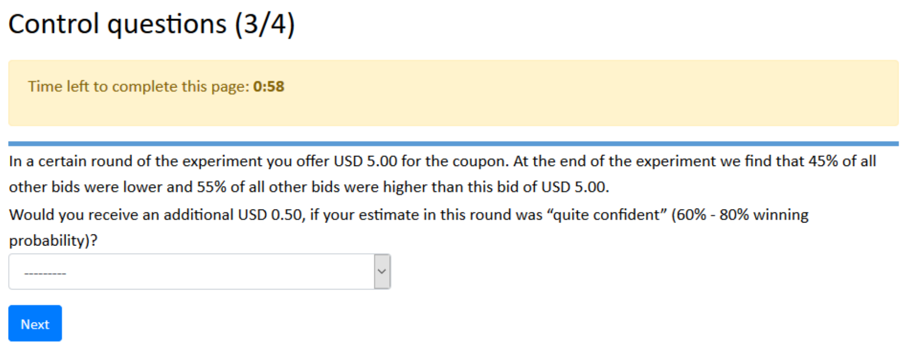


Figure 9: Experimental Instructions



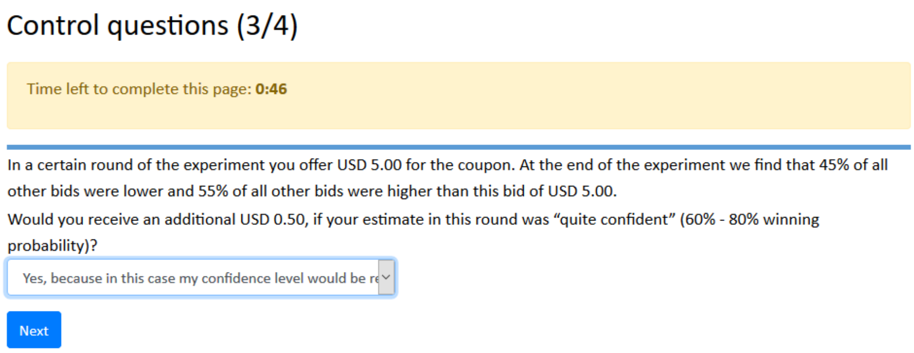
Control questions (3/4)

Time left to complete this page: **0:58**

In a certain round of the experiment you offer USD 5.00 for the coupon. At the end of the experiment we find that 45% of all other bids were lower and 55% of all other bids were higher than this bid of USD 5.00.
Would you receive an additional USD 0.50, if your estimate in this round was “quite confident” (60% - 80% winning probability)?

Next

Figure 10: Experimental Instructions



Control questions (3/4)

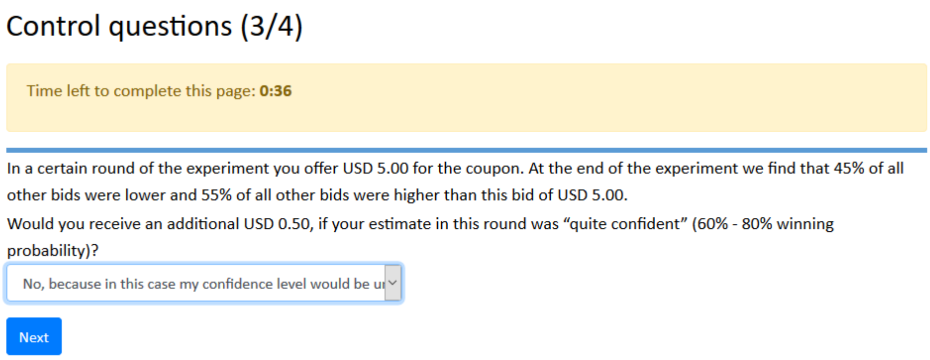
Time left to complete this page: **0:46**

In a certain round of the experiment you offer USD 5.00 for the coupon. At the end of the experiment we find that 45% of all other bids were lower and 55% of all other bids were higher than this bid of USD 5.00.
Would you receive an additional USD 0.50, if your estimate in this round was “quite confident” (60% - 80% winning probability)?

Yes, because in this case my confidence level would be re

Next

Figure 11: Experimental Instructions



Control questions (3/4)

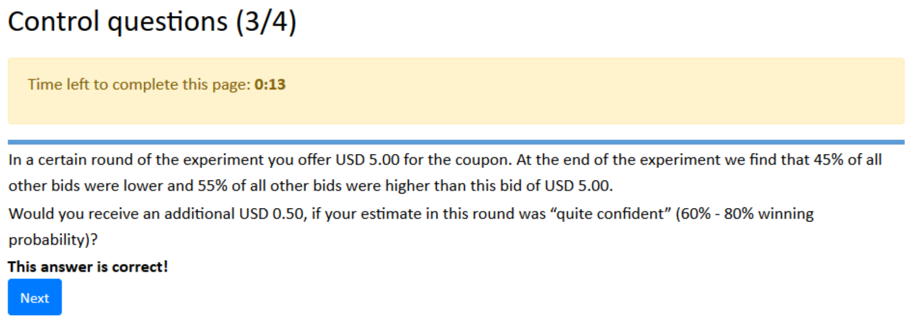
Time left to complete this page: **0:36**

In a certain round of the experiment you offer USD 5.00 for the coupon. At the end of the experiment we find that 45% of all other bids were lower and 55% of all other bids were higher than this bid of USD 5.00.
Would you receive an additional USD 0.50, if your estimate in this round was “quite confident” (60% - 80% winning probability)?

No, because in this case my confidence level would be u

Next

Figure 12: Experimental Instructions



Control questions (3/4)

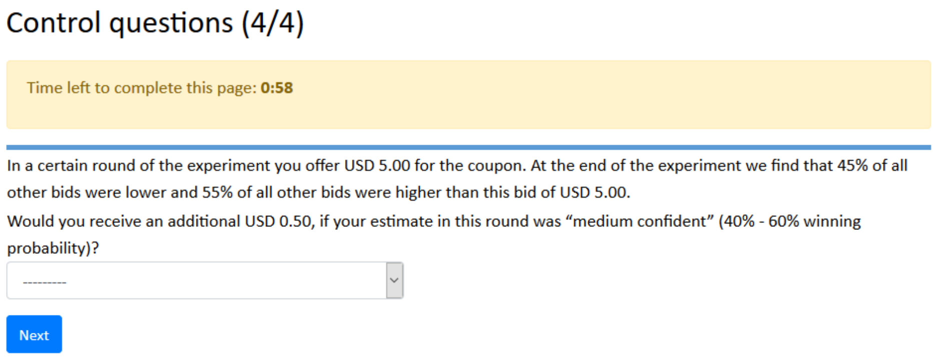
Time left to complete this page: **0:13**

In a certain round of the experiment you offer USD 5.00 for the coupon. At the end of the experiment we find that 45% of all other bids were lower and 55% of all other bids were higher than this bid of USD 5.00.
Would you receive an additional USD 0.50, if your estimate in this round was “quite confident” (60% - 80% winning probability)?

This answer is correct!

Next

Figure 13: Experimental Instructions



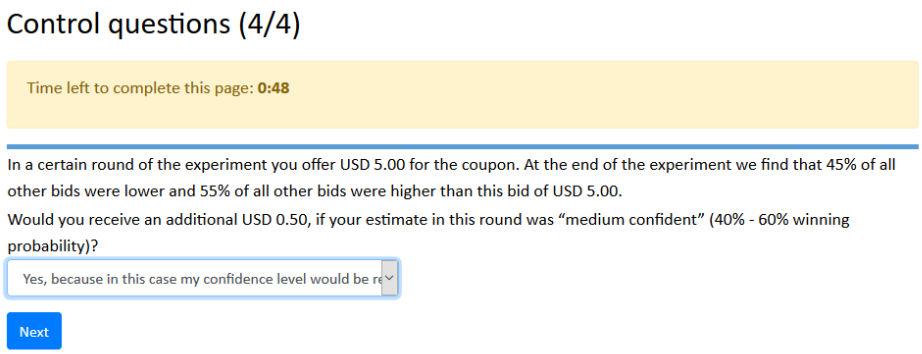
Control questions (4/4)

Time left to complete this page: **0:58**

In a certain round of the experiment you offer USD 5.00 for the coupon. At the end of the experiment we find that 45% of all other bids were lower and 55% of all other bids were higher than this bid of USD 5.00.
Would you receive an additional USD 0.50, if your estimate in this round was “medium confident” (40% - 60% winning probability)?

Next

Figure 14: Experimental Instructions



Control questions (4/4)

Time left to complete this page: **0:48**

In a certain round of the experiment you offer USD 5.00 for the coupon. At the end of the experiment we find that 45% of all other bids were lower and 55% of all other bids were higher than this bid of USD 5.00.
Would you receive an additional USD 0.50, if your estimate in this round was “medium confident” (40% - 60% winning probability)?

Yes, because in this case my confidence level would be re

Next

Figure 15: Experimental Instructions

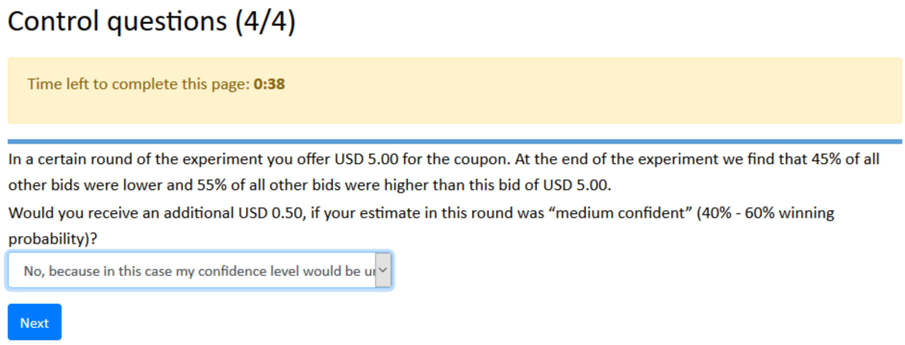


Figure 16: Experimental Instructions

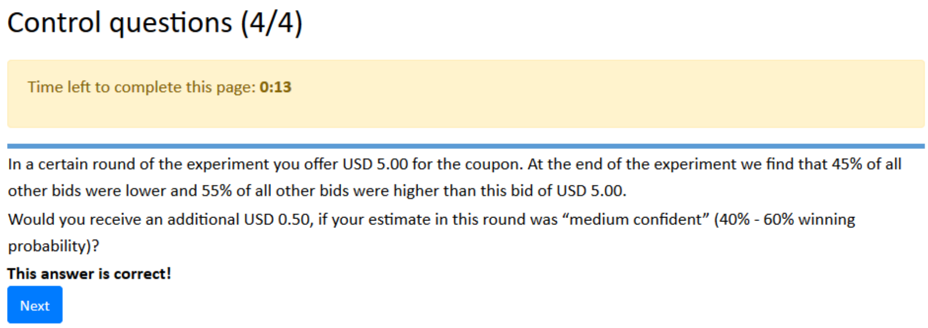


Figure 17: Experimental Instructions

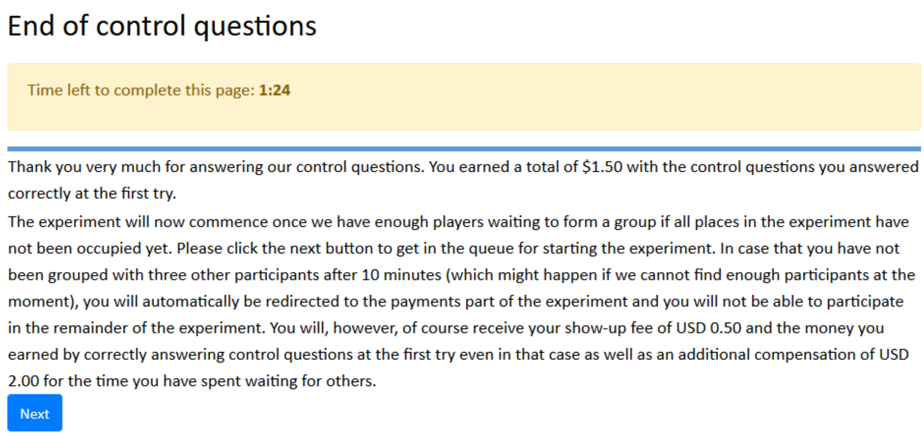


Figure 18: Experimental Instructions

Information

Remaining time on this page **0:38**

Please take note of the following information: **After having submitted your offer, you must wait 5 minutes until you are told the results of the auction. Once these 5 minutes are over, we inform you whether you have won the auction or not.**

Figure 19: Experimental Instructions

Information

Remaining time on this page **0:38**

Please take note of the following information: **After having submitted your offer, you will be told immediately whether you have won the auction or not. Afterwards you must wait 5 minutes until the next round starts.**

Figure 20: Experimental Instructions

Submit your offer

Remaining time on this page: **1:38**

Your coupon value in this round is $4.00. So your offer can be between $0.00 and $4.00.

Note that you now play against one opponent whose value for the coupon is either USD 0.00, USD 2.00, USD 4.00, USD 6.00, USD 8.00, or USD 11.00. His offer can also be between $0.00 and HIS coupon value.

Please provide your offer and your confidence of winning against your opponent.

Once the timer has run down, you must wait 5 minutes until you are told the results of the auction.

My offer is: $0.00

Given my above offer my confidence of winning is: Not confident at all (0% - 20%)

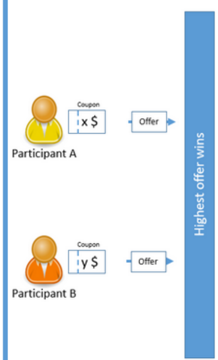
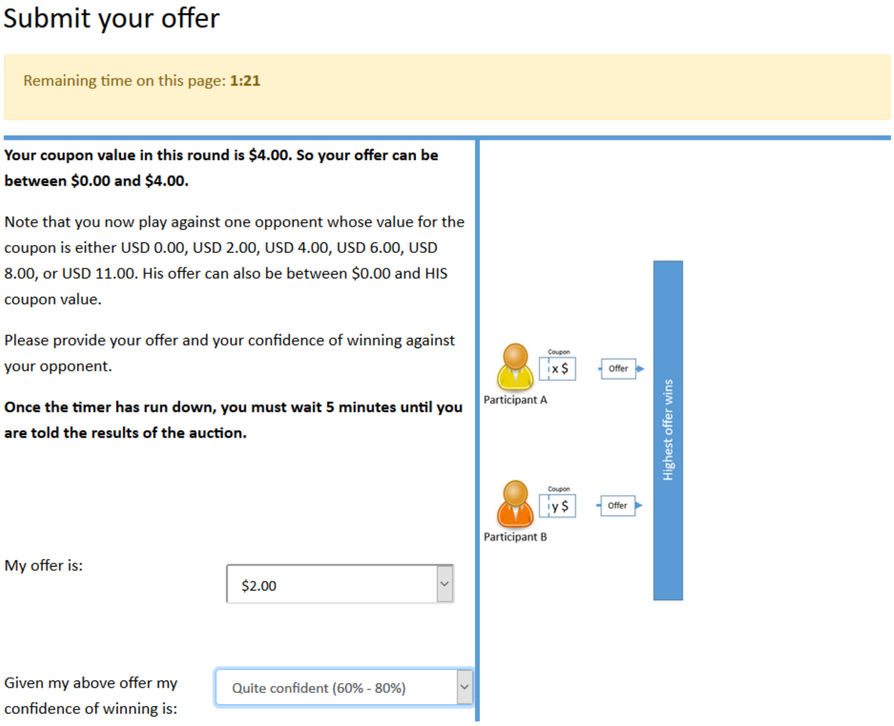


Figure 21: Experimental Instructions



Submit your offer

Remaining time on this page: **1:21**

Your coupon value in this round is $4.00. So your offer can be between $0.00 and $4.00.

Note that you now play against one opponent whose value for the coupon is either USD 0.00, USD 2.00, USD 4.00, USD 6.00, USD 8.00, or USD 11.00. His offer can also be between $0.00 and HIS coupon value.

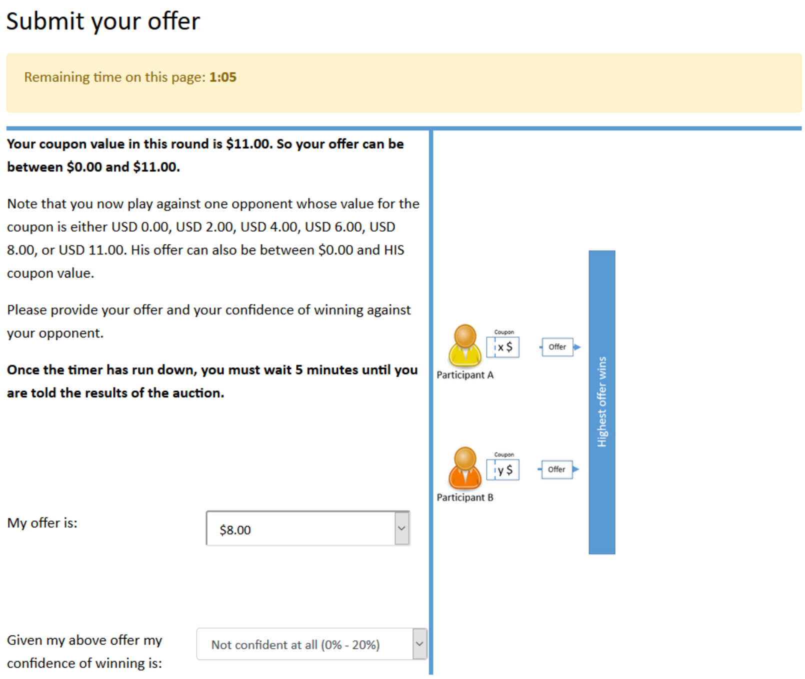
Please provide your offer and your confidence of winning against your opponent.

Once the timer has run down, you must wait 5 minutes until you are told the results of the auction.

My offer is: $2.00

Given my above offer my confidence of winning is: Quite confident (60% - 80%)

Figure 22: Experimental Instructions



Submit your offer

Remaining time on this page: **1:05**

Your coupon value in this round is $11.00. So your offer can be between $0.00 and $11.00.

Note that you now play against one opponent whose value for the coupon is either USD 0.00, USD 2.00, USD 4.00, USD 6.00, USD 8.00, or USD 11.00. His offer can also be between $0.00 and HIS coupon value.

Please provide your offer and your confidence of winning against your opponent.

Once the timer has run down, you must wait 5 minutes until you are told the results of the auction.

My offer is: $8.00

Given my above offer my confidence of winning is: Not confident at all (0% - 20%)

Figure 23: Experimental Instructions

Submit your offer

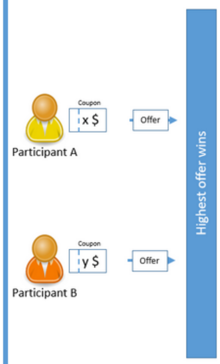
Remaining time on this page: **0:50**

Your coupon value in this round is $2.00. So your offer can be between $0.00 and $2.00.

Note that you now play against one opponent whose value for the coupon is either USD 0.00, USD 2.00, USD 4.00, USD 6.00, USD 8.00, or USD 11.00. His offer can also be between $0.00 and HIS coupon value.

Please provide your offer and your confidence of winning against your opponent.

Once the timer has run down, you must wait 5 minutes until you are told the results of the auction.



My offer is: $1.00

Given my above offer my confidence of winning is: Very confident (80% - 100%)

Figure 24: Experimental Instructions

Please wait here

Remaining time on this page: **2:47**

Please wait here for 5 minutes.

Summary of your bid:

In the currently ongoing round, you have offered **$10.00** for the coupon, which you value at **$11.00**.

Given your bid, you have estimated your confidence of winning to be between **80% - 100%**

Figure 25: Experimental Instructions

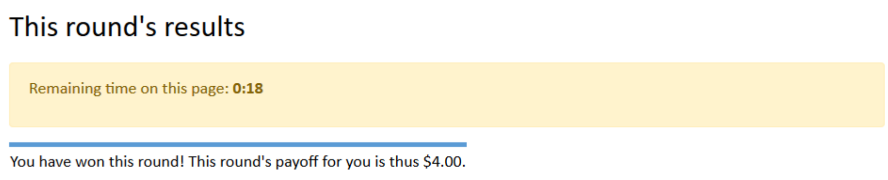


Figure 26: Experimental Instructions

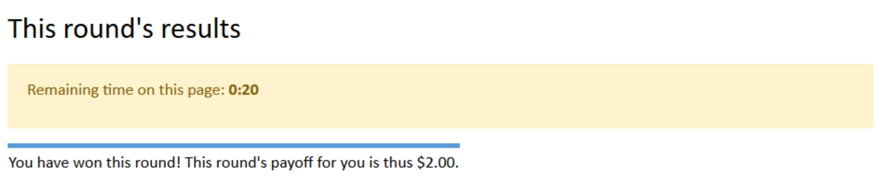


Figure 27: Experimental Instructions

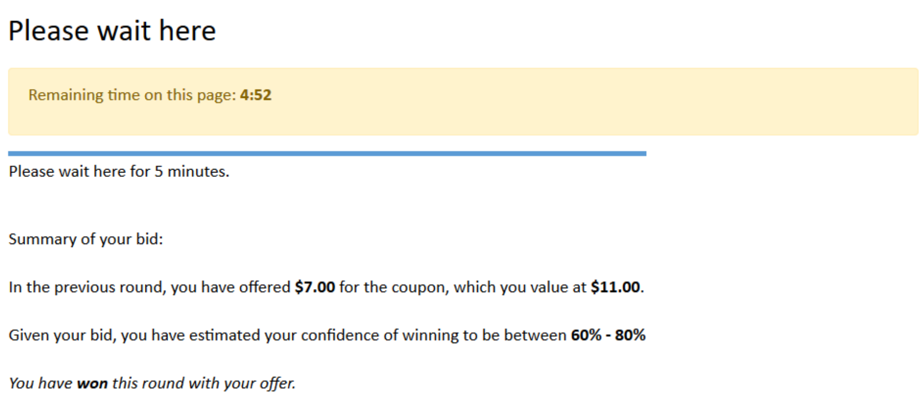


Figure 28: Experimental Instructions

Results of probability guesses

Remaining time on this page: **0:29**

Your confidence of winning was equal to your actual probability of winning in the rounds: [1, 2, 4, 5].

Each of the correct guesses yields you an additional payoff of USD 0.50, thus your payoff for these guesses increases by: $2.00.

Next

Figure 29: Experimental Instructions

Final results

Remaining time on this page: **0:42**

You have won in rounds [5].

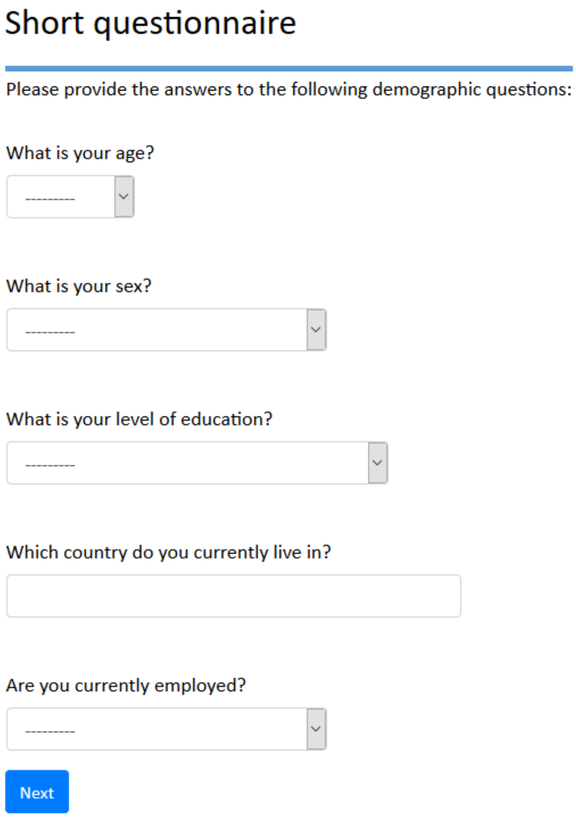
All these wins yielded you a payoff of $1.00.

Additionally, your confidence of winning was equal to your actual probability of winning in the rounds: [1, 2, 4, 5], thus increasing your payoff by $2.00.

Your total payoff is hence $3.00 + the money you earned by answering control questions correctly at the first try (namely $1.50) + the fixed payment of $0.50.

Next

Figure 30: Experimental Instructions



Short questionnaire

Please provide the answers to the following demographic questions:

What is your age?

What is your sex?

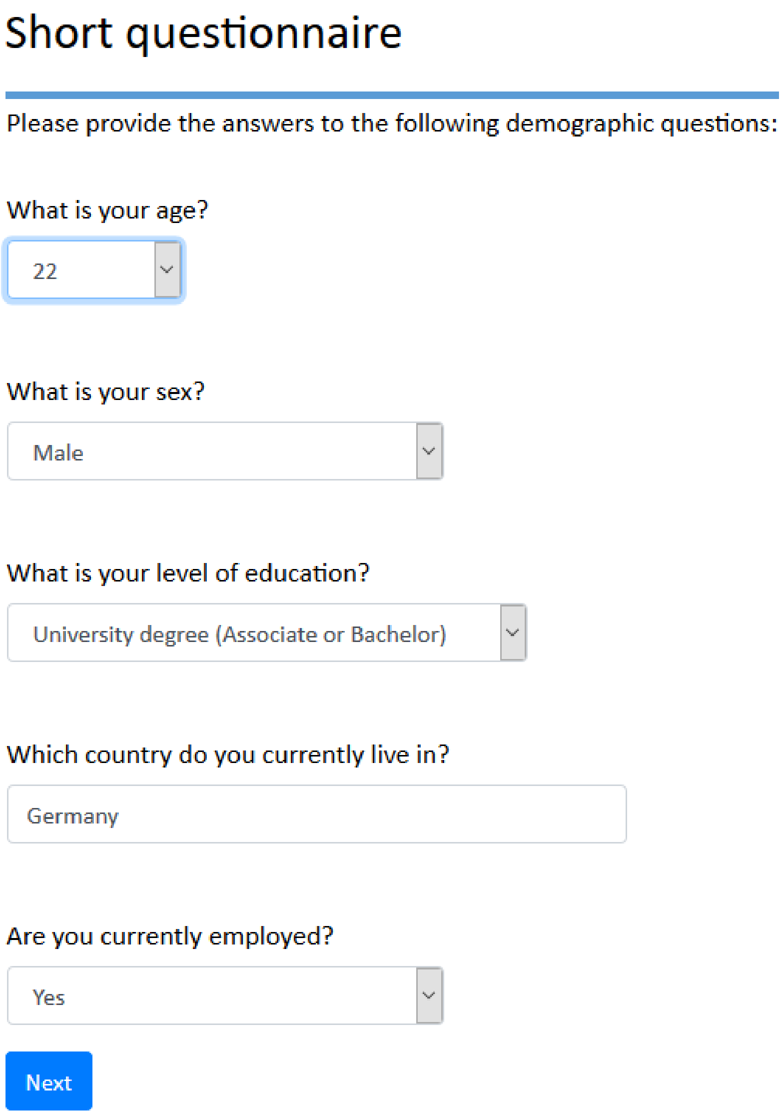
What is your level of education?

Which country do you currently live in?

Are you currently employed?

Next

Figure 31: Experimental Instructions


Short questionnaire

Please provide the answers to the following demographic questions:

What is your age?

22

What is your sex?

Male

What is your level of education?

University degree (Associate or Bachelor)

Which country do you currently live in?

Germany

Are you currently employed?

Yes

Next

Figure 32: Experimental Instructions

MTurk code

Thank you very much for participating in today's experiment. Your participation is highly appreciated and will yield valuable insights for a new theory we aim to propose in the field of behavioral economics. In order to receive your payoff, you must enter your individual completion code on the mTurk page.

Your completion code is UQQCTX.

You can now leave this window and enter your completion code into MTurk.

Figure 33: Experimental Instructions

7.2 Experiment 2

7.2.1 Experimental Design

The second experiment was a within-subject design experiment and consisted of two auction rounds representing the two treatments of the experiment (FAR and CLOSE): In treatment FAR, they received feedback 4 weeks after the bid, and in treatment CLOSE they received feedback immediately after the bid.

Auction. In both rounds participants were bidding on a coupon, that each participant had a certain valuation for. The valuation of the coupon in a certain round was determined in the following way: At first, subjects independently drew a personal number from 1 to 10, with each value being equally likely. In the two auction rounds, a multiplier equal to 4 Euros and 5 Euros respectively applied to this number. [18] The valuation of a subject was then calculated by multiplying the personal number with the multiplier and was hence correlated between the two rounds. [19] Bidders where then asked to submit any (integer) bid between 0 Euros and their valuation. The bidder submitting the highest bid received the coupon, accordingly his payoff from the auction was valuation minus his bid. The bidder submitting the lower bid received a payoff of zero.

Probability Estimate. In addition to bidding, participants had to provide an estimate on their winning probability given their bid. To do so, they could choose from a set of 'confidence values', i.e. $\{0\%; 5\%; ...; 95\%; 100\%\}$ that they estimated

[18] To sort out sequence effects, participants where randomly selected into one of four treatments, which varied in the sequence of (i) the treatments (FAR - CLOSE vs CLOSE - FAR) and (ii) the multiplier (4 Euros - 5 Euros vs 5 Euros - 4 Euros)

[19] This was done to (i) make the treatments easily comparable and (ii) avoid consistency seeking, i.e. simply bidding the same in both rounds.

their winning probability to be. In experiment 2, this estimate was not incentivized.

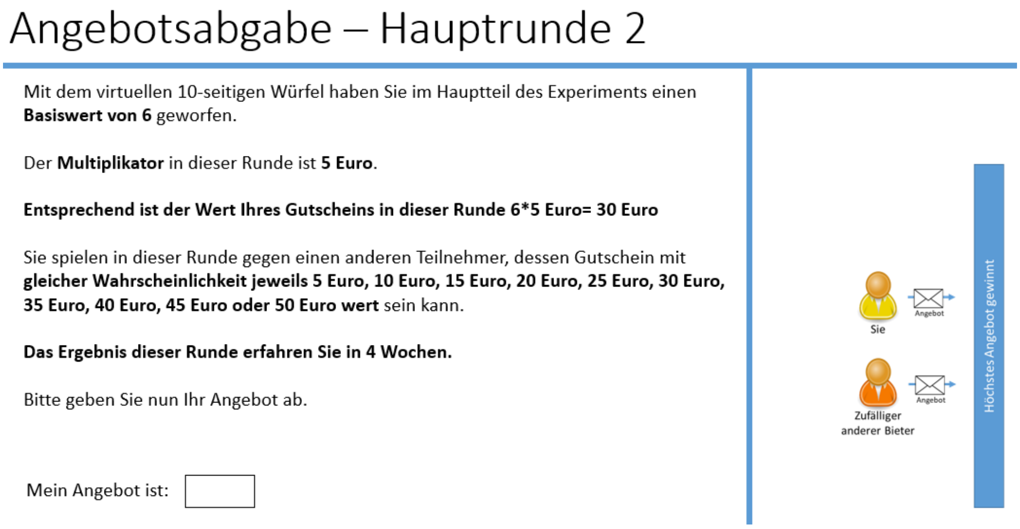


Figure 34: Screenshot of decision situation in FAR

Timing. The timing of the experiment was the following: Participants were matched into one of four treatments: CLOSE-5-FAR-4, CLOSE-4-FAR-5, FAR-4-CLOSE-5 and FAR-5-CLOSE-4. Subjects in CLOSE-5-LONG-4 entered the first submission screen, where they were told their valuation (consisting of their personal number and the multiplier of 5 Euros applying to all bidders in this round) for the coupon. They were then asked to submit a bid, and we told them that they would receive feedback immediately after the second auction round. They then were asked to give us an estimate on their winning probability. On the second submission screen, subjects in CLOSE-5-LONG-4 were again told their valuation (consisting of their personal number and the multiplier of 4 Euros applying to all bidders in this round) for the coupon. They were then again asked to submit a bid, and we told them that they would receive feedback 4 weeks after the experiment., followed by another screen to submit a probability estimate. In the other treatments we proceeded accordingly, varying the sequence of feedback and multiplier. Figure 34 displays a screenshot of the decision situation that participants were facing in the treatment FAR of FAR-5-CLOSE-4. Moreover, the full set of screenshots can be provided on request.

7.2.2 Experimental procedures and data sample

The experiments were conducted online and took place on the 24th and 25th of May 2022. Using the recruiting system ORSEE (Greiner, 2015), we invited a random sample of the Cologne Laboratory for Economic Research (CLER) via email, where they received a Zoom link. In the Zoom meeting, subjects where given individual links to the ZEW server, where the experimented was hosted. The whole experiment was computerized using the programming environment oTree (Chen, Schonger, and Wickens, 2016).

Subjects first received detailled instructions (see Appendix) and then participated in 10 test rounds against a computer to get familiar with the first-price auction.

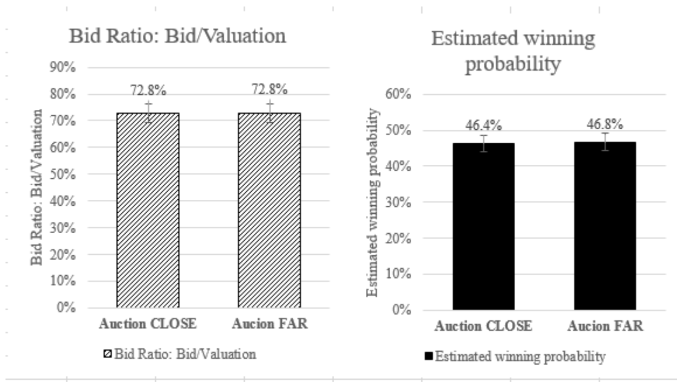
In total, 81 subjects participated in the experiment, with 20 subjects participating in treatments CLOSE-4-FAR-5, FAR-4-CLOSE-5 and FAR-5-CLOSE-4 and 21 subjects in treatment CLOSE-5-FAR-4.

Payoffs were stated in Euros. Participants were paid out via Paypal 4 weeks after the experiment. The average payoff for the entire experiment was 9 Euros, including a fixed payment of 2 Euros. The experiment lasted around 30 minutes on average.

7.2.3 Results

In experiment 2, behavior also does not significantly differ between treatments.

Figure 35: Bid ratio and estimated winning probability



This figure displays the average bid ratios as well as the average estimated winning probability per treatment.

Figure 35 displays average values of bid ratios[20] and assessment for both treatments. As can be seen in the figures, average values are not substantially different, both for bids and probability assessments. Conducting two-sided Mann Whitney U tests, I find no significant difference for either bids or probability assessment between the treatments (the p-values are 0.67 and 0.96 respectively).

[20]As a proxy for 'aggressiveness of bids' I used bid ratios, i.e. bid divided by valuation.

References

Andersson, G. (1996): "The benefits of optimism: A meta-analytic review of the Life Orientation Test," *Personality and Individual Differences*, 21(5), 719–725.

Armantier, O., and N. Treich (2009): "Subjective probabilities in games: An application to the overbidding puzzle," *International Economic Review*, 50(4), 1079–1102.

Baker, M., R. S. Ruback, and J. Wurgler (2007): "Behavioral corporate finance," in *Handbook of empirical corporate finance*, pp. 145–186. Elsevier.

Bell, D. E. (1985): "Disappointment in decision making under uncertainty," *Operations research*, 33(1), 1–27.

Brunnermeier, M. K., and J. A. Parker (2005): "Optimal expectations," *American Economic Review*, 95(4), 1092–1118.

Buehler, R., D. Griffin, and M. Ross (1994): "Exploring the" planning fallacy": Why people underestimate their task completion times.," *Journal of personality and social psychology*, 67(3), 366.

Caplin, A., and J. Leahy (2001): "Psychological expected utility theory and anticipatory feelings," *The Quarterly Journal of Economics*, 116(1), 55–79.

Chen, D. L., M. Schonger, and C. Wickens (2016): "oTree - An open-source platform for laboratory, online, and field experiments," *Journal of Behavioral and Experimental Finance*, 9, 88–97.

Drobner, C. (2022): "Motivated beliefs and anticipation of uncertainty resolution," *American Economic Review: Insights*, 4(1), 89–105.

Gollier, C., and A. Muermann (2010): "Optimal choice and beliefs with ex ante savoring and ex post disappointment," *Management Science*, 56(8), 1272–1284.

Kőszegi, B., and M. Rabin (2006): "A model of reference-dependent preferences," *The Quarterly Journal of Economics*, 121(4), 1133–1165.

Loewenstein, G. (1987): "Anticipation and the valuation of delayed consumption," *The Economic Journal*, 97(387), 666–684.

Seaward, H. G., and S. Kemp (2000): "Optimism bias and student debt," *New Zealand Journal of Psychology*, 29(1), 17.

Shepperd, J. A., J. A. Ouellette, and J. K. Fernandez (1996): "Abandoning unrealistic optimism: Performance estimates and the temporal proximity of self-relevant feedback.," *Journal of Personality and Social Psychology*, 70(4), 844.

Taylor, K. M., and J. A. Shepperd (1998): "Bracing for the worst: Severity, testing, and feedback timing as moderators of the optimistic bias," *Personality and Social Psychology Bulletin*, 24(9), 915–926.

Van Dijk, W. W., M. Zeelenberg, and J. Van der Pligt (2003): "Blessed are those who expect nothing: Lowering expectations as a way of avoiding disappointment," *Journal of Economic Psychology*, 24(4), 505–516.

Weinstein, N. D. (1980): "Unrealistic optimism about future life events.," *Journal of personality and social psychology*, 39(5), 806.

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