Common Value Auctions with Voluntary and Qualified Entry

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Abstract

We study auctions under different entry rules. In the field, individuals self-select into auctions and regulations often require them to meet specific qualifications. In this experiment we assess the role of voluntary entry and financial requirements on the incidence of severe overbidding and bankruptcies, which are widespread in common value auctions. We show that voluntary entry amplifies overbidding and increases bankruptcy rates. Qualified entry has only modest impacts on overbidding. This study adds new insights to existing experiments where all subjects are usually placed exogenously into auctions.

Keywords: Experiments; self-selection; winner’s curse; procurement; company takeover.

JEL Classification: D44; D03
1. Introduction

In common value auctions, bidders compete for an item that has the same value for everyone. Typically the item value is uncertain and bidders base their decisions on estimates of the true value, which is generally observed only after the auction is over. Canonical examples of this type of auction include procurement of public construction and public works projects, and leases and sales of government assets such as mineral extraction rights and the radio spectrum. Reverse auctions for private procurement of inputs or services also have a strong common value component. Persistent overbidding is a robust empirical finding for these types of auctions, both in naturally-occurring data and in data from controlled experiments (Wilson, 1992; Kagel and Levin, 2002). The winning bidder often incurs systematic losses, a phenomenon known as the “Winner’s Curse.”

This study investigates the implications of sampling biases due to self-selection and restricted entry on the winner’s curse using laboratory common-value auctions. Our main research question is whether selecting bidders in different ways leads to an improvement in auction performance and bidding behavior. This could occur, for example, through additional opportunities for individual learning, since previous experimental research on the winner’s curse shows that bidding performance improves over time. To vary learning opportunities, we consider a benchmark situation where bidders are randomly assigned to a given auction and compare it with two other situations where entry into auctions occurs either through the self-selection of bidders or through qualification—in which only the better-earning bidders can bid in the more risky and higher-stake auctions. One key measure of performance is bankruptcy rates, as bankruptcy generally implies a lack of completion of the transaction or task, generating a cost for society and the termination of (possibly long-term) supply relationships. We also compare behavior with the theoretical predictions for equilibrium bidding in these treatments, and seek to identify the characteristics of bidders who self-select into bidding in common value auctions. This study joins a wave of experimental investigations of specific auction rules that are of interest for field applications (Armantier et al., 2013, Merlob et al., 2012).

This paper focuses on a comparison of different mechanisms through which the sample of participants is selected into bidding. In the field, auction participants self-select into bidding and are not a random sample of the population. We know little about the bidding behavior of those who seek to enter these auctions compared to the population at large. Moreover, the pool of
potential bidders presents an additional selection bias because entry in many auctions is restricted by the auctioneer. This is particularly relevant for public procurement auctions, although is present also in auctions with indicative bidding.\footnote{In auctions with indicative bidding, bidders are short-listed after a first round of non-binding bids. The short list is established based on the level of the bid and on considerations about bidders' qualifications. This procedure has been employed in privatization, takeover, and acquisition auctions (Kagel et al. 2008). Examples include the acquisition of Ireland's cable television provider Cablelink Ltd., the privatization of the Ente Nazionale Idrocarburi of Italy, the takeover auction for Daewoo Motors of South Korea and some real estate markets (Foley, 2003).}

Almost all auction experiments, by contrast, do not disclose the nature of the experiment when recruiting subjects and require everyone to participate in auction bidding.\footnote{Theoretical models considering endogenous entry include Harstad (1990), Hausch and Li (1993), Levin and Smith (1994), and McAfee and McMillan (1987).} The only selection that takes place in the laboratory is generally through an eventual bankruptcy, which leads the subject to drop out of the auction, or low earnings that discourage subjects from returning to “experienced” sessions (Casari et al., 2007). Moreover, very few auction experiments have considered endogenous entry. Nearly all of those consider the independent private values setting (Ivanova-Stenzel and Salmon, 2004; Palfrey and Pevnitskaya, 2008; Ertaç et al., 2011), where the winner’s curse does not occur since bidders know their own value with certainty. In these experiments bidders tend to enter the auction too often. Cox et al. (2001) is the only previous experiment that studies endogenous entry in common value auctions. Subjects’ alternative to auction bidding was the collection of a known “safe haven” payment. Cox et al. (2001) study market size given that entry is endogenous. In our paper market size is fixed and we study the selection of bidders in markets. We allow subjects to choose between different bidding activities, and also compare different selection procedures for entry and not only voluntary self-selection.

It is important to study self-selection or “qualification” requirements to enter common value auctions because they could affect the extent and origins of the winner’s curse, which is a severe departure from the predictions of the risk neutral Nash equilibrium whose source is still unknown. One leading interpretation is that bidders’ reasoning fails to account for the adverse selection implicit in the winning event. Even if ex-ante estimates were unbiased for everyone, the winner is expected to have the highest estimate among all bidders. Hence, when conditioning on the event of winning, the winner's estimate will be (ex-post) biased upward (Charness and Levin, 2009). Regardless of the source of the winner’s curse, substantial evidence exists that it fades away only very slowly and when bidders are allowed enough exposure to the task. Such
convergence toward the equilibrium predictions is achieved through a combination of individual learning and harsh selection through the survival of the smartest (Casari et al., 2007). Our design allows participants to gain some experience through low-stake tasks with a similar underlying logic, which sets up a more favorable situation for learning and sorting the most able bidders into the high-stake task. Moreover, we include an alternative task that is simpler than an auction and expectations about others’ information or rationality levels play no role. It is possible that selection at entry also reduces or eliminates the winner’s curse in common value auctions. In particular, there may be important welfare implications depending on whether the adjustment takes place through learning, survival, or selection at entry.

Policy measures that prevent bankruptcies, such as in public procurement, are intended to improve social welfare. As noted above, government auctions for public works and reverse auctions for private procurement have a strong common value component. Participation in such auctions is often highly regulated and limited to qualified bidders in order to prevent the bankruptcy of winning contractors. Such bankruptcies are in practice very costly due to the social cost of the consequent delay in the completion of public infrastructure, delivery of needed inputs or services, and the disappearance of the organizational capital embedded in a firm (goodwill). Our experimental design manipulates access to the auction markets in some ways analogous to these qualification regulations and assesses the impact on bankruptcy.

We report two main results. First, voluntary entry into common value actions does not reduce the winner’s curse, as the fraction of overbidders is higher when participants self-select into auctions than in the case of random assignment. Second, a simple version of the qualification procedure based on cumulative earnings does not eliminate winner’s curse bidding but only marginally reduces it. Thus, voluntary entry does not improve auction performance both when compared to random assignment and to a simple qualified entry mechanism. Allowing participants to learn the logic of common-value auctions with low-stakes and then eventually opting for a high-stake task does not help to reduce the winner’s curse.

2. Selection in Field Auctions
A well-known example of the costly impact of overbidding and bankruptcies is the 1996 FCC auction for the C-block radio spectrum, which received winning bids of $10.2 billion. The FCC established that auction receipts would be collected through an installment plan that permitted
the winning bidders to pay their debt obligations over a ten-year period. At the time, the C-block auction was viewed as a huge success. Several licensees later declared bankruptcy, however, and many others returned the bandwidth originally assigned to them. As a result, less than 10 percent of spectrum issued in the C-block auction was allocated as bid, with the remainder either tied up in lengthy bankruptcy court proceedings or returned to the FCC for re-auction (Committee on Commerce, 1998; Plott, 2000). This case shows the welfare cost of bankruptcy, both in terms of lost organizational capital for the winning entities and in terms of unused assets.

In order to avoid a socially undesirable outcome of bankruptcy by the selected contractor, it is common to require that bidders pre-qualify. For example, European law restricts participation to public work auctions through a certification system. To be certified a firm must meet several criteria regarding financial soundness and technical capabilities. In the European Union there are criteria concerning the current ability to successfully complete the project and others about the recent experience in projects of similar type and amount (Directives 93/37/EEC, 97/52/EC, and 2001/78/EC).

In particular, a contractor can be excluded as unsuitable in accordance with criteria of economic and financial standing and of technical knowledge or ability. First, a bidder must not have already asked for bankruptcy protection. Second, prior to bidding each bidder is required to supply proof of good financial and economic standing in terms of guarantees by banks, balance sheets, or in other forms. This provision helps ensure that the bidder will be able to absorb an eventual loss originating from a miscalculated bid without going bankrupt. In our experimental design, we adopt similar criteria to restrict participation in the auctions. Third, a bidder must possess the technical capability to complete the project, including evidence about management’s skills, equipment availability and current workforce. Fourth, the firms must have already had substantial experience in carrying out projects of the same type and scale. This experience refers to the proper completion of projects according to the rules of the trade in the last five years,

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3 National legislations that implemented the European Directives provide additional details. For instance, the Italian legislation (Law 109/94 and Ordinance DPR 34/2000) requires a deposit in a locked bank account. Higher discounts on the baseline budget of the procurement auction require a greater deposit. Deposit requirements range from a minimum of two percent for no bid discount to twelve percent for a 20% bid discount, to thirty-two percent for a 30% bid discount. Legislation about qualifying bidding is common also in other nations; for instance, see the registration requirements for the Singapore Building Construction Authority (2014).

4 According to canonical theory, the rationale for the second criterion may be to avoid the problem of rational “overbidding” when there is little to lose, which increases the risk of bankruptcy. Moreover, even in equilibrium, ex-post profits of the winner may be negative. The criterion on technical capability is not relevant in the abstract experimental design.
Interestingly, Dyer and Kagel (1996) mention specialization as a voluntary strategy of contractors in order to avoid the worst effect of the winner’s curse. Within an economic model of auction bidding, specialization could provide a restriction in the support of the distribution of the private estimate of the object, or a reduction in the variance, which would reduce the common value component of the object. This aspect does not play a direct role in our experimental design.

Some national legislation requires bidders to have experience on how to handle projects of comparable size of the one currently bid. When a firm is in the official list of recognized contractors, it is generally authorized to bid in government auctions within a maximum baseline budget. A newly established firm will have to acquire experience in small projects before being able to bid in large projects. This regulated progression from small to large value auctions could provide an effective solution to the high rate of bankruptcies of inexperienced bidders.

Some auctioneers may not care about bidder bankruptcies, of course, and could view the overbidding and bidder losses as profitable outcomes to encourage. In private procurement settings, for example, buyers could benefit when suppliers suffer from the winner’s curse. In other cases the auctioneer has long-term objectives and may have concerns for bidders’ long-term viability. Consider for instance auction houses that may want to discourage overbidding as a way to maintain a good reputation among the public, or buyers of services or material inputs that will be delivered frequently over a long-term contract or are completed with a long horizon. The entry restrictions in public procurement and privatization settings indicate that some auctioneers place a value on avoiding bankruptcies.

3. Theoretical Considerations

In each session all subjects placed bids in three activities: a high-stake, a medium-stake and a low-stake activity. There were n=5 subjects in each activity to focus on comparisons that hold the number of bidders constant, except for brief periods following bidder bankruptcies. Previous studies indicate that 5 competing bidders provide an environment with sufficient competition for

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5 Italian law lists 47 distinct types of projects (art. 18 DPR 34/2000), where experience in a different type of project is irrelevant for pre-qualification. For instance, experience in building power plants does not help to qualify for maintenance works of the power grid, and experience in providing lighted road signs for highways does not help to qualify for bidding to supply non-lighted road signs. Moreover, a firm is placed in one of eight budget categories, each one characterized by a maximum budget ranging from a quarter of a million euros to fifteen million euros and above. In the recent past the firm must have successfully completed at least one project of the same type with a budget of at least forty percent the maximum ceiling of the category (art. 3 DPR 34/2000). This condition could be met both with projects for the government or for the private sector.
the winner’s curse to emerge. The high-stake and medium-stake activities were common value auctions with identical rules, except for the conversion rate of points into dollars. The low-stake activity was a company takeover game. The high-stake activity yielded equilibrium earnings more than five times as large as the low-stake activity (Figure 1). Activities differed in their potential rewards as well as their relative riskiness. In particular, the low-stake activity involved no competition with other subjects, and hence no strategic risk. Below we describe each activity, beginning with the common value auctions.

The high- and medium-stake activities were common value auctions where, in each period the item value $x_o$ was randomly drawn from a uniform distribution with upper and lower bounds [50, 950]. In each auction each bidder received a private information estimate, $x$, drawn from a uniform distribution on an interval centered on the actual item value [$x_o - 15, x_o + 15$]. Using a first price sealed-bid auction procedure, bids were ranked from highest to lowest with the high bidder paying the amount bid and earning profits equal to $x_o - b_1$, where $b_1$ is the high bid.

The Nash equilibrium solution will be discussed only in reference to estimates in the interval 65 ≤ $x$ ≤ 935 (called region 2), where by design about 97 percent of the observations lie (Wilson 1977, Milgrom and Weber, 1982). Within region 2, bidders have no end point information to help in calculating the expected value of the item. For risk neutral bidders the symmetric risk neutral Nash equilibrium (RNNE) bid function $f(x)$ is given by (Kagel and Richard, 2001):

$$f(x) = x - 15 + h(x), \text{ where}$$

$$h(x) = \left\lfloor \frac{30}{(n+1)} \right\rfloor \exp\{(-n/30)(x-65)\}$$

and $n$ is the number of active bidders in the auction. This equilibrium bid function combines strategic considerations similar to those involved in first-price private-value auctions, and item valuation considerations resulting from the bias in the estimate value conditional on the event of winning. We deal with the latter first.

In common-value auctions bidders usually win the item when they have the highest, or one of the highest estimates of value. Define $E[x_o \mid X = x_{1n}]$ to be the expected value of the item conditional on having $x_{1n}$, the highest among $n$ estimate values. For estimates in region 2,

$$E[x_o \mid X = x_{1n}] = x_{1n} - \left\lfloor \frac{(n-1)}{(n+1)} \right\rfloor 15.$$
This provides a convenient measure of the extent to which bidders suffer from the winner’s curse since in auctions in which the high estimate holder always wins the item, bidding above \( \text{E}[x_o | X = x_{1n}] \) results in negative expected profit.\(^6\)

Recall that within region 2, \((x - 15)\) is the smallest possible value for \(x_o\), and that \(x\) is the unconditional expected value of \(x_o\) (the expected value, \textit{independent} of winning the item), so that the expected value, conditional on winning, must be between \((x - 15)\) and \(x\). Thus, from equation (3) it is clear that the “bid factor,” the amount bids need to be reduced relative to the signal in order to correct for the adverse selection effect from winning the auction, is quite large relative to the range of sensible corrections. With \(n = 5\) the bid factor required to generate zero expected profits is 10.00, or approximately 67% of the total bid factor in the RNNE.\(^7\) Strategic considerations account for the rest of the bid factor. The strategic element results from the fact that by only correcting for the adverse selection effect, the winner would earn zero expected profit. As such, a bidder would find it profitable to lower her bid from this hypothetical benchmark (equation 3) since zero expected gains are lost by doing so even if this causes her not to win the item, and strictly positive expected gains are obtained should she win the item with the lower price. The interplay of these strategic considerations between different bidders results in the additional discounting of bids relative to estimate values beyond equation (3).

The \textit{low-stake activity} was a \textit{company takeover game} where there was a buyer and a seller who moved sequentially (e.g. Samuelson, 1984). We used this auction environment to provide a bidding activity for bankrupt subjects and those who wished to avoid bidding in the interactive common value auctions. Similar to the common value auction, subjects who fail to condition on the event of winning may suffer from the winner’s curse. This bidding activity thus allows us to assess subjects’ general and initial propensities to overbid but in a simplified environment that eliminates strategic uncertainty and has smaller opportunities to gain and lower risk to lose money. In this auction the buyer made a take-it-or-leave-it offer \( b \in [0,36] \) to a computer seller whose company’s value was \(s\). The seller either rejected or accepted the bid. The payoff for the seller was \(s\) if she rejected and \(b\) if she accepted. The payoffs for the buyer were 0

\(^6\) This design mostly followed Casari et al. (2007). Even with zero correlation between bids and estimate values, if everyone else bids above \(\text{E}[x_o | X = x_{1n}]\), bidding above \(\text{E}[x_o | X = x_{1n}]\) results in negative expected profit as well. As such, if the high estimate holder frequently wins the auction, or a reasonably large number of rivals are bidding above \(\text{E}[x_o | X = x_{1n}]\), bidding above \(\text{E}[x_o | X = x_{1n}]\) is likely to earn negative expected profit.

\(^7\) This approximation is based on the fact that within region 2 the RNNE bid function is well approximated by \(f(x) = x - 15\), because the negative exponential term \(h(x)\) in equation 1, approaches zero rapidly as \(x\) moves beyond 65.
if the seller rejected and \((1.5s - b)\) if she accepted. The company could have possible values between 6 and 24, \(s \in \{6.00, 6.01, \ldots, 23.99, 24.00\}\). When making a decision, the seller had private information about \(s\), while the buyer only knew that each realization of \(s\) had equal probability. The computer seller accepted all bids greater or equal to the seller’s company value.

Hence, the task was a bilateral bargaining problem against a computer with asymmetric information and valuations. The informational disadvantage of the buyer was offset by an assumption that the buyer's value was 1.5 times the seller value, \(s\). We computed the predictions following the Holt and Sherman (1994) model of rational and naïve bidding. A rational buyer had the following objective function (4):

\[
\text{Rational objective: } \left( \frac{b - 6}{24 - 6} \right) \cdot 1.5 \cdot \left( 6 + \frac{b - 6}{2} \right) - b
\]

(4)

A bid of 12 is optimal for the risk-neutral rational buyer who accounts for the selection effect arising from the fact that sellers only accept bids that exceed their valuation \(s\). This bid yields an expected profit of 0.5. If instead the buyer is naïve and ignores this selection, she maximizes the following objective function (5) that uses the unconditional mean value of \((24-6)/2=9\):

\[
\text{Naïve objective: } \left( \frac{b - 6}{24 - 6} \right) \cdot 1.5 \cdot \left( 6 + \frac{24 - 6}{2} \right) - b
\]

(5)

Such incorrect reasoning would lead to a higher optimal bid of 14.25. This incorrect reasoning is of course sub-optimal, and leads to an expected profit of 0.43.

4. Experimental Procedures

The experiment involved three treatments, which differed in the way subjects were allocated into activities: random assignment, qualified entry, and voluntary entry. The focus is on the voluntary and qualified entry into auctions with different stakes, and the random assignment serves as a baseline that replicates the standard procedure in auction experiments. Bidders chose to enter the different auction activities in the voluntary entry treatment. The qualified entry treatment relies on an objective measure of past performance to determine the bidders in each auction type.

At the start of the session everyone chose an amount up to $5 to place into a risky investment that yielded 0 or three times the invested amount with equal probability. This simple task followed the design of Gneezy and Potters (1997) to measure subjects’ preferences toward
risk. Subjects could allocate $0.00, $0.50, ..., $4.50, or $5.00. The outcome of this risky investment decision was determined at the end of the session.

Each session had 15 subjects and comprised 34 paid periods, divided between a training part and main part. The training was identical across treatments and aimed at familiarizing subjects with the various activities: low-stake, medium-stake and high-stake auctions. For each activity there was a dry run (unpaid) period followed by 3 periods for profit. Each subject began the session with a starting balance of $10 and accrued period earnings according to activity-specific rules. Training began for everyone with the low-stake auction, where subjects received $1 for every 4 points acquired. Subjects received full feedback after each period: their computer screens displayed the realized company value for the buyer, their period earnings in points, and their cumulative balance in dollars.

The training continued with the medium-stake auction, where subjects received $1 for every 4 points acquired from winning auctions. For this activity, the participants were randomly divided into three independent markets with five bidders each. Subjects stayed in the same market across periods 4-6, except in case of bankruptcy, which occurred if a subject had a negative US dollar cumulative balance. Bankrupt bidders are no longer liable for losses and for this reason are placed in the low-stake auction to prevent the possibility of irresponsibly high bidding. Each auction involved new random draws for the true item value ($x_o$) and for item private estimates ($x$). The instructions informed the subjects about the underlying distribution of $x_o$ and estimate values. An admissible bid was any number between 0.00 and $x + 22.50$. Subjects received full feedback at the end of each auction: all bids were posted from highest to lowest along with the corresponding estimate values (bidder identification numbers were suppressed) and the value of $x_o$. Profits (or losses) were calculated for the high bidder and reported to all bidders as well. These implementation details are fairly standard in experimental common value auction research. The training phase ended with the high-stake auction. This activity was identical to the medium-stake auction described above, except for a more favorable conversion rate: subjects received $1 for every 2 points earned. Every subject also received $0.25

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8 Cox et al. (2001) finds no evidence that limited liability increases the winner’s curse. Since in our experiment some markets occasionally had fewer than five bidders, the number of bidders in the subject’s market was always posted at the top of bidders’ computer screens.

9 This upper restriction on allowable bids was intended to prevent bankruptcies resulting from typing errors, while still permitting substantial overbidding. Bids could be specified in up to two decimal places. A copy of the instructions are included in the appendix.
per period for participation in the medium-stake and high-stake auctions, regardless of the auction outcome. This participation bonus was necessary to make these auctions financially more attractive, since overbidding (documented below and throughout this common value auction literature) typically led to negative trading profits for the winning bidder. Since this additional fixed payment is realized identically for both winners and losers, it does not change the optimal bidding strategy.10

The main part of the session comprised 25 periods. Subjects in the same session were allocated into three different activities: five subjects bid in low-stake auctions, five in the medium-stake auction, and five in the high-stake auction. In every period each subject placed a bid in just one activity. The rule to allocate subjects to activities varied by treatment and was explained in the final set of instructions.

The allocation into activities remained fixed for a block of five periods. At the start of every block subjects observed the list of all individual U.S. dollar profits earned in the previous block sorted by activity and without identities. At that point, beginning with the first block following the training periods, subjects were reallocated into the three activities in a manner that depended on the experimental treatment. Bankrupt bidders were automatically assigned to the low-stake auction.11

Under the Random Assignment treatment, subjects were reassigned to activities randomly at the start of every 5-period block. Since all random draws were independent, in principle it was possible for a subject to be assigned to the same activity in all periods. In practice this never occurred, except for one subject who was bankrupt in all periods due to large losses during the training periods. This subject thus always bid in the low-stake auction.

Under the Qualified Entry treatment, all subjects in a session were ranked according to their accumulated point earnings at the start of every 5-period block. This earnings ranking excluded the extra points assigned for merely participating in the common value auctions. The top five earners entered the high-stake auction, the bottom five earners entered the low-stake auction.

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10 Before each activity of the training phase, an experimenter read aloud the instructions while subjects followed along on their own copy. At the conclusion of these initial instructions subjects answered five computerized quiz questions to test their instruction comprehension for that activity, and were paid $1 for each correct answer. Besides providing incentives for subjects to consider the instructions carefully, this quiz also provided reinforcement of the key points and generated immediate clarifying feedback along with explanations for any wrong answers.

11 In one of the 12 sessions, more than five bidders were bankrupt during six of the final periods. In that case, we reduced the market size of the medium-stake auction to four bidders, with the number of bidders always posted on subjects’ computer screens.
auction, and subjects ranked 6 to 10 were placed in the medium-stake auction. Any ties were broken randomly. This selection procedure is intended to place the more successful bidders (based on past performance) in the high value auction, similar to the good financial standing and successful bidding experience included in the qualification procedure for auctions in the field discussed in Section 2. Of course, the technical capability required for qualification is not a criterion relevant for a laboratory experiment. As with any auction, some of the success and past performance is due to luck, here due to the random signals received which influence the likelihood of winning the auction but paying a price above value. Past performance is also due in part to skill, such as bidding conservatively to avoid negative earnings and the winner’s curse. Thus, this past performance used to qualify for the high-stake and riskier auction is a noisy measure of bidder ability.

Under the Voluntary Entry treatment, subjects stated their first, second and third choice for which activity they wanted to bid in for the upcoming 5-period block. Bankrupt subjects were not offered an opportunity to rank the activities, but were automatically placed into the low-stake auction. The allocation algorithm provided subjects with the incentive to truthfully reveal their preferences over activities without interference from strategic considerations about over- or under-subscription of activities. The algorithm first placed five subjects into the high-stake auction. Subjects obtained their first choice whenever possible. Since the capacity was 5 bidders in each auction activity, sometimes an activity was over-subscribed. In such cases the assignment to the high-demand activities was randomly determined among those who ranked that activity highest. When an activity was under-subscribed, we next allocated those subjects who ranked that activity as second choice. Subjects who did not get their first choice were placed into their second choice whenever possible. If there were still slots available, we then considered also those who ranked it third choice. The algorithm then placed five subjects into the medium-stake auction following the same rules as above. (Before proceeding to assign subjects to the medium-stake auction, the algorithm removed their preferences for the high-stake auction from their rankings since this auction was already filled.)

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12 Bidders were placed into a common value auction that they least preferred in only 2 times (out of 261 non-bankrupt activity rankings). If a subject who could not get their first choice specified a common value auction as their second choice, then they were assigned this second choice when space was available. If a subject who could not receive their first choice instead indicated that the low-stake auction was their second choice, then they were placed in the low-stake auction unless the common value auctions did not yet have 5 bidders each.
Our design required subjects to choose between three similar bidding activities, which differ most substantially in their payoff scale and risk. This (approximately) holds constant the level of challenge and inherent interest across activities so that selection and entry into the high-stake auction is based on economic opportunities. A simplified alternative design could have provided subjects who did not enter the common value auctions with some constant payment, but this could have led subjects to enter the auctions to avoid the boredom of merely collecting a small and uninteresting payment each period. This could be one reason for the over-entry into independent private value auctions observed in previous experiments that feature a simple known payment for non-entry (Palfrey and Pevnitskya, 2008; Ertaç et al., 2011).

These treatments deal both with bidders’ selection and restricted entry issues. While in Qualified Entry bidders do not choose to enter, they do in Voluntary Entry. The type of bidders that enter may vary and that is one key domain of investigation. In all treatments, the number of bidders per high- and medium-stake auctions is held constant to preserve comparability of results.

This experiment presents five main differences from Cox et al. (2001). First, market size is by design fixed and not endogenous. Second, the outside option consists of the allocation to an alternative activity and not simply a sure payment. Third, we provide full feedback about the activity outcome, which is more than just the winning bid and the true value of the item. Fourth, we dismissed bankrupt subjects from further bidding as in their “specialized” treatment. Fifth, we did not provide any graphical aids for the bidding decision.

We recruited 180 subjects by email using ORSEE (Greiner, 2015), drawn from the diverse student population at Purdue University. Each treatment involved 60 subjects divided into 4 sessions. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). No eye contact was possible among subjects during the experiment due to visual dividers between computer stations. Average earnings were $20.08 per subject (standard deviation $7.20). Sessions lasted less than two hours, including instruction reading, quizzes, and a post-experiment questionnaire.

5. Results
Here we report five main results. This section is articulated into subsections that focus on the main treatment effects (Results 1-3), the impact of self-selection (Result 4), and the types of
individual bidders (Result 5). Before presenting the main results, it is useful to comment on the patterns of bidder turn-over across the auctions. If the group composition is determined largely because of stable preferences for a specific auction, then there may be in little turn-over. A similar outcome may occur if the group composition depends on individual cumulative earnings, given that the high-stake auction generates higher potential profit. In the experiment, instead, the turn-over rates were generally high. In the Qualified Entry treatment only 20% of the bidders remained in the high-stake auction for the entire session, which is an average of one out of five bidders. This fraction was just 8% in the Voluntary Entry and 0% in Random Allocation treatment. Bidder selection was more effective in keeping subjects out of the high-stake auction. About 53% never entered it in the Qualified Entry treatment, 32% in Voluntary Entry, and 15% in Random Allocation treatment.

5.1 Main Treatment Effects
Self-selecting into their preferred activity is generally credited for improving agents’ welfare. Our first result indicates, however, that assigning people to activities according to their revealed preferences made them worse off on average, despite preferences being elicited in an incentive-compatible way.

Result 1: The pooled profits from all activities were lower when subjects could voluntarily choose where to bid than in the other treatments.

Support: Table 1 reports the total profits earned by bidders. Subjects in the Voluntary Entry treatment on average earned over 20 percent lower profit compared to the other two treatments, and cross-sectional regressions shown in the appendix (with robust variance estimates clustering to account for intra-session correlation) indicate that these profits are significantly lower than the Qualified Entry treatment (p-value=0.039) and marginally significantly lower than the Random Assignment control treatment (p-value=0.075).

Many participants randomly assigned to a common value auction often placed bids with negative expected profits. The data are thus consistent with the literature documenting the winner’s curse (Kagel and Levin, 2002). Our novel finding is that the frequency of these winner’s curse bids increased in the Voluntary Entry treatment.
Result 2: When bidders voluntarily enter into the common value auctions, they suffered from the winner’s curse more frequently than in the other treatments.

Support: Table 2 and Figure 2 provide support for Result 2. Table 2 summarizes the profits and frequency of winner’s curse bids in the common value auctions for the three treatments (col. 1, 2 and 4, 5, respectively) based on the 25 periods following the initial training periods.

The winner’s curse frequency in the Voluntary Entry treatment is nearly one-half of the bids, compared to about one-third of the bids in the other two treatments (Table 2). In order to compare the bidding performance of the auctions across treatments, we focus on the propensity to submit winner’s curse bids using standard panel data econometrics. In particular, we estimate probit models to compare overbidding across treatments, using robust variance estimates that allow for intra-subject and intra-session correlation. Treatment differences are assessed through dummy variables. These estimates are reported in the appendix, and they indicate that the winner’s curse frequency is marginally significantly higher in the Voluntary Entry treatment compared to the Random Assignment control treatment ($p$-value=0.056) and compared to the Qualified Entry treatment ($p$-value=0.081). \(^{13}\)

The above comparisons refer to all bidders, but of course the directly payoff-relevant bids in a given period are the highest, winning bids. Here we consider winning bidders who bid above the conditional expected value and therefore suffered from the winner’s curse (Column 5 of Table 2). Based on panel regression estimates shown in the appendix (with robust variance estimates for session clustering), we conclude that in the Qualified Entry treatment the 55 percent rate is significantly lower ($p$-value<0.001) than the 76 percent rate in the Voluntary Entry treatment.

With experience, subjects learn to avoid in part the winner’s curse but learning appears retarded in the Voluntary Entry treatment. Figure 2 shows that the frequency of winner’s curse bids starts at approximately one-half and then declines over time in all treatments. The decline starts earlier in the Qualified Entry and Random Assignment treatments, compared to the Voluntary Entry treatment where this frequency fluctuates upward in many early periods and remains near or above one-half of the bids until the final third of the session.

\(^{13}\) Small differences across treatments exist in the training periods, but these bids occur before any treatment manipulations are introduced. The same statistical tests applied to these training periods never reveal any significant differences across treatments. This indicates that the random assignment of subjects to treatments worked properly.
We now turn to performance under Qualifying Entry.

*Result 3:* In the *Qualified Entry* treatment, pooled profits were indistinguishable from Random assignment. Only with respect to severe overbidding, in the Qualified Entry treatment bidders were marginally better.

*Support:* Tables 1, 2, and 3 provide support for Result 3. The difference in terms of pooled profits between the Qualified Entry and Random Assignment treatments was not significant (*p*-value=0.367). In terms of overbidding frequency, the Qualified Entry treatment is marginally significantly lower than the 67 percent rate in the Random Assignment treatment (*p*-value=0.084, Table 2). In addition to profits and overbidding, another measure of performance is the rate of bankruptcies. By the end of the session, 5 percent of bidders go bankrupt in the Qualified Entry treatment, which was significantly lower than the 13 percent in the Random Assignment treatment (*p*-value=0.005) and the 18 percent in the Voluntary Entry treatment (*p*-value=0.003).14

5.2 Self Selection: Who Chooses to Enter the High-Stake Auctions?

Recall that in the Voluntary Entry treatment, every 5 periods the non-bankrupt subjects ranked the three activities and entered into their most preferred activity whenever possible. When ranking activities, subjects’ decision screens displayed the historical profit performance of individual bidders (shown anonymously) in each activity during the preceding block of periods. This information revealed that the high-stake auction exhibited the lowest average profit and the highest (variance) risk (Table 1), and therefore a subject who believes he would achieve typical earnings should avoid it. Nevertheless, the high-stake auction was the first choice in 40% of bidders’ rankings, the medium-stake auction was first choice in 32%, and the low-stake auction was the first choice the remaining 27%. This suggests that subjects focused on factors other than the mean and variance returns of the alternative bidding activities when choosing which auction to enter.

There exist several reasons to expect better performance of bidders in the Voluntary Entry compared to the Random Assignment treatment but also reasons to expect worse performance, depending on the type of bidders who voluntarily enter the auctions. For this exploratory study we offer for consideration the following six factors through which entry might affect the

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14 These statistics are based on cross-sectional probit models shown in the appendix, which cluster robust variance estimates that account for intra-session correlation.
frequency of bankruptcies and winner’s curse bids. Factors 1, 2, and 3 point toward improved performance and factors 4, 5 and 6 point toward detrimental effects.

First, confused subjects may avoid the high-stake common value auctions. Those subjects who did not understand the rules of the common value auction and are forced to participate in the Random Assignment treatment may opt to stay out in the Voluntary Entry treatment. Second, subjects with no prior auction experience may stay out. In the field, bidders in highly complex auctions are generally professionals who specialize and self-select into that activity. These factors are conjectures based on a notion of ambiguity aversion (e.g. Chen et al., 2007).

Third, subjects who plan to place “passive” bids may enter in greater numbers in common value auctions. A bid is passive when the aim is not to be competitive and win but instead to obtain the $0.25 participation payment awarded each period to bidders in the common value auction markets. This factor is specific for our experimental design and biases the experiment toward finding a better performance under the Voluntary Entry treatment. The experiment was calibrated to include this participation payment to maintain the attractiveness of the common value auctions in light of the large and systematic winner’s curse. With the current design, this provides the opportunity for a small but risk-free payment each period for a bidder willing to bid passively. Thus, the average earnings by other aggressive bidders may be irrelevant for a subject who is considering a passive bidding strategy.

Fourth, subjects with greater tolerance for risk may enter in larger numbers into common value auctions and bid aggressively. This factor is also a conjecture as there is no theoretical result providing unambiguous impacts of risk attitude on bidding in common value auctions, but in some circumstances more risk seeking agents place higher bids (Kagel and Richard, 2001). Fifth, subjects who prefer contests and competition the most may enter more frequently into common value auctions. This factor is based on behavioral results that show how subjects’ “joy of winning” is a component of the utility function in bidding activities (Cooper and Fang, 2008), even when it leads to negative earnings (Sheremeta, 2010). We posit that its influence is weakest in the low-stake auction because it does not involve a direct competition with other bidders. Sixth, overconfidence may also play role (Camerer and Lovallo, 1999). It is not the presence of overconfidence per se that can damage the performance of self-selection into activities but its correlation with abilities. If the degree of overconfidence is negatively correlated with the ability
to bid, self-selection into the activities can make session participants worse off than random assignment.

To provide some initial evidence regarding these factors in mind, we next explore systematically what characteristics influenced subjects’ decision on whether to enter the high-stake auction.

Result 4: Subjects who seek to enter the high-stake auction are more frequently male, have no previous experience in field auctions, have high cumulative earnings, and have avoided losses more frequently in previous common value auctions. Subjects who display a greater tolerance for risk are less likely to enter.

Support: Support for Result 4 comes from Table 4, which presents two probit models of bidders’ choice to rank the high-stake auction as their top choice. Model (1) includes as regressors the frequency of experienced losses and highest private estimates in earlier periods, and model (2) employs instead the subject’s accumulated earning balance up to the period of entry choice. Since these earnings are endogenous, we use an instrumental variable approach that employs the frequency of receiving the high estimate in previous common value auctions and the period number as instruments for this variable. The results are consistent across both specifications.15

The increased entry likelihood for male subjects is consistent with research documenting men’s greater willingness to enter competitions (e.g., Croson and Gneezy, 2009). The estimates also show that factors 2, 4, and 5 discussed above are significant in influencing voluntary entry, although not always in the expected direction. Consider first the evidence on factors expected to improve the performance of the Voluntary Entry treatment (1, 2, and 3). Confusion does not appear to play a significant role. Table 4 includes variables to capture subject comprehension and confidence, but none of these variables are significantly associated with high-stake auction entry.16 The high-stake auction does not attract bidders that have more auction experience in the field; in fact, it is more likely to attract naïve bidders (i.e., those who report no auction

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15 These models exclude some other factors that are never correlated with auction preference, such as self-reported grade point average, class standing, and major field of study. We also include a dummy for only the final block of periods, since all other period block dummy variables were never statistically significant. Estimates of similar models for preference of the medium-stake auction do not reveal any significant explanatory variables, so we do not report them here.

16 To measure confidence, after reading the instructions for the allocation rules after the training periods were over, we asked subjects “How do you think you will rank in terms of earnings among all participants?” There were five possible options, ranging from being among the three highest earners to be among the lowest three earners out of group of fifteen. This “confidence” question was not incentivized.
experience in the field), which may be an important reason for the high rates of the winner’s curse and bankruptcy in this Voluntary Entry treatment. Our initial conjecture goes in the opposite direction to the empirical evidence. A possible interpretation is that high risk aversion is associated to low cognitive ability (Dohmen et al., 2010), which is relevant for bidding in a complex setting such as common-value auctions.

Passive bidders exist but are few in number. A risk-free bid for the current parameters is one that is 15 experimental points or more below a subject’s value estimate. Such bids are certain to lie at or below the true common value, but they won only 2 of the 300 high-stake auctions after the training periods. Such bids represent only 5.8% of all high-stake auction bids after training. This rate of risk-free bidding was much higher in the Voluntary Entry treatment (12.2%), however, compared to the Qualified Entry (1.8%) and Random Assignment (3.5%) treatments. This provides evidence that bidding in the common value auctions varied depending on how bidders selected into the alternative bidding activities.

Consider now the evidence on factors expected to make the performance of the Voluntary Entry treatment worse (factors 4, 5, and 6). Subjects who are most willing to take on risk according to our separate risk assessment task, investing at least $4 out of their $5 stake in an attractive but risky investment, are significantly less likely to want to enter the high-stake auction. This is opposite to what was conjectured, but is consistent with the substantially greater frequency of passive and risk-free bids submitted in the Voluntary Entry treatment mentioned above, indicating that these are submitted by the more risk averse bidders who entered this auction. These passive bidders were not the cursed winners who suffered losses and sometimes went bankrupt. The frequency of both winner’s cursed bids and risk-free bids is higher in the Voluntary Entry than in other treatments, which suggests that the high-stake auction attracts different types of bidders. Some cautious bidders enter but seek mostly to collect the high-stake auction participation payment rather than bid competitively, while some other aggressive bidders frequently suffer from the winner’s curse perhaps due to lower cognitive ability. On balance the latter group tends to dominate since aggregate profits are lower and bankruptcies are higher in this treatment.

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17 We attempted to estimate similar models using only the subset of bidders who chose risk-free bids in a majority of the 5 periods in the block following their entry choice. Unfortunately, too few bidders satisfy this criterion for meaningful analysis.
5.3 Types of Individual Bidders

The overall treatment comparisons reported above obscure substantial variation across individual subjects. Some subjects bid much higher than others and often go bankrupt, some overbid but do not always bid above the conditional expected item value, others bid closer to Nash equilibrium levels and avoid losses (but rarely win auctions), and a few subjects are passive and bid low, effectively withdrawing from the auction. In order to classify subjects into different types, we employ their median bid factor, where the bid factor equals to the bid minus the private estimate. This median is calculated considering all post-training common value auction bids submitted by each individual.

Based on median bid factors, we classified 167 subjects into five categories, which are shown in Table 5. A small group of bidders had median bid factors of less than -28 and thus effectively withdrew from bidding. The risk neutral Nash equilibrium bid factor was around -15, except for the infrequent cases of item values near the boundary of the value domain (outside of “region 2”). Bidders in category b had median bid factors within one unit of this level. The vast majority of bidders overbid compared to this benchmark, and our classification procedure divides them into those with a bid factor that implies typical expected winner’s curse bids (bid factor > -10; category d) and those who overbid by a smaller amount (bid factor ≤ -10; category c). A small number of subjects (category e) had positive median bid factors indicating bids that often exceeded their estimate. The lowest two classes d and e contain the subjects whose median overbid was large enough to exceed the conditional expected value, so they can be considered winner’s curse bidders. The next result indicates that Voluntary Entry leads to more winner’s curse bidders in the common value auction than does Qualified Entry.

Result 5: Bidders prone to winner’s curse bids participate more frequently in common value auctions in the Voluntary Entry treatment than the Qualified Entry treatment.

Support: In the Voluntary Entry treatment about 52.6 percent of subjects are winner’s curse bidders (row (f) in Table 5), which is not significantly different from the Random Assignment baseline (p-value=0.285), and is on the threshold of marginal significance compared to the 35.3

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18 Individual median bid factors are highly correlated between the training periods and the post-training treatment periods (correlation coefficient=0.85). Consequently, the bidder classification is similar in the training and the post-training periods. Individual subjects typically either remain in their same class or improve by one class, due to the general reduction in overbidding over time (illustrated in Figure 2).

19 The statistical tests reported in this paragraph are all based on probit models shown in the appendix that employ robust variance estimates that allow for intra-session correlation.
percent in the Qualified Entry treatment ($p$-value=0.106). In the Voluntary Entry treatment nearly one-half of the bids submitted in the common value auctions were placed by individuals who were classified as winner’s curse bidders (row (g) in Table 5); by contrast, only about 30 percent of the common value auction bids were submitted by such bidders in the other two treatments. The difference in these frequencies between Voluntary Entry and Random Assignment is not quite statistically significant ($p$-value=0.158), but the difference between Voluntary Entry and Qualified Entry is significant ($p$-value=0.034).

6. Conclusions

In naturally-occurring settings firms and individuals voluntarily enter when deciding to bid in auctions, and in many cases the auctioneer screens potential bidders in order to have only qualified participants. Qualifying bidding is especially important in procurement auctions, such as in public works projects. We report the first laboratory experiment on common value auctions that incorporates simplified versions of these entry mechanisms and study their impact on bidding behavior, profits, the winner’s curse, and bankruptcies.

We report two main findings. First, letting auction participants self-select into the activities without barriers to entry has null or negative consequences on performance. Voluntary entry actually increases the fraction of overbidders in common value auctions compared to the benchmark of random allocation of subjects to auctions and does not lower bankruptcy rates. This result is not due to more people entering into the auction, as we kept market size constant. Thus, voluntary entry does not improve auction performance over random allocation of bidders. There exist arguments to expect an improvement and others to expect a deterioration of performance. This study provides empirical evidence showing a net detrimental effect of self-selection in common-value auctions. Possible reasons are an inaccurate self-assessment of bidders’ own skills and prospects for earnings in the various activities, or a relevant component of joy of winning for common-value auctions. This study leaves open various possible interpretations, but it does not provide any evidence that allowing participants to learn the logic of common-value auctions with low-stakes and then eventually opting for a high-stake task helps to reduce the winner’s curse.

We also study entry based on bidders’ “qualifications” as summarized by past cumulative earnings, a simple dimension representing success in previous auctions analogous to an
important criterion for participation in large field auctions. Qualifying entry reduces winner’s curse bidding only marginally in comparison to random assignment of subjects to auctions. This small behavioral difference arises even though some of the past performance in winning and profits earned is due to luck (i.e., the particular signal draws) rather than just skill at avoiding overbidding and the winner’s curse. Qualification also reduces the frequency of bankruptcies, as expected, but without fully eliminating it. In the field, qualifications for entry are both financial (as in the experiment) and technical. This study shows that purely financial criteria are insufficient to remove winner’s curse in bidding. They help in reducing bankruptcy rates but fail to select the most competent bidders. Whenever there is a common-value component in auctions, regulations about technical and experiential requirements should also be a key element in restricting entry to bidders.

REFERENCES


# Table 1: Mean Period Earnings (US Dollars)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Low-stake auction</th>
<th>Medium-stake Auction</th>
<th>High-stake Auction</th>
<th>Sum of earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Random Assignment</strong></td>
<td>0.148</td>
<td>0.033</td>
<td>0.055</td>
<td>+0.236</td>
</tr>
<tr>
<td></td>
<td>(0.856)</td>
<td>(0.998)</td>
<td>(1.694)</td>
<td></td>
</tr>
<tr>
<td><strong>Qualified Entry</strong></td>
<td>0.090</td>
<td>0.087</td>
<td>0.043</td>
<td>+0.220</td>
</tr>
<tr>
<td></td>
<td>(0.818)</td>
<td>(0.936)</td>
<td>(1.482)</td>
<td></td>
</tr>
<tr>
<td><strong>Voluntary Entry</strong></td>
<td>0.052</td>
<td>-0.017</td>
<td>-0.061</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td>(0.844)</td>
<td>(1.021)</td>
<td>(1.796)</td>
<td></td>
</tr>
<tr>
<td><strong>Treatments Pooled</strong></td>
<td>0.099</td>
<td>0.035</td>
<td>0.014</td>
<td>+0.148</td>
</tr>
<tr>
<td></td>
<td>(0.840)</td>
<td>(0.985)</td>
<td>(1.657)</td>
<td></td>
</tr>
</tbody>
</table>

Note: Standard deviations shown in parentheses
Table 2: Summary Statistics for Common Value Auction by Treatment

|                        | (1) Average Profits (in tokens) | (2) RNNE Bid Average Profits (in tokens) | (3) Auctions won by Bidder with $x_{1n}$ (percent) | Percent of Winner’s Curse Bids, $b > \mathbb{E}[x_0 | X = x_{1n}]$ |
|------------------------|----------------------------------|------------------------------------------|--------------------------------------------------|--------------------------------------------------|
| Random Assignment      | -1.64 (0.51)                     | 4.91 (0.31)                              | 57.8                                              | 35.8 66.5                                        |
| Qualified Entry        | -1.54 (0.47)                     | 4.91 (0.31)                              | 67.5                                              | 36.6 55.3                                        |
| Voluntary Entry        | -2.61 (0.58)                     | 5.27 (0.36)                              | 61.9                                              | 48.8 75.6                                        |

Notes: $b =$ bid, $x_0 =$ item value, $x_{1n} =$ highest private estimate, RNNE = Risk Neutral Nash Equilibrium. Only periods with 5 bidders, pooling medium-stake and high-stake auctions, and value draws in region 2 are included. (1) reports the average period profits of the winner in each treatment (including relevant participation points), with standard errors in parentheses; (2) displays the average profits that would be earned at the RNNE for the realized value and estimate draws, with standard errors in parentheses; (3) indicates the percent of auctions in which the bidder with the highest estimate won the auction; (4) and (5) show the percentage of bids that are winner’s curse bids, which are defined as bids that exceed the item’s expected value conditional on being the highest estimate.
Table 3: Accumulated Profits and Bankruptcy Rates

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average Cumulative Profit in the final period</th>
<th>Percent of Subjects Bankrupt in the final period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment</td>
<td>$12.30 ($1.20)</td>
<td>13.3 (8 of 60 subjects)</td>
</tr>
<tr>
<td>Qualified Entry</td>
<td>$12.25 ($1.05)</td>
<td>5.0 (3 of 60 subjects)</td>
</tr>
<tr>
<td>Voluntary Entry</td>
<td>$9.70 ($1.15)</td>
<td>18.3 (11 of 60 subjects)</td>
</tr>
</tbody>
</table>

Note: Standard error of the mean shown in parentheses. Subjects began session with $10 endowment.
Table 4: Probit Models of Preference for High-stake Auction

(Voluntary Entry Treatment Only)

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Model (1)</th>
<th>Model (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 = top preference for high-stake auction</td>
<td>Model (1)</td>
<td>Model (2)</td>
</tr>
<tr>
<td>0 = otherwise</td>
<td>Frequency of Losses in Previous Common Value Auctions (0.311)</td>
<td>Frequency of Losses in Previous Common Value Auctions (0.311)</td>
</tr>
<tr>
<td></td>
<td>Frequency Received highest Value Estimate in Previous Common Value Auctions (0.215)</td>
<td>Frequency Received highest Value Estimate in Previous Common Value Auctions (0.215)</td>
</tr>
<tr>
<td></td>
<td>USD Earnings Balance at Time of Ranking (Instrumental Variable) (0.074)</td>
<td>USD Earnings Balance at Time of Ranking (Instrumental Variable) (0.074)</td>
</tr>
<tr>
<td></td>
<td>High tolerance for risk (Investing $4 or more out of $5 in Risk Task) (0.349)</td>
<td>High tolerance for risk (Investing $4 or more out of $5 in Risk Task) (0.349)</td>
</tr>
<tr>
<td></td>
<td>Perfect Score on Instructions (0.320)</td>
<td>Perfect Score on Instructions (0.320)</td>
</tr>
<tr>
<td></td>
<td>Poor Score on Instructions (0.324)</td>
<td>Poor Score on Instructions (0.324)</td>
</tr>
<tr>
<td></td>
<td>Comprehension Quiz (below 80%) (0.388)</td>
<td>Comprehension Quiz (below 80%) (0.388)</td>
</tr>
<tr>
<td></td>
<td>Confident to be high Earner in Session (top 40%) (0.416)</td>
<td>Confident to be high Earner in Session (top 40%) (0.416)</td>
</tr>
<tr>
<td></td>
<td>Confident to be low Earner in Session (bottom 20%) (0.592)</td>
<td>Confident to be low Earner in Session (bottom 20%) (0.592)</td>
</tr>
<tr>
<td></td>
<td>Male (0.286)</td>
<td>Male (0.286)</td>
</tr>
<tr>
<td></td>
<td>No Field Auction Experience Reported (e.g., eBay) (0.315)</td>
<td>No Field Auction Experience Reported (e.g., eBay) (0.315)</td>
</tr>
<tr>
<td></td>
<td>Final Block of Periods (0.151)</td>
<td>Final Block of Periods (0.151)</td>
</tr>
<tr>
<td></td>
<td>Constant (0.437)</td>
<td>Constant (0.437)</td>
</tr>
<tr>
<td>Observations</td>
<td>261</td>
<td>261</td>
</tr>
<tr>
<td>Number of Subjects Included</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Pseudo R-squared</td>
<td>0.154</td>
<td>0.154</td>
</tr>
</tbody>
</table>

Notes: Standard errors robust to clustering on subjects are shown in parentheses. ** p<0.01, * p<0.05 (two-tailed tests)
**Table 5: Classification of Bidders into Types**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Total in Classification</th>
<th>Random Assignment</th>
<th>Qualified Entry</th>
<th>Voluntary Entry</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Conservative or Withdraw</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>(b) About Nash: Median bid within 1 of Nash</td>
<td>22</td>
<td>8</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>(c) Small Overbid: median bid ≤ $E[x_0</td>
<td>X = x_{1n}]$</td>
<td>70</td>
<td>27</td>
<td>26</td>
</tr>
<tr>
<td>(d) Winner’s curse: $E[x_0</td>
<td>X = x_{1n}] &lt; median bid &lt; own estimate X$</td>
<td>62</td>
<td>19</td>
<td>17</td>
</tr>
<tr>
<td>(e) Strong Winner’s curse: median bid &gt; own estimate X</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>(f) Percent of subjects classified in (d) and (e) (Winner’s Curse bidders) in post-training periods</td>
<td>39.0</td>
<td>35.3</td>
<td>52.6</td>
<td></td>
</tr>
<tr>
<td>(g) Percent of bids submitted in post-training periods in common value auction by subjects in (d) and (e)</td>
<td>30.8</td>
<td>27.9</td>
<td>47.8</td>
<td></td>
</tr>
</tbody>
</table>

Note: Classification based on Median Bid Factors in post-training periods when pooling medium and high-stake auction bids. Total number of classified subjects is 167, which submitted common value auction bids in the post-training periods. Of the 180 subjects who participated in the experiment, 13 always bid in the low-stake auction, often because they were already bankrupt during the training periods. Category (b) includes 21 subjects who fit the definition plus a 22nd subject who had a median bid factor of -17.9. This individual could have also been included in the withdrawal group, and this reclassification would have no influence on the conclusions drawn here.
Figure 1: Equilibrium and actual earnings of the three possible activities

Notes: Average per-period earnings when placing a RNNE bid. The large and medium-stake auctions consider only region 2 and are based on the average gain of 4.25 points when winning plus the fixed bonus of 25 US dollar cents. Actual earnings are computed pooling all treatments (Table 1).
Figure 2: Frequency of winner’s curse bids

![Graph showing the frequency of winner’s curse bids across different auction periods and entry conditions.](image-url)
Appendix: Pairwise Treatment Comparisons for Results Summarized in Text

Treatment Comparisons of per-Bidder Profits Earned (Result 1)

Dependent Variable = subject earnings

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Model (1)</th>
<th>Model (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment Treatment Dummy</td>
<td>2.60(^+)</td>
<td>2.56(^*)</td>
</tr>
<tr>
<td>(1.25)</td>
<td>(1.01)</td>
<td></td>
</tr>
<tr>
<td>Qualified Entry Treatment Dummy</td>
<td>9.70(^**)</td>
<td>9.70(^**)</td>
</tr>
<tr>
<td>(0.67)</td>
<td>(0.67)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>9.70(^**)</td>
<td>9.70(^**)</td>
</tr>
<tr>
<td>(0.67)</td>
<td>(0.67)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.021</td>
<td>0.023</td>
</tr>
</tbody>
</table>

Notes: Omitted treatment is the Voluntary Entry treatment. Standard errors robust to clustering on sessions are shown in parentheses. \(^*\) p<0.05, \(^+\) p<0.10.

Probit Models of Winner’s Curse Bid Frequency (Result 2)

Models 1 and 2: Dependent Variable = 1 iff submitted bid is a winner’s curse bid
Models 3 and 4: Dependent Variable = 1 iff winning bid is a winner’s curse bid

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Model (1)</th>
<th>Model (2)</th>
<th>Model (3)</th>
<th>Model (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment Treatment Dummy</td>
<td>-0.33(^+)</td>
<td>-0.24</td>
<td>-0.55(^**)</td>
<td></td>
</tr>
<tr>
<td>(0.17)</td>
<td>(0.22)</td>
<td>(0.15)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qualified Entry Treatment Dummy</td>
<td>-0.03</td>
<td>-0.31(^+)</td>
<td>-0.55(^**)</td>
<td></td>
</tr>
<tr>
<td>(0.12)</td>
<td>(0.18)</td>
<td>(0.14)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.03</td>
<td>-0.03</td>
<td>0.68(^**)</td>
<td>0.68(^**)</td>
</tr>
<tr>
<td>(0.12)</td>
<td>(0.12)</td>
<td>(0.14)</td>
<td>(0.14)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>1595</td>
<td>1670</td>
<td>319</td>
<td>334</td>
</tr>
<tr>
<td>Pseudo R-squared</td>
<td>0.013</td>
<td>0.011</td>
<td>0.007</td>
<td>0.033</td>
</tr>
</tbody>
</table>

Notes: Omitted treatment is the Voluntary Entry treatment. Standard errors robust to clustering on subjects are shown in parentheses. \(^*\) p<0.05, \(^+\) p<0.10.
**Probit Models of Subject Bankruptcy (Result 3)**

Dependent Variable = 1 iff Subject ends session bankrupt

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Model (1)</th>
<th>Model (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment Treatment Dummy</td>
<td>0.53**</td>
<td>0.74**</td>
</tr>
<tr>
<td></td>
<td>(0.19)</td>
<td>(0.25)</td>
</tr>
<tr>
<td>Voluntary Entry Treatment Dummy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-1.64**</td>
<td>-1.64**</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Observations</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Pseudo R-squared</td>
<td>0.035</td>
<td>0.063</td>
</tr>
</tbody>
</table>

Notes: Omitted treatment is the Qualified Entry treatment. Standard errors robust to clustering on sessions are shown in parentheses. ** p<0.01, * p<0.05.

**Probit Models of Bidder Type (Result 5)**

Models 1 and 2: Dependent Variable = 1 iff Subject is classified as a winner’s curse bidder (row f of Table 5)
Models 3 and 4: Dependent Variable = 1 iff the bid is submitted in common value auction by a subject classified as a winner’s curse bidder (row g of Table 5)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Model (1)</th>
<th>Model (2)</th>
<th>Model (3)</th>
<th>Model (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Assignment Treatment Dummy</td>
<td>-0.35</td>
<td>-0.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.32)</td>
<td>(0.32)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qualified Entry Treatment Dummy</td>
<td></td>
<td></td>
<td>-0.53*</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.27)</td>
<td>(0.25)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.07</td>
<td>0.07</td>
<td>-0.05</td>
<td>-0.05</td>
</tr>
<tr>
<td></td>
<td>(0.26)</td>
<td>(0.26)</td>
<td>(0.23)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>Observations</td>
<td>116</td>
<td>108</td>
<td>1944</td>
<td>1966</td>
</tr>
<tr>
<td>Pseudo R-squared</td>
<td>0.014</td>
<td>0.022</td>
<td>0.022</td>
<td>0.032</td>
</tr>
</tbody>
</table>

Notes: Omitted treatment is the Voluntary Entry treatment. Standard errors robust to clustering on sessions are shown in parentheses. ** p<0.01, * p<0.05.
Appendix: EXPERIMENTAL INSTRUCTIONS (Not Intended for Publication)

Risk Elicitation Task Shown only with On-Screen Instructions:

At the beginning of this experiment you will make 5 risky choices. You are asked to choose the portion of this amount between $0 and $20 that you wish to invest in a risky option. The rest of this money will be accumulated in your final balance.

The risky option in this experiment is an equal chance that the investment will fail or succeed. If the investment fails, you lose the amount you invested. If the investment succeeds, you receive three times the amount invested.

How do you determine if you succeeded? After you have chosen how much you wish to invest, you will toss a coin to determine whether you succeeded or failed. If the coin comes up heads, the amount you chose to invest; if the coin comes up tails, you lose the amount invested.

<table>
<thead>
<tr>
<th>Amount Invested</th>
<th>Earnings if tails</th>
<th>Earnings if heads</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
</tr>
<tr>
<td>$2.50</td>
<td>$4.50</td>
<td>$0.00</td>
</tr>
<tr>
<td>$5.00</td>
<td>$4.00</td>
<td>$7.00</td>
</tr>
<tr>
<td>$7.50</td>
<td>$3.50</td>
<td>$10.50</td>
</tr>
<tr>
<td>$10.00</td>
<td>$3.00</td>
<td>$13.00</td>
</tr>
<tr>
<td>$2.50</td>
<td>$2.50</td>
<td>$10.50</td>
</tr>
<tr>
<td>$3.00</td>
<td>$2.00</td>
<td>$11.00</td>
</tr>
<tr>
<td>$3.50</td>
<td>$1.50</td>
<td>$12.00</td>
</tr>
<tr>
<td>$4.00</td>
<td>$1.00</td>
<td>$13.00</td>
</tr>
<tr>
<td>$4.50</td>
<td>$0.50</td>
<td>$14.00</td>
</tr>
<tr>
<td>$5.00</td>
<td>$0.00</td>
<td>$15.00</td>
</tr>
</tbody>
</table>

Please enter how much you would like to invest in a risky option: [ ]

You will toss the coin at the end of today's session.

Submit investment
INSTRUCTIONS (Individual Auction)

This is an economic experiment about decision making under uncertainty. Various agencies have provided funds for the experiment. Listening carefully to these instructions will help you to earn a significant amount of money, which you will receive in cash privately at the end of the experiment. You will also take a short quiz at the end of these instructions and will earn $1 for every correct answer.

You are a potential buyer in this experiment. The computers take the role of the potential seller. You will choose an amount to bid on an item, without knowing the exact value of the item. You can think of the item as a closed envelope that contains dollar banknotes; you don’t know exactly how much money is inside. You will participate in several trading periods where you will bid in an auction, which can be of different types. It could be:

- individual auction,
- low value auction,
- or high value auction.

In each period you bid on a single item. In different periods, the items are different. As we will explain in a moment, random draws will determine the value of the items. These random draws are independent from period to period. You can think about an urn containing balls. A ball is drawn and then put back into the urn. Thus a high value in one period tells you nothing about the likely value in the next period – whether it will be high or low.

You are welcome to ask questions by raising your hand. Please wait for an experimenter to come to your seat before asking your question. While the experiment is in progress, please do not to speak or in any other way communicate with other participants. This is important to the validity of the study.

I - INDIVIDUAL AUCTION

In an individual auction, the item will be worth more to you than it is to the current owner. The owner may sell you the item and knows the item's value. You are the only potential buyer and at the time you make a bid you don’t know the exact value of the item.
In each auction period, you enter a bid for an item, using a computer screen like the one below.

The item's value to its current owner will come from a random draw generated by the computer and will always be between 6 and 24 points. All cent values within the range will be equally likely. In other words, any value between 6 and 24 points, such as 6.00, 6.01,..., 23.99, 24.00 will be equally likely.

The item's value to you, should you acquire it, will be 1.5 times as much as the value for its current owner, so it will range between 9 and 36:

\[
\text{Value of the item to you} = 1.5 \times \text{Value to current owner}.
\]

For example, if the item is worth 10 points to its current owner, it will be worth 15 to you; if the item is worth 20 to its current owner, it will be worth 30 to you.
Each period has a simple timeline: first you must decide what you wish to bid for the item; then the computer draws a random number; the current owner either sells the item or not; finally, you can see the results.

Everyone should have received a decision sheet. When you place your bid, please also write it down in the decision sheet and circle the appropriate Auction Type, in this case I. For the first four periods I has already been circled for you. After you have entered your bid, there will be a random draw to determine the item's value. The computer takes the role of the current owner. If your bid is greater than or equal to the item's value to its current owner, you will acquire the item because you offered a high enough price. In this case, your gain or loss will be the item's value to you (the buyer), which is 1.5 times the value to its current owner, minus your bid. If your bid is less than the item's value to its current owner, you will not acquire the item because your offer is too low, and will neither gain nor lose anything. Your earnings are zero in periods that you do not acquire the item. You are the only potential buyer.

$$\text{Value to current owner} = \text{random number between 6 and 24}$$

1. If $\text{Bid} \geq (\text{Value to current owner})$, 
   \[ \text{Earnings} = 1.5 \times (\text{Value to current owner}) \text{ minus (Your Bid)} \]

2. If $\text{Bid} < (\text{Value to current owner})$, 
   \[ \text{Earnings} = 0 \]

At the end of the period, please record on the decision sheet the value of the item for you and your earnings in points. There is also a column for the current balance in dollars. You will begin the experiment with a starting balance of $10.00. When you gain money during a period, your current balance will increase by the amount that you gain. When you lose money during a period, your current balance will decrease by the amount you lose. For the individual auction, your earnings in points will be divided by a factor of 4 to obtain your dollar earnings. To calculate the current balance in dollars, take the period earnings in points divided by 4 and add them to the balance in dollars in the previous line.

Some common questions: What does "equally likely" mean? Suppose that there is a roulette wheel with 1801 equally spaced stopping points, which are labeled: 6.00, 6.01, 6.02, ..., 23.99,
24.00. Then a hard spin would make the chance of stopping on any one point exactly the same as the chance of stopping on any other, so all values are "equally likely."

Can I bid 0? Yes, you can bid 0 or any positive amount.

My balance is 18 points. Can I bid 25? Yes, you are permitted to bid in excess of your current balance in any given period.

Are there any questions?

Period 1 will be a practice period for you to familiarize yourself with the rules and has no impact on your earnings (a dry run). Your decisions in period 2, 3, and 4, however, will impact your earnings. We will check to make sure everyone is filling out their record sheet correctly at the end of the first period.

In the quiz you are about to take on your computer you will earn $1 for every correct answer, and you may consult the instructions before answering any question.
<table>
<thead>
<tr>
<th>Period</th>
<th>Auction Type</th>
<th>Private Estimate (for H,L)</th>
<th>Your Bid</th>
<th>Item Value for Buyer</th>
<th>Period Earnings in points</th>
<th>Current Balance in $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(dry)</td>
<td>H L I</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td>$ 10</td>
</tr>
<tr>
<td>2</td>
<td>H L I</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>3</td>
<td>H L I</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>4</td>
<td>H L I</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>5(dry)</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>6</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>7</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>8</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>9(dry)</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
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<tr>
<td>10</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>11</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>12</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>13</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>14</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>15</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>16</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>17</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>28</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>29</td>
<td>H L I</td>
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<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>30</td>
<td>H L I</td>
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<td></td>
<td></td>
<td>$_________</td>
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<tr>
<td>31</td>
<td>H L I</td>
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<td></td>
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<td>$_________</td>
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<tr>
<td>32</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>33</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>34</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>35</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>36</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
<tr>
<td>37</td>
<td>H L I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$_________</td>
</tr>
</tbody>
</table>
ID _____  Today’s date ________________________

**Final Payment Sheet**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment Task Earnings</td>
<td>$______</td>
</tr>
<tr>
<td>Quiz Earnings</td>
<td>$______</td>
</tr>
<tr>
<td>Paid Auction Earnings</td>
<td>$______</td>
</tr>
</tbody>
</table>

**Total Amount Paid (Numbers summed above)** $______
Individual Auction Quiz Questions (computerized on zTree, $1 for each correct answer)

1. You will know the exact value of the item to you before entering your bid (True/False).

Text for incorrect answer: “Your answer is incorrect. The correct answer is False. As stated on page 1 of the instructions, ‘You will choose an amount to bid on an item, without knowing the exact value of the item.’”

2. If the item has a value of 15 to the current owner, how much is it worth to you if you acquire it?

Text for incorrect answer: “Your answer is incorrect. The correct answer is 22.5. As stated at the bottom of page 1 of the instructions, ‘The item's value to you, should you acquire it, will be 1.5 times as much as the value for its current owner’. And so if the value to the current owner is 15, the item’s value to you is 1.5*15=22.5.”

3. What is the lowest possible amount that the item could be worth to you if you acquire it?

Text for incorrect answer: “Your answer is incorrect. The correct answer is 9. As stated on page 1 of the instructions, ‘The item's value to its current owner will come from a random draw generated by the computer and will always be between 6 and 24 points.’ The lowest value to the current owner is 6, and since the value to you is 1.5 times as much as the value to the current owner the lowest value to you is 1.5*6=9.

4. How much do you earn in a period if you do not acquire the item?

Text for incorrect answer: “Your answer is incorrect. The correct answer is 0. As stated on page 2 of the instructions, ‘Your earnings are zero in periods that you do not acquire the item.’

5. If you acquire the item in a period, losing money is impossible. In other words, you cannot have negative period earnings (True/False).

Text for incorrect answer: “Your answer is incorrect. The correct answer is False. As stated on page 2 of the instructions, in periods that you bid high enough to acquire the item your earnings are ‘Earnings = 1.5 x (Value to current owner) minus (Your Bid)’. If (Your Bid) exceeds 1.5 x (Value to current owner) then your earnings would be negative for that period.
L - LOW-VALUE AUCTION

You will take a short quiz at the end of these instructions and will earn $1 for every correct answer.

In the low-value auction, your task is to submit bids for a single item in competition with other buyers. At the beginning, participants in this room will be divided into separate auctions with five bidders each. The value of the item is the **same for all buyers in the same auction**. At the time you bid, however, the exact value of the item will be unknown to you. Instead, each buyer will receive some information about the value of the item which you should find useful in determining your bid, as explained later.

The **value of the item** \((V^*)\) will be assigned randomly and will lie between 50.00 and 950.00 points. Any value within this interval has an **equally likely chance** of being drawn. Although you do not know the value of the item \(V^*\) prior to bidding, you will receive a private estimate of it which will narrow down the range of possible values.

**Private Estimates** of \(V^*\) consist of random numbers drawn from the interval \(V^* - 15\) and \(V^* + 15\). Any value within this interval has an **equally likely** chance of being drawn. Each bidder gets an independent private estimate. You can think about an urn containing balls. A ball is drawn and then put back into the urn before drawing another estimate.

For **example**, suppose the value of the item is \(V^* = 328\) points. Then private estimates will consist of random numbers between 313 \((328 - 15)\) and 343 \((328 + 15)\). Any value in this interval has an equally likely chance of being drawn as your private estimate. The line diagram below shows what’s going on in this example.

![Diagram showing value of the item with private estimates](image-url)
The data below provides an example of the private estimates drawn in past auctions with 5 bidders. (Note we’ve ordered these estimates from highest to lowest.)

Value of the item $V^* = 328.00$;

Private estimates:
- 339.45
- 337.43
- 335.82
- 323.89
- 315.41

You will note that some private estimates are above the $V^*$ and some are below $V^*$. Over a long series of auctions, the differences between your private estimate and $V^*$ will average out close to zero. For any given auction, however, your private estimate can be above or below the value of the item $V^*$. That’s the nature of the random process generating the private estimates.

In each auction period, you enter a bid for an item, using a computer screen like the one below.
In an auction, the high bidder acquires the item and receives earnings equal to the difference between the value of the item and the amount he/she bid, plus 1 point. That is

\[
\text{Earnings for high bidder} = 1 + (\text{Value of item}) - (\text{Highest Bid}) \\
\text{Earnings for other four bidders} = 1
\]

If you are the high bidder, you may gain or lose money. If you do not make the high bid on the item, you will not acquire the item. In this case, you simply earn 1 point for that period. Any loss you may suffer in some periods will be deducted from the starting balance and from the profits you earn in other periods of today’s experiment. However, should your balance drop to zero (or less) during the session you will be placed in the individual auction until you restore a positive balance. For this reason, there may be less than 5 bidders in any given auction.

In case of ties for the high bid the computer will randomly determine who will acquire the item. Please record your bid and private estimate on the decision sheet under Auction Type L. For the next four periods L has already been circled for you. At the end of each period, you will see the results on your screen. The results include the value of the item \(V^*\), the private estimates of all bidders along with their bids, and the period earnings for the high bidder. **For the low-value auction, your earnings in points will be divided by a factor of 4 to obtain your dollar earnings.**

There will be a reserve price of \(V^* - 30\) in each auction. If the high bid is below the reserve price the item will not be sold that auction period and the high bidder will earn 1 point.

Some common questions. How can I use my private estimate to place a bid?

A private estimate allows you to compute your lowest and highest limits for the value of the item \(V^*\). Notice that \(V^*\) must always be greater than or equal to your private estimate minus 15. Further, \(V^*\) must always be less than or equal to your private estimate plus 15. You will find your lowest and highest limits for \(V^*\) displayed on the screen.
I received a private estimate below 50 points (or above 950). Isn’t that strange? No, it is fine: this value just indicates that V* is close to 50 (or 950).

Can I bid 0? Yes, you can bid 0 or any positive amount.

My balance is 300 points. Can I bid 525? Yes, you are permitted to bid in excess of your current balance in any given period.

Let’s summarize the main points:

1. The high bidder earns the item and makes a profit = 1 + value of item (V*) – amount he/she bid. All other bidders earn 1 point. Earnings can be positive or negative.
2. Prior to bidding, the value of V* is unknown to you but is always between 50 and 950 points. Any value in this interval has an equally likely chance of becoming V*.
3. Your private estimate of V* will be randomly drawn from the interval V* - 15 and V* + 15. Any value in this interval has an equally likely chance of being drawn. Note that V* can never be more than your private estimate plus 15, or less than your private estimate minus 15.
4. The values of V* are determined randomly and independently from period to period. Thus a high V* in one period tells you nothing about the likely value in the next period.

Are there any questions?

Period 5, like period 1, will be a practice period for you to familiarize yourself with the rules and has no impact on your earnings (a dry run). Your decisions in periods 6, 7, and 8, however, will impact your earnings. You will always be with the same group of bidders for these four periods. We will check to make sure everyone is filling out their record sheet correctly at the end of period 5.

In the quiz you are about to take on your computer you will earn $1 for every correct answer, and you may consult the instructions before answering any question.
Low Value Auction Quiz Questions (computerized on zTree, $1 for each correct answer)

1. If the item has a value of 615 points and you acquire it by placing a bid of 611, how much do you earn in points for the period?

Text for incorrect answer: “Your answer is incorrect. The correct answer is 5. As stated on page 3 of the instructions, ‘Earnings for high bidder = 1 + (Value of item) – (Highest Bid)’. If you plug into this equation 615 for the Value of item and 611 for the Highest Bid, the earnings are 1+615-611=5.”

2. What is the lowest possible amount that the item could be worth (V*) if your private estimate is 456?

Text for incorrect answer: “Your answer is incorrect. The correct answer is 441. As stated on page 4 of the instructions, ‘V* must always be greater than or equal to your private estimate minus 15.’ Since in this example your private estimate is 456, the lowest possible value of the item is 456-15=441.

3. How much do you earn in periods that you do not acquire the item?

Text for incorrect answer: “Your answer is incorrect. The correct answer is 1. As stated on page 3 of the instructions, ‘If you do not make the high bid on the item, you will not acquire the item. In this case, you simply earn 1 point for that period.’

4. If you acquire the item in a period, losing money is impossible. In other words, you cannot have negative period earnings (True/False).

Text for incorrect answer: “Your answer is incorrect. The correct answer is False. As stated on page 3 of the instructions, ‘Earnings can be positive or negative.’ In periods that you have the highest bid but your bid is more than 1 point above the Value of the item V*, the following equation from page 1 of the instructions indicates that your earnings would be less than zero: ‘Earnings for high bidder = 1 + (Value of item) – (Highest Bid)’.

5. If the value of the item V* is 120.00, is it possible that my private estimate is 133.52? (True/False)

Text for incorrect answer: “Your answer is incorrect. The correct answer is True. As stated on page 1 of the instructions, ‘Private Estimates of V* consist of random numbers drawn from the interval V* - 15 and V* + 15.’ and on page 2 ‘For any given auction, however, your private estimate can be above or below the value of the item V*.’
H - HIGH-VALUE AUCTION

The rules in the high-value auction are the same as for the low-value auction. The only difference concerns the earnings conversion rate between points and dollars and the additional fixed point earnings for auction participants.

YOUR EARNINGS IN POINTS WILL BE DIVIDED BY TWO TO BE CONVERTED INTO DOLLAR EARNINGS.

EVERYONE RECEIVES 0.5 POINTS EACH PERIOD WHEN PARTICIPATING IN THE HIGH VALUE AUCTION

On the record sheet, your decisions will be recorded under Auction Type H.

Are there any questions?

You will be randomly divided into new groups of five bidders each for separate auctions. Period 9, like periods 5 and 1, will be a practice period for you to familiarize yourself with the rules and has no impact on your earnings (a dry run). Your decision in periods 10, 11, and 12 will impact your earnings. You will always be with the same group of bidders for these four periods.
INSTRUCTIONS FOR REMAINING PERIODS (Random Assignment Treatment)

IN WHICH AUCTION TYPE WILL YOU BID?

There are going to be 25 additional periods. Your auction type is determined randomly for these remaining periods.

Every five periods you will be assigned or reassigned to one of the auction types. Five participants will be placed in the high-value auction, five participants will be placed in the individual auction, and five participants will be placed in the low-value auction.

However, should your current dollar balance be at zero (or less) during the experiment you will be placed in the individual auction until you restore a positive current balance. A participant with a zero or negative current balance will never be placed in the low-value or high-value auction. Should there be many participants with a zero or negative current balance, there may be 5, 4 or 3 bidders in the low-value or high-value auctions.

Let’s summarize the sources of your current balance in US dollars:

(1) Starting balance of $10.
(2) Auction earnings as explained above. The conversion rate between points and dollars can be 1 to 2 or 1 to 4 depending on the auction type.
(3) In addition, everyone will receive their earnings from the computerized quizzes, including participants with a negative current balance.
(4) Everyone will also receive their payment from their risky investment decision made at the start of the experiment.

Are there any questions?
INSTRUCTIONS FOR REMAINING PERIODS (Qualified Entry Treatment)

IN WHICH AUCTION TYPE WILL YOU BID?

There are going to be 25 additional periods. Your auction type depends on how you rank among the participants in terms of auction earnings.

Every five periods you will be assigned or reassigned to one of the auction types. The 5 participants with the highest number of points earned will be placed in the high-value auction. The 5 participants with the lowest number of points earned will be placed in the individual auction. The other 5 participants will be placed in the low-value auction.

However, should your current dollar balance be at zero (or less) during the experiment you will be placed in the individual auction until you restore a positive current balance. A participant with a zero or negative current balance will never be placed in the low-value or high-value auction.

Should there be many participants with a zero or negative current balance, there may be 5, 4 or 3 bidders in the low-value or high-value auctions.

Let’s summarize the sources of your current balance in US dollars:

2. Auction earnings as explained above. The conversion rate between points and dollars can be 1 to 2 or 1 to 4 depending on the auction type.
3. In addition, everyone will receive their earnings from the computerized quizzes, including participants with a negative current balance.
4. Everyone will also receive their payment from their risky investment decision made at the start of the experiment.

Are there any questions?
INSTRUCTIONS FOR REMAINING PERIODS (Voluntary Entry Treatment)

IN WHICH AUCTION TYPE WILL YOU BID?

There are going to be 25 additional periods. In the next period, we will ask your preferences about the three types of auctions. Please input 1 for your most favorite type of auction, 2 for your second favorite, and 3 for your least favorite. Whenever possible, you will be placed in your most favorite type of auction. In case there are too many requests for an auction type, you will be placed in your second favorite auction or maybe in your least favorite.

Every five periods we will ask your preference again. You may be in the same auction type or in a different auction type depending on your ranking and upon availability.

Should your current dollar balance be at zero (or less) during the experiment you will be placed in the individual auction until you restore a positive current balance. A participant with a zero or negative current balance will never be placed in the low-value or high-value auction. Should there be many participants with a zero or negative current balance, there may be 5, 4 or 3 bidders in the low-value or high-value auctions.

Let’s summarize the sources of your current balance in US dollars:

2. Auction earnings as explained above. The conversion rate between points and dollars can be 1 to 2 or 1 to 4 depending on the auction type.
3. In addition, everyone will receive their earnings from the computerized quizzes, including participants with a negative current balance.
4. Everyone will also receive their payment from their risky investment decision made at the start of the experiment.

Are there any questions?