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In It to Win It: Experimental Evidence on Unique Bid Auctions.

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Diskussionsbeitrag Nr. B-20-16

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IN IT TO WIN IT: EXPERIMENTAL EVIDENCE ON UNIQUE BID AUCTIONS.

Caroline Baethge · Marina Fiedler · Ernan Haruvy

We examine bidding motives in discrete-point unique bid auctions in a laboratory setting. In lowest (highest) unique bid auctions, the participant with the lowest (highest) unique bid wins the auction. We posit two sets of motives in this type of auctions – a winning motive that is driven by the desire to win and a profit motive that is driven by the expected payoff. In the lowest unique bid auction (LUBA), the profit and winning motive lead to the same bidding strategy in equilibrium. In the highest unique bid auction (HUBA), the profit and winning motive lead to different bidding strategies in equilibrium. Using a utility-based choice framework, we identify and characterize the motives. Our findings suggest that bidders' behavior is driven by an array of motives. We find that not only does the winning motive play a key role in behavior, but other considerations such as reinforcement and coordination enter as well.

Keywords

unique bid auctions · bidding behavior · experiment · learning

Highlights

- We introduce new discrete-point unique bid auctions in the laboratory.
- We characterize two sets of motives – a profit motive and a winning motive.
- In the highest unique bid auctions, winning and profit motives lead in different directions.
- A utility-based choice framework is shown to disentangle the motives.
- Bidding behavior is driven by an array of motives including reinforcement and coordination.

1. Introduction

Many popular auctions on the internet incorporate a lowest unique bid auction (LUBA) design. According to Gallice (2009), LUBAs began appearing in Scandinavia in 2006 before rapidly diffusing into other European countries. In the U.K., such sites are popular (e.g., BidGrid, BidBudgie). Besides being attractive for customers for their perceived bargain price, which is typically a small fraction of the retail price, and excitement value[1], unique bid auctions are also potentially profitable for auctioneers. Most of them specify a minimum number of required bids with a non-negligible bidding fee before the auctioned item is awarded to the lowest unique bid. In many cases, this bidding fee is responsible for the bulk of revenues.

The game-theoretic solution to unique bid auctions is far from trivial. Many LUBA auctions are dynamic, in that bidders bid sequentially, each bid is costly, and following each bid the bidder receives a signal about his chance of winning. Gallice (2009) characterizes solutions for such settings.

In other unique bid auctions, the focus is on a sealed bid setting, where bids are made simultaneously. In that setting, the equilibrium solution is a mixed strategy with a probability on each possible bid. There are many asymmetric mixed strategy equilibria that solve this game, and one symmetric mixed strategy equilibrium that is typically the focus of investigation (e.g., Otsubo et al. 2013).

The contribution of the present work is in combining the profit motive considered by most works on the topic (detailed in section 2) with a winning motive concerned with maximizing the winning probability. The winning motive is sometimes referred to as winning drive or excitement factor as proposed by Chakraborty et al. (2014). Despite the anecdotal evidence shown by Chakraborty et al. (2014) that there exists a competitive type – in a LUBA the top five bidders in the field are the most aggressive bidders in several auctions – empirically it is hard to separate that type of winning-driven behavior from pure profit maximization. This is because in LUBAs, given a particular belief about the distribution of others' bids, the strategy that maximizes profit is also the strategy that maximizes winning probability[2].

In contrast, under highest unique bid auctions (HUBAs), there is a potential conflict between profit maximization and winning probability maximization. Given a belief about the distribution of others, a lower bid may be preferred to a higher bid with higher probability for

[1] Chakraborty et al. (2014) find evidence of some aggressive bidders that appear motivated by excitement.
[2] Actually, given mixed NE distribution of bids, the rational equilibrium bidder should be indifferent between all possible bids within the support. We consider beliefs that are more adaptive in nature.

winning, simply because it implies a lower payment. We exploit this tradeoff to separate out the two motives.

Despite its similar design, there are almost no examples of highest unique bid auctions being implemented. HUBAs differ only concerning the winning rule in that the bidder with the highest unique bid wins. When comparing both types of unique bid auctions one can see that a LUBA does not differentiate between a choice motivated by payoff maximization and a choice influenced by the probability to win. The HUBA, on the other hand, results in a different bidding strategy for each motive. This type of auction can also be compared to a patent race since it is a firm's goal to be the first one to submit the best unique patent. Once handed in, all other firms lose.

We aim to make two primary contributions. First, we contribute to the body of work on auction formats by investigating and contrasting two types of unique bid auctions – LUBA and HUBA – in a novel laboratory experiment with discrete price points. Secondly, our investigation centers on whether or not subjects behave solely according to profit maximization or are also influenced by other motives – a winning motive in particular. The setting we investigate allows us to discover whether bidding behavior is similar or diverging in the two types of unique bid auctions.

2. Related Literature

The extant literature on lowest unique bid auctions (Chakraborty 2014 ; Eichberger and Vinogradov 2008; Gallice 2009; Houba et al. 2008; Otsubo et al. 2013; Radicchi et al. 2012; Rapoport et al. 2009; Scarsini et al. 2010; Wachter and Norman 2006) which is mainly concerned with the equilibrium solution and its predictive power of bidding behavior.

Otsubo et al. (2013) was one of the first studies on LUBA and HUBA to use laboratory experiments. They conducted two laboratory studies on unique bid auctions. They restricted the bidding interval to 4 and 25 integers and the number of bidders to five in their first study, focusing solely on the LUBA. In their second study, they conducted both LUBAs and HUBAs with a bidding interval restricted to 25 integers and including ten participants per auction. In that second study – the only study we know of that compares LUBA and HUBA – the winning bidder received the amount of his or her submitted bid – making this is a reverse auction. Given the reverse auction incentives, their HUBAs and LUBAs are the reverse of ours – their HUBA is loosely the theoretical equivalent of our LUBA and vice versa. The motives of receiving the highest payoff possible and increasing the probability of winning operate in the same direction in their HUBA whereas they diverge in their LUBA (in ours it is the opposite). While they do not explicitly investigate these opposing motives (which is an important point of the current investigation), they do acknowledge this as a likely reason that their LUBA and HUBA patterns are not mirror images of one another.

Östling et al. (2011) examined a variation of LUBA that did not involve the subjects paying their submitted number. They called this variation LUPI (lowest unique positive integer) games. While their games involved submitted numbers, the games are not proper auctions as in Otsubo et al. (2013) because participants' submitted numbers do not affect their payoffs. Moreover, in these games, the number of entrants was random and roughly followed a Poisson distribution. While the solution concept applied to these games is Poisson Nash, which is different from our games, the solution concept of mixed Nash equilibrium and the distributions of the bids do bear similarities both theoretically and empirically to our study and to Otsubo et al. (2013).

Lastly, Raviv and Virag (2009) collected data via an internet auction platform with different products using a HUBA as a selling mechanism. They allowed for multiple bids and incorporated a bidding fee c > \$0. Their main findings suggest that bidding behavior only depends on the number of bidders, but not on the size of the prize or the highest possible bid allowed. Bidders in their study tended to place bids farther from the maximum allowed bid as the number of bidders increased.

3. Theory

3.1. The Profit Motive – Equilibrium Characterization of Five-Point Unique Bid Auctions

In a five-point unique bid auction, bidders choose a bid $x \in \{0, 0.25, 0.50, 0.75, 1.00\}$ with a probability $p(x)$. All bidder strategies are expressed in terms of vector $p(x)$. The bid increment ε is 0.25 and the prize v is equal to 1.01. Let $w(x)$ denote the probability of x being the outright winning bid and $tie(x)$ denote the probability of a tie at bid x. In case of a complete tie, that is, all four bidders choose the same bid x or two choose one bid and two choose another, the prize would be awarded randomly to one of the bidders with a probability of ¼. The unconditional winning probability is therefore given by $w(x) + \frac{tie(x)}{4}$.

Table 1 shows the computation of $w(x)$ and $tie(x)$ for each x in the HUBA and LUBA for the given belief vector $b(x)$. This vector indicates the belief regarding the probability that a bid x will be chosen by another player as well. Note that $b(x)$ is equivalent to $p(x)$ in a symmetric Nash equilibrium, which will be discussed shortly. The index I on b_i

indicates the bid in numerical order from 0 to 1. This means that that b_1 is the belief regarding the probability of a bid at 0, b_2 is the belief for a bid of 0.25, etc.

Table 1

The Probabilities of Winning and Tying for the HUBA and LUBA

	Probability of winning $w(x)$given belief vector $b(x)$.		Probability of tying $tie(x)$ given belief vector $b(x)$.
bid *i*	**HUBA**	**LUBA**	**HUBA/ LUBA**
0	$b_2^3 + b_3^3 + b_4^3 + b_5^3 +$	$(1 - b_1)^3$	$b_1^3 + 3b_1(b_2^2 + b_3^2 + b_4^2 + b_5^2)$
0.25	$b_3^3 + b_4^3 + b_5^3$ $+3(b_3^2 + b_4^2 + b_5^2)b_1$ $+b_1^3$	b_1^3 $+3b_1^2(1 - b_1 - b_2)$ $+(1 - b_1 - b_2)^3$	$b_2^3 + 3b_2(b_1^2 + b_3^2 + b_4^2 + b_5^2)$
0.50	$b_4^3 + b_5^3$ $+3(b_4^2 + b_5^2)(1 - b_3 - b_4 - b_5)$ $+(1 - b_3 - b_4 - b_5)^3$	$b_1^3 + b_2^3$ $+3(b_1^2 + b_2^2)(1 - b_1 - b_2 - b_3)$ $+(1 - b_1 - b_2 - b_3)^3)$	$b_3^3 + 3b_3(b_1^2 + b_2^2 + b_4^2 + b_5^2)$
0.75	b_5^3 $+3b_5^2(1 - b_4 - b_5)$ $+(1 - b_4 - b_5)^3$	$b_1^3 + b_2^3 + b_3^3$ $+3(b_1^2 + b_2^2 + b_3^2)b_5$ $+b_5^3$	$b_4^3 + 3b_4(b_1^2 + b_2^2 + b_3^2 + b_5^2)$
1	$(1 - b_5)^3$	0	$b_5^3 + 3b_5(b_1^2 + b_2^2 + b_3^2 + b_4^2)$

Following Table 1, we examine symmetric equilibria where all bidders have the same belief vector b, mixing probabilities p, tying and winning probabilities $tie$and w, and we impose that $b = p$. The key in computing mixed strategy equilibria is that all strategies within the support have the same expected utility. The general objective function for the case of four bidders is therefore given by:

$$max_x \; E\pi(x) = \Sigma_x (v - x) * (w(x) + \frac{tie(x)}{4}) \qquad (1)$$

The condition for a mixed strategy equilibrium on a support of $[b_{low}, b_{high}]$ with b_{low} being the lowest and b_{high} being the highest possible bid within the strategy profile is:

$$E\pi(b_{low}) = E\pi(b_{low} + 0.25) = \cdots = E\pi(b_{high}) \quad (2)$$

Equation (2), in conjunction with the unconditional winning probabilities in Table 1, implies that in equilibrium lower bids within the support occur with higher probability in the LUBA. The equilibrium strategy profile satisfying this condition is shown in Table 2. Specifically, Table 2 shows the probability of each bid in equilibrium under LUBA and HUBA.

Table 2

The Equilibrium Outcomes for the HUBA and LUBA

	Mixed Strategy Nash Equilibrium under Profit Maximization	
Bid	HUBA	LUBA
0	0.009	0.548
0.25	0.304	0.452
0.50	0.371	0
0.75	0.316	0
1	0	0

3.2. The Winning Motive

The winning motive – also known as joy of winning – has been documented in the experimental auction literature (e.g., Ertaç et al. 2011). Raviv and Virag (2009) solved the LUBA game for bidders motivated by what they termed as “probability maximization”. We call bidders who are motivated by the maximization of their probability to win as driven by a “winning motive”. Accordingly, in addition to payoff maximization (the “profit motive”), we consider the possibility that players are driven by the winning motive. The winning motive focuses on the maximization of the winning probabilities and ignores payoff consequences, therefore removing bid x to be equal to zero from the payoff computation in equation (1). As in the calculation of the payoff maximization (“profit motive”) equilibrium, mixed strategy equilibria generally imply that a bidder is indifferent between the bids in the support, so the utility must be the same for any of the bids within the support. That is, $U(x_k)$ must be equal over all bids within the support, where $x_k, k = 1, \dots, 5$ denotes all the available bids, ordered from low to high.

The condition for mixed strategy equilibrium on a support of $[b_{low}, b_{high}]$ then becomes:

$$U(b_{low}) = \alpha\left(w(x_k) + \frac{tie(x_k)}{4}\right) = U(b_{high}) \qquad (3)$$

for all x_k, $k = 1, \dots, 5$

Parameter α in equation (3) simply denotes the joy of winning part of the utility of winning the prize, irrespective of the payoff. We note that with four bidders and the above stated equilibrium characterization, only the top (bottom) two bids can be sustained in the support of the equilibrium in the HUBA (LUBA). This is because the only way the third highest (lowest) bid can win in the HUBA (LUBA) is if there is a complete tie at the bids above (below) it. This, however, can only happen if the three other bids are all the same bid, and in a symmetric equilibrium this happens with too small a probability to have a feasible solution that meets condition (3).

We now return to the winning and tying probabilities in Table 1. These winning and tying probabilities as functions of beliefs have the same functional form for both payoff maximization ("the profit motive") and the winning motive, although the probabilities themselves are different in equilibrium once we impose the equality stated in equation (3). Plugging the functional forms from Table 1 into equation (3) and imposing the restriction that only two bids remain in the support (i.e., for LUBA, $b_1 + b_2 = 1$) we get for LUBA:

$$(1 - b_1)^3 + \frac{1}{4}[b_1^3 + 3b_1(1 - b_1)^2] = b_1^3 + \frac{1}{4}[b_2^3 + 3b_2(b_1^2)] \qquad (4)$$

It is easy to see that the solution to equation (4) is equivalent to $b_1 = b_2$. Imposing the equilibrium condition $p = b$, this results in mixed strategy equilibrium with a probability of ½ for the lowest two bids (0 and 0.25) in the LUBA. Likewise, the same solution concept results in equal probabilities for the highest two bids (0.75 and 1) in the HUBA.

In other words, any bid chosen below 0.75 in the HUBA and above 0.25 in the LUBA indicates a bidding motive other than the winning motive.

3.3. *A Model of Choice*

Recall from section 3.1 and Table 1 that beliefs play a key role in our analysis. Let b denote a 5x1 vector of beliefs by bidder i in period t regarding the likely probabilities of others to choose each bid. The probabilities of winning and tying with each bid, given beliefs about the other three bidders, are then specified as shown in Table 1. We use an equilibrium model, so we impose that $b = p*$, where $p*$ is the vector of equilibrium probabilities, as specified in Table 2. Next, we specify utilities associate with each bid x_k, where $k = 1,\ldots 5$. The three-parameter utility we formulate for bidder i in period t is as follows:

$$U_{it}(x_k) = \left[w(x_k) + \frac{tie(x_k)}{4}\right](\alpha + v - x_k) + \beta U_{it-1}(x_k)d_{it-1k} + \gamma p_{0t-1} \quad (5)$$

The term in the square brackets, $w(x_k) + \frac{tie(x_k)}{4}$, is the probability of receiving the payoff. Thus, the product of that term and $(\alpha + v - x_k)$ is simply the expected payoff in experimental currency for the bid x_k, when $\alpha = 0$ A parameter $\alpha > 0$ implies an added utility from winning, that is, in addition to the actual payoff. The natural interpretation of $\alpha > 0$ is that it is the value in terms of experimental currency that a person ascribes to winning. However, if α was far larger than the prize, one would have to be cautious in ascribing it a monetary value, but one could say that winning is then more important than monetary considerations. The parameter β is the weight on the reinforcement value of the past. The indicator variable d_{it-1k} is equal to 1 when bid k was chosen by bidder i in period $t-1$ and is equal to 0 otherwise. Thus, if a bidder chose bid k in the past and won a prize with that bid, the bid gets reinforced. If a bid was not chosen or did not result in a prize, it does not get reinforced.

Finally, collusion is an ever-present in many auctions formats, and especially in some formats that more readily lend themselves to collusion (see Hu et al., 2011; Sherstyuk et al. 2008). Accordingly, the parameter γ denotes the weight on the coordinated action of a bid of 0. A bid of 0 is the collusive outcome. If everybody chose 0, that would yield the maximum social payoff, albeit not in equilibrium. So in the interest of social payoff maximization, one could choose to bid 0 if others seem to be choosing it as well.

The utilities are then mapped to probabilities via the logistic mapping, so that the probability of observing bid x_k is:

$$\Pr_{it}(x_k) = \frac{\exp(\lambda U_{it}(x_k))}{\sum_{j=1,5}\exp(\lambda U_{it}(x_j))} \quad (6)$$

The parameter λ is the precision parameter. When it is equal to zero, all bids are predicted to be equally likely. When the precision parameter is approaches infinity[3], bidders bid their strict best response with probability 1. This normally implies that empirically, with a large precision parameter, we would not predict a mixed strategy probability (< 1) for an action unless beliefs about the actions of others corresponded precisely to the mixed strategy profile. The likelihood function is then specified by:

$$LL = \prod_i \prod_t \prod_k \ln\ (\text{Pr}_{it}(x_k))\, d_{itk} \qquad (7)$$

4. Design and Procedure

4.1. Experimental Design

The lowest and highest unique bid auctions were conducted in fixed groups of four subjects with partner matching for five consecutive periods. The subjects first played the LUBA for five periods, followed by the HUBA. We reversed the order in a control sessions. The experimental design for both types is reported in Table 3.[4]

Table 3

Experimental Design

	Minimum	Maximum
Group Size (k)	4	4
Rounds (t)	5	5
Bidding Interval	5 price points	5 price points
Prize (v)	1.01 L€	1.01 L€
Winning Bid (b*)	lowest unique bid	highest unique bid
Payoff	v-b*	v-b*

Notes. N=96. The bidding fee was c=0.

The LUBA required the subjects to submit a discrete bid between 0.00 LC (lab currency) and 1.00 LC on a 1.01 LC prize (v). Subjects could choose five possible bids equivalent to 0.00, 0.25, 0.50, 0.75, or 1.00 LC. The subject submitting the lowest unique bid (b*) won the auction. In order to avoid loss aversion only the winning subject had to pay his

[3] A moderately large number, however, will functionally serve the purpose of being close enough to infinity when placed inside the exponential.
[4] The complete instructions are reported in Appendix A.

or her own bid. The payoff was determined by the prize being awarded minus the submitted winning bid (v-b*). The subjects did not have to pay an entry fee (c = 0) and could only submit one single bid in each of the five rounds being played. Feedback was only given after each auction round with information on the group's lowest unique bid or a possible tie and the subject's own payoff. In case of a complete tie the prize was randomly awarded to one of the group members with a probability of 1/k (i.e. ¼). After submission the subjects were asked to state a reason for their bid and additionally conducted a task on risk aversion (Holt and Laury 2002) before answering a post-experimental questionnaire which contained questions on age, gender, course and experimental experience.

The HUBA is almost similar in design with only one different rule: the subject submitting the highest unique bid is selected as the winner and receives 1.01 LC minus his or her own bid.

4.2. Experimental Procedure

Our experiments were computerized with z-Tree (Fischbacher 2007) and conducted at the UT Dallas Laboratory and the Passau University Laboratory between September and November 2014. The seven sessions lasted about 40 minutes and yielded an average payoff of $21.54 including a show-up fee of $5 in Dallas and an average payoff of 8.75 € including a show-up fee of 3.5 € in Passau. Overall, 96 subjects took part in the experiment.[5]

5. Analysis and Results

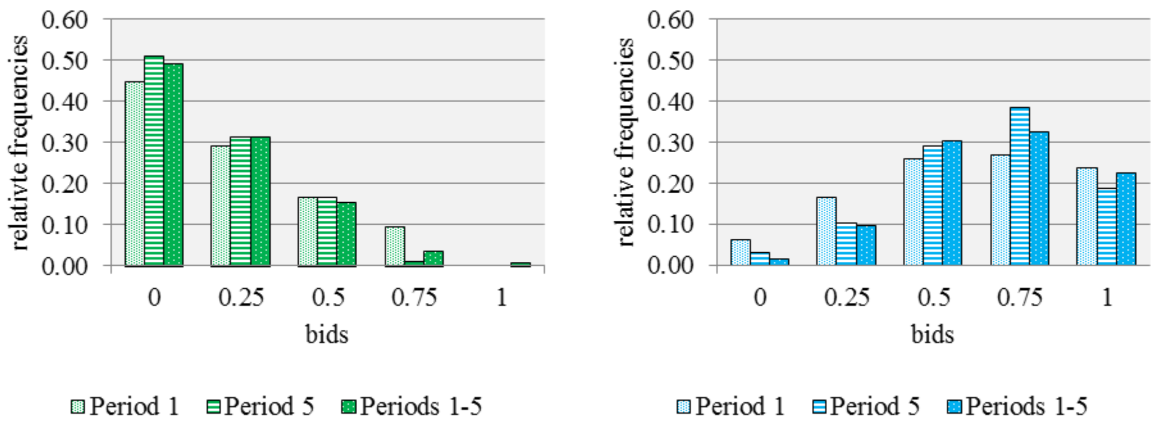
5.1. Descriptive Results

Figure 1 reports the distribution of choices in the LUBA (1a) and HUBA (1b) for the first and last experimental round, as well as aggregated over all five periods.

[5] The results are robust across the two subject pools in either the LUBA or HUBA.

Figure 1

(a) LUBA *(b) HUBA*



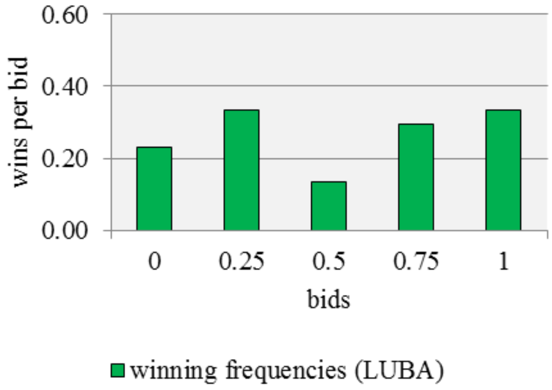
The mean chosen bid in the LUBA was 0.227 with 0.00 being the lowest and 0.75 being the highest submitted bid in round 1. As Figure 1a shows, 44% of round 1 bids were 0, followed by 29% choosing bid 0.25. The mean chosen number in the HUBA was 0.615 with 0.00 being the lowest and 1.00 the highest submitted bid in round 1. Subjects mostly chose bids within a range of 0.50 to 1.00 as illustrated by Figure 1b.

5.2. Results on Bidding Behavior

The actual winning frequencies and profits per bid are aggregated over all five periods and shown in Figure 2a and 3a for the LUBA and Figure 2b and 3b for the HUBA. Based on the theoretical considerations (see section 3), Figure 4 illustrates the theoretical frequencies as compared to the actual bidding frequencies in round 1 and 5 showing the deviation from the suggested mixed strategy equilibrium including payoff consequences for the LUBA (4a) and HUBA (4b).

Figure 2

(a) LUBA



(b) HUBA

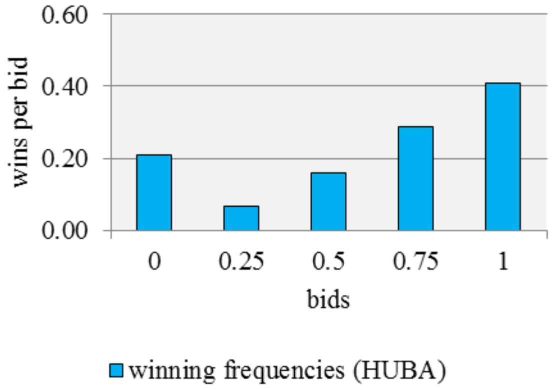
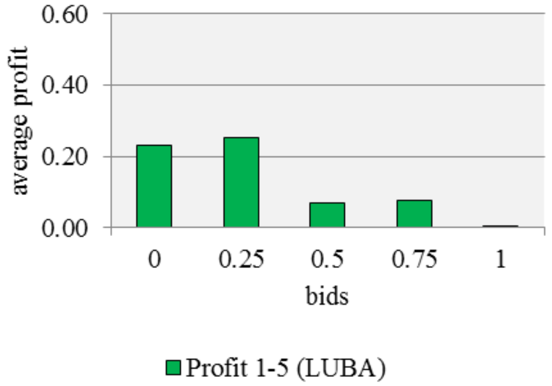


Figure 3

(a) LUBA



(b) HUBA

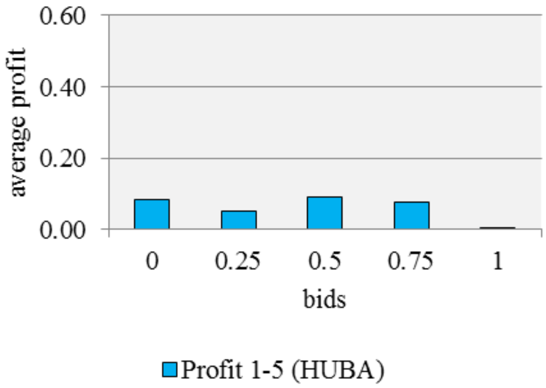
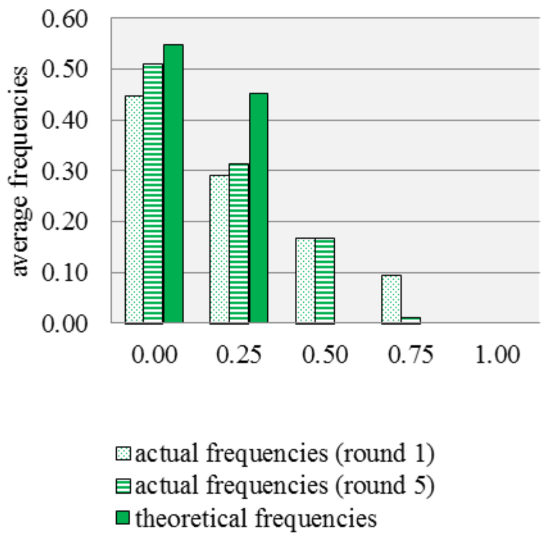


Figure 4

(a) LUBA



(b) HUBA

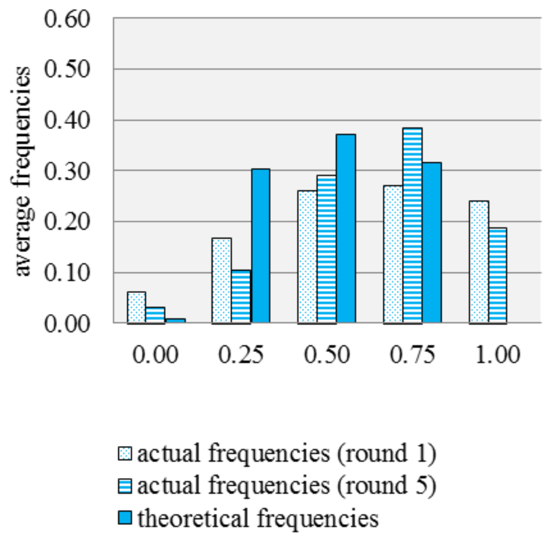


Figure 4a and 4b illustrate the actual relative bid frequencies for period 5 – showing the converged outcome based on the five-period historical incentives. Above we see that the actual bidding frequencies are driven in part by winning probability maximization and in part by expected profit maximization.

To recap some of the theory, since winning and profit motives overlap in LUBA, bidders are expected to play equal proportions of 0 and 0.25 in the auction. Moreover, with positive weight on coordination, we expect higher frequency of 0 than 0.25. In line with these predictions, in LUBA, 51.04% choose a bid of 0 in period 5, 31.25% choose 0.25, 16.67% choose bid 0.50 and only 1.04% choose 0.75. No one chooses a bid of 1 in the LUBA. When looking at the actual bid frequencies in round 5 in the LUBA (see Figure 4a), one can see that the two lowest bids are predominant thus offering support to the equilibrium prediction. The proportion of 0 and 0.25 bids implies that 82.29% of the bidders adhere to either or both winning and profit motives. The smaller frequencies observed for bids 0.5 and 0.75 in the LUBA are partially corresponding to the ranking of their observed past payoffs as shown by Figure 3a. This implies some sensitivity to the payoff ranking and is consistent with the utility mapping of equation 6. Informally, it means that bidding probabilities correspond in ranking to the observed ranking of payoffs.

In the HUBA, the theory we presented predicted that the winning motive would result in some bids of 1, despite 1 being a dominated bid in terms of payoff maximization. In line with this prediction, in HUBA 18.75% of period 5 bids are bids of 1 (see Figure 4b). This means that a minimum of 18.75% of bids could be classified as probability maximizing bids[6], thus offering support to the existence of the winning motive. Given our theoretical predictions, the winning motive implies an equal mix between 1 and 0.75. We could reasonably expect that remaining 37.5% of the bids, which is equivalent to two times the 18.75% choosing 1, would be probability maximizing bids. This implies that 18.75% needs to be subtracted from the 0.75 bar in the histogram of Figure 4b, which is currently at 38.54%, to get to the relative frequency of profit maximizing bids at 0.75, leaving 19.79%. Following this subtraction of the probability maximizing bidders, all our remaining Figure 4b frequencies double to bring back the sum of proportions to 100%. We get 58.34% (29.17% times 2) of the remaining bids to be at a bid of 0.5, 20.84% (10.42% times 2) of the remaining bids at 0.25, and 6.26% (3.13% times 2) at 0. The ranking of proportions corresponds partially to the expected payoff rankings (see Figure 3b) showing that at least some of the bidders best respond to the actual payoffs.

[6] They are dominated by all other possible bids on profit.

Next we detail the regression results for the choice model of equations 5 and 6. Table 4 below gives the parameter estimates and significance levels.

Table 4

Regression Analysis of the Choice Model

Fit Statistics

-2 Log	Likelihood	2608.0
AIC	(smaller is better)	2616.0
AICC	(smaller is better)	2616.1
BIC	(smaller is better)	2635.5

Description	Parameter	Estimate		Pr > |t|
Precision parameter	●	13.420 (1.024)	**	<0.001
Weight on Winning Motive	♋	0.164 (0.010)	**	<0.001
Reinforcement	♌	0.055 (0.017)	**	<0.001
Coordination	♑	0.054 (0.014)	**	<0.001

Note. Robust standard errors in parenthesis.

We see that all parameters are positive and significant, indicating that all four motives – profit maximization, winning, reinforcement, and coordination – are present. The weight on the winning motive is 0.164 (std. error 0.010, $p<0.001$). Looking at equation (5), the interpretation in terms of utility is that winning is worth an additional 0.164 LC on top of the prize itself. That makes the bid of 1 in the HUBA no longer inferior. In fact, if a player possessing this weight on winning in the utility function played against the mix strategy Nash equilibrium under pure payoff maximization, this player would be playing best response by choosing a bid of 1. For comparison, the expected payoff under the mixed Nash equilibrium computed in Table 2 for HUBA is 0.114 LC. The reinforcement parameter of 0.055 (std. error 0.017, $p < 0.001$) implies that utility realized in the past period serves to increase the attraction of that same action in the present period by roughly 5%. Lastly, the coordination parameter of 0.054 (std. error 0.014, $p < 0.001$) is significant, explaining the higher propensity to bid zero in the LUBA treatment.

6. Conclusions

We studied unique bid auctions with five fixed price points and showed how to disentangle winning and profit motives of bidders. Unique bid auctions are an interesting selling mechanism because they add complexity to regular auction rules. What is particularly interesting about these auctions is that whereas a choice driven by the desire to win the auction coincides with a payoff maximizing choice in the lowest unique bid auction (LUBA), those motives actually diverge in the highest unique bid auction (HUBA). We showed that in the LUBA, bidders should predominantly choose bids 0 and 0.25, whether driven by winning or profit motives. In the HUBA, however, the predicted theoretical frequencies are substantially different. Bidders driven by the winning motive would choose bids 1 and 0.75 with equal probability. However, for profit maximizers, the mixed strategy equilibrium prescribes bidders mixing among all bids – except a bid of 1.

The results show that the observed frequencies of bids actually correspond to the different types of auctions and the predicted bidding motives. In HUBA, some bidders are driven by the winning motive, as evident by the observed prominent and persistent choice of a bid of 1, which is a clearly inferior choice from a payoff maximizing standpoint. In LUBA, where winning and profit motives overlap, most of the subjects choose the predicted bids of 0 and 0.25.

Based on the insights gleaned from the present work, there are several natural directions for future research. First, as we come to have a better understanding of behavior in unique bid auctions, we are increasingly equipped to conduct a serious revenue characterization of these formats and comparisons with more traditional auction formats such as first price auctions (e.g., Gallice 2009). Second, a natural extension in future research could introduce designs conducive to an investigation of the reasoning levels and hierarchical thinking of subjects. Such research has been shown particularly useful in unique bid auctions (Gneezy 2005)[7]. Östling et al. (2011) examined a model of hierarchical thinking in LUPI games (discussed in section 2), which are a variation on LUBA. A hierarchical thinking model was shown to fit the data better than an equilibrium model. The current study was not designed to empirically separate out such levels of reasoning and the HUBA in particular shows none of the distributional properties investigated in Östling et al. (2011) or Gneezy (2005). However, given the findings of the present study with extreme points, one could conceivably implement

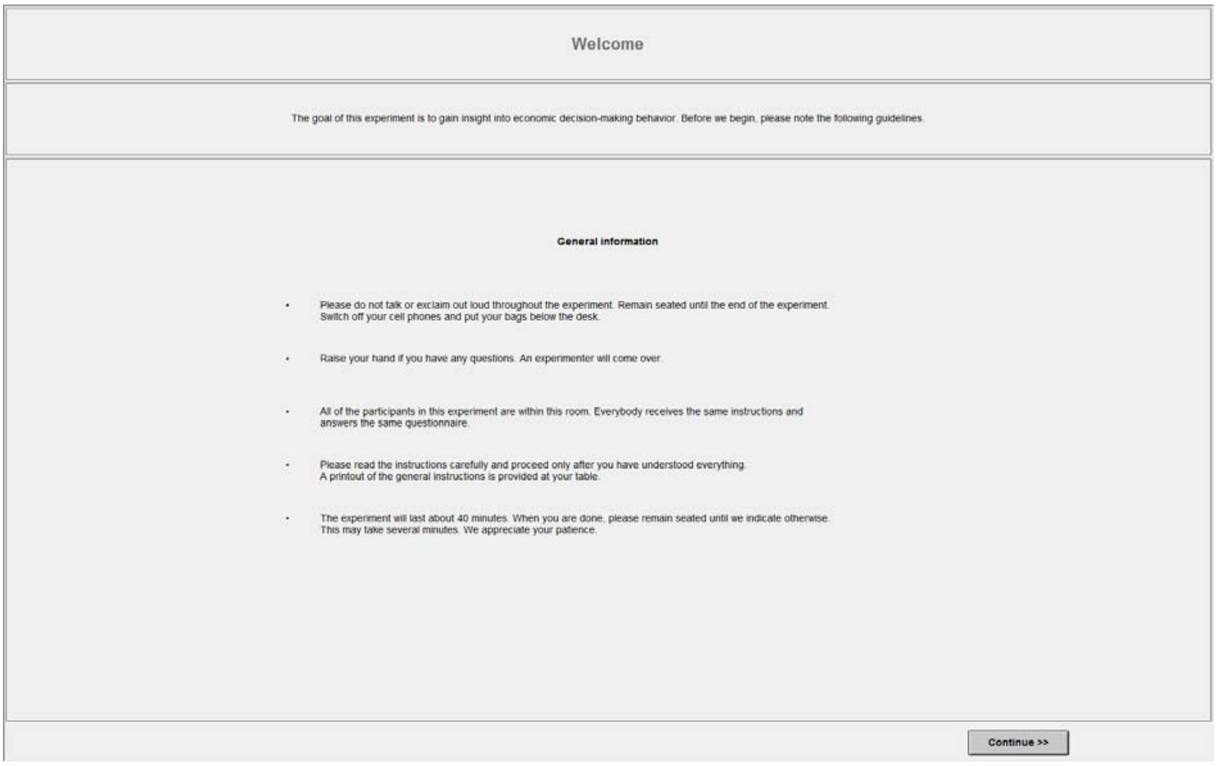
[7] Gneezy (2005) studied two-player reverse first-price auctions, where the bidder with the lowest bid won the amount of his or her bid, and ties received half their bid. While technically this is just a first-price auction, given that there are only two players, it is equivalent to a reverse HUBA as we define it (it is a reverse auction so LUBA and HUBA switch) – and the winning motive and profit motive diverge.

winning rules between highest and lowest unique bids. For example, the unique bid closest to ⅔ of the average wins. Such winning rules would allow for comparisons of models of hierarchical thinking along the lines proposed by Nagel (1995) and Stahl (1996) for the guessing game.

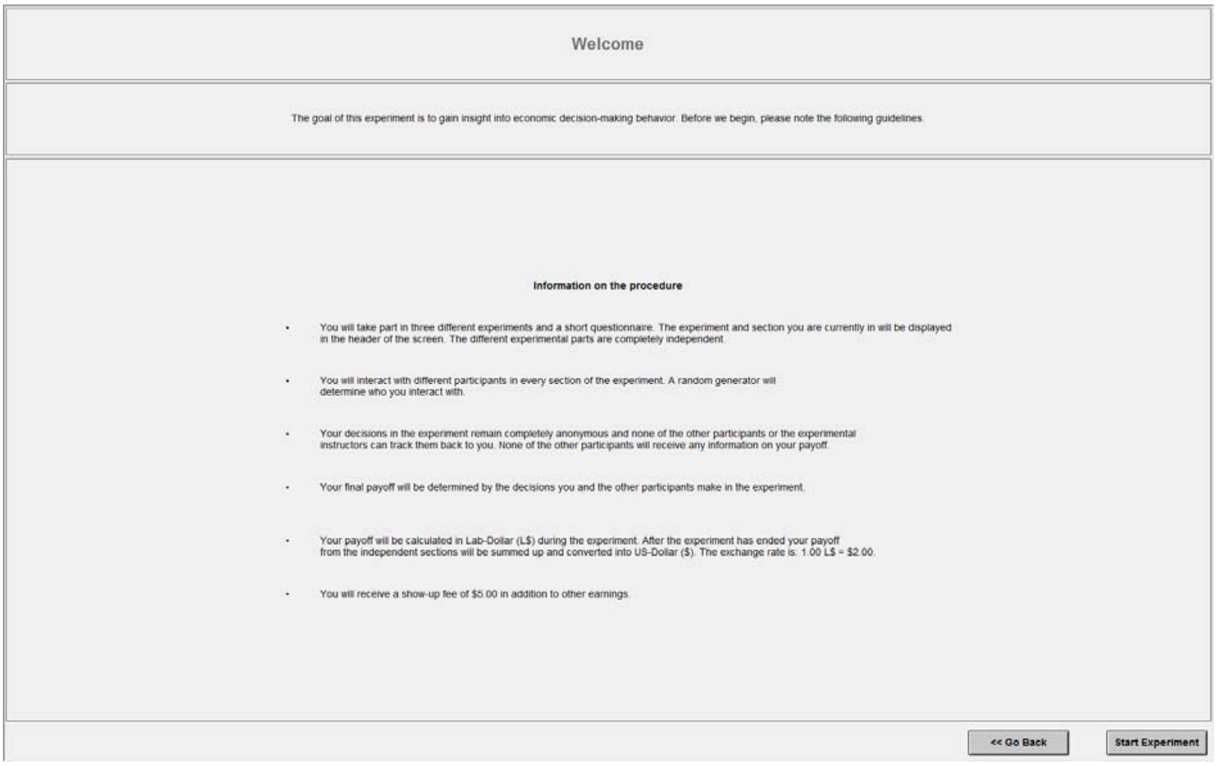
Appendix A: Experimental Instructions

Treatment 1 – HUBA, LUBA

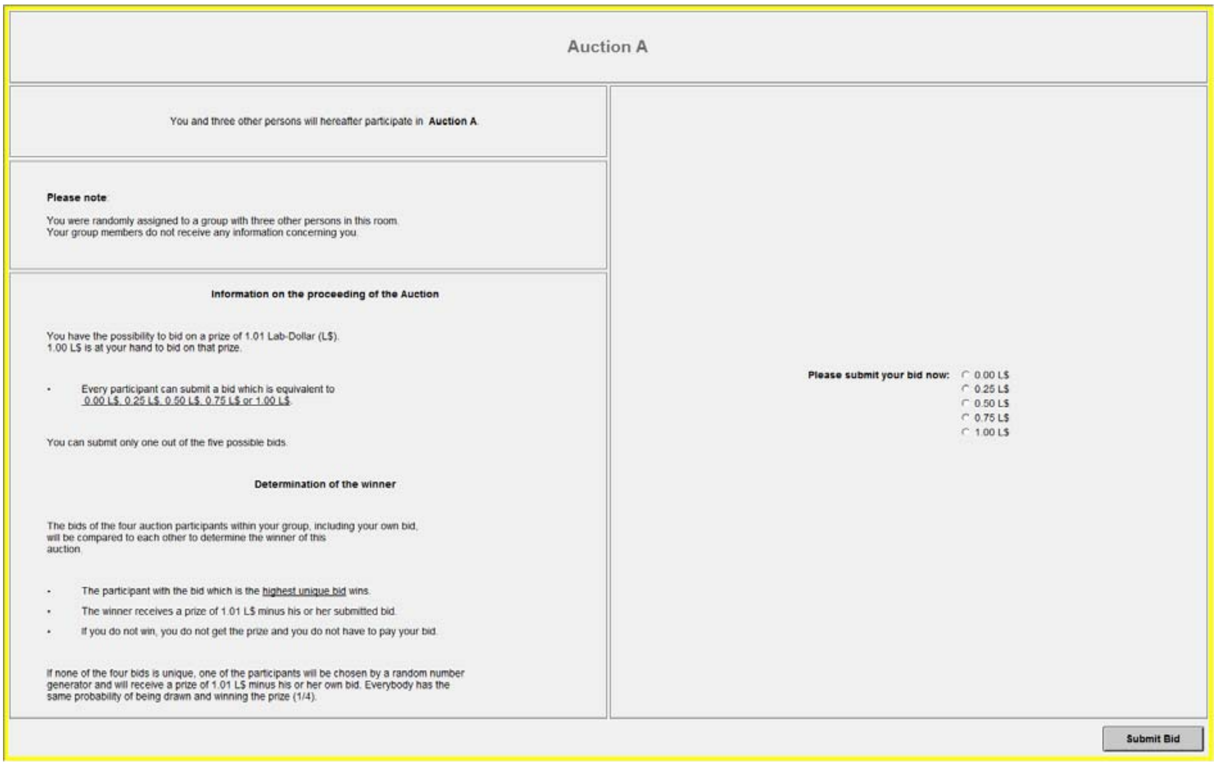
Introduction 1/2



Introduction 2/2

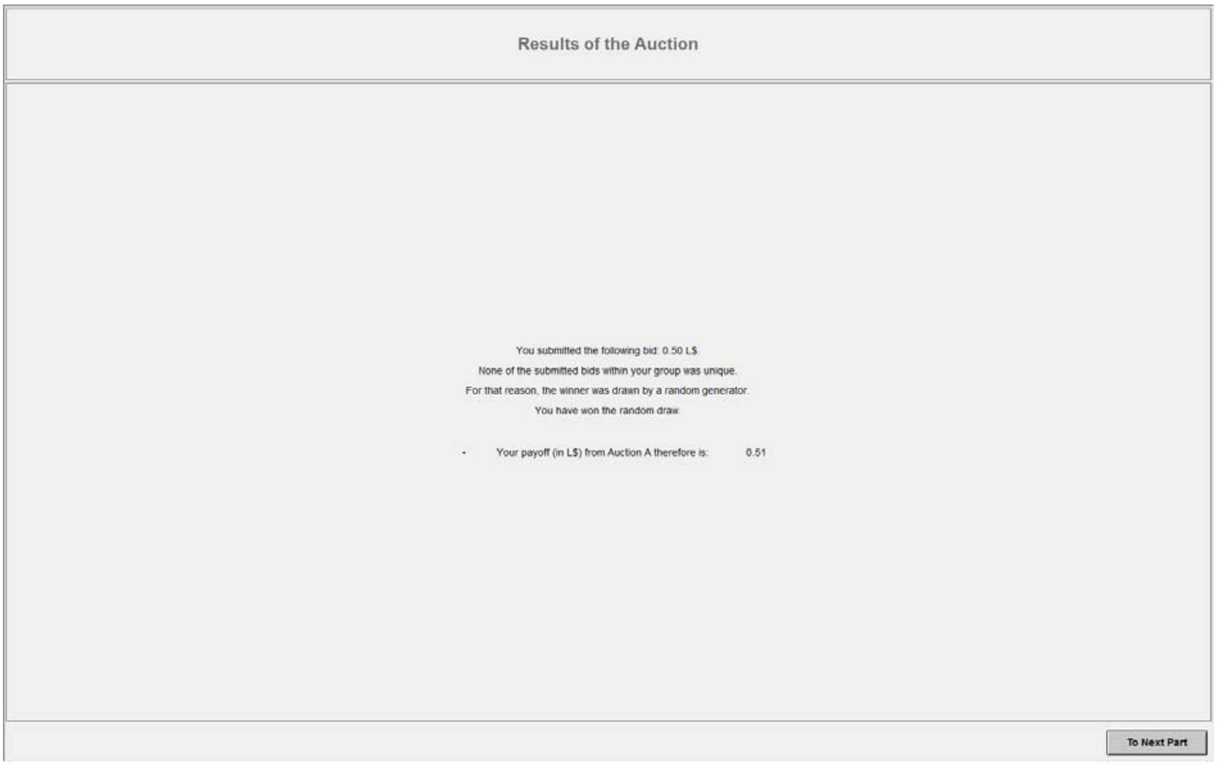


Auction A – Bid

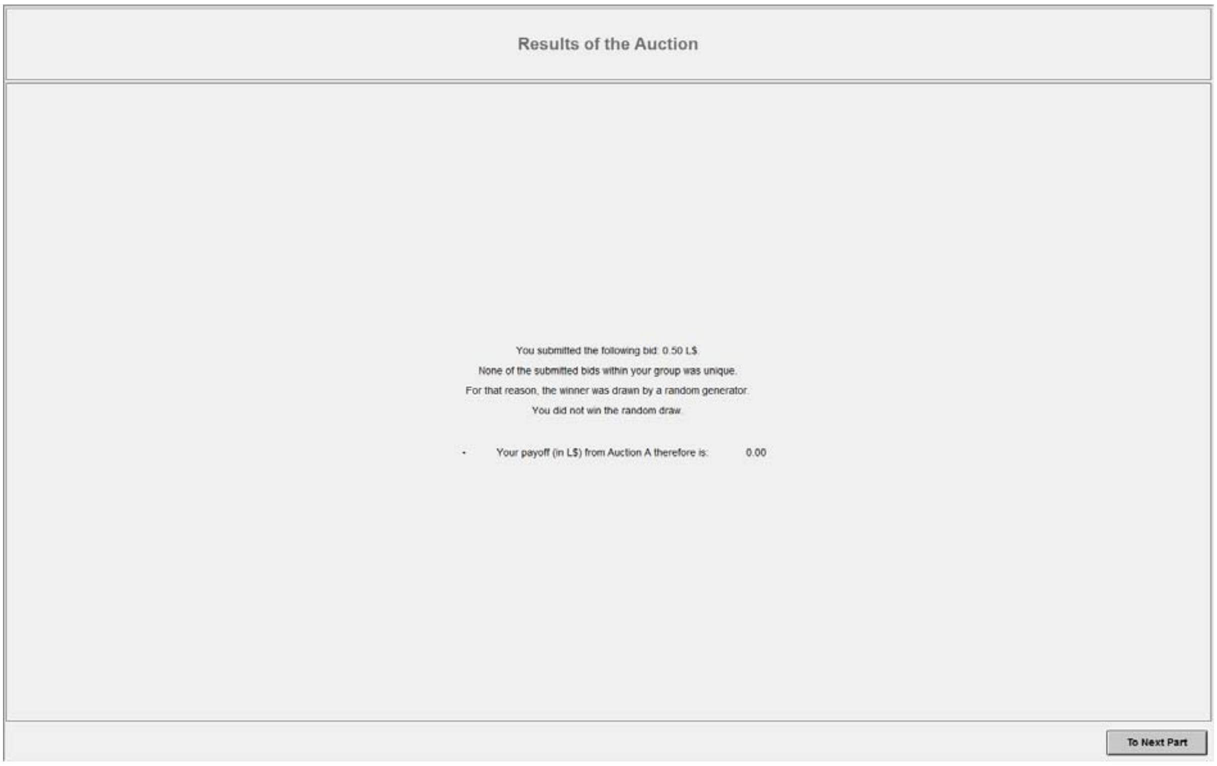


Auction A – Statement

Auction A – Winner of a Tie



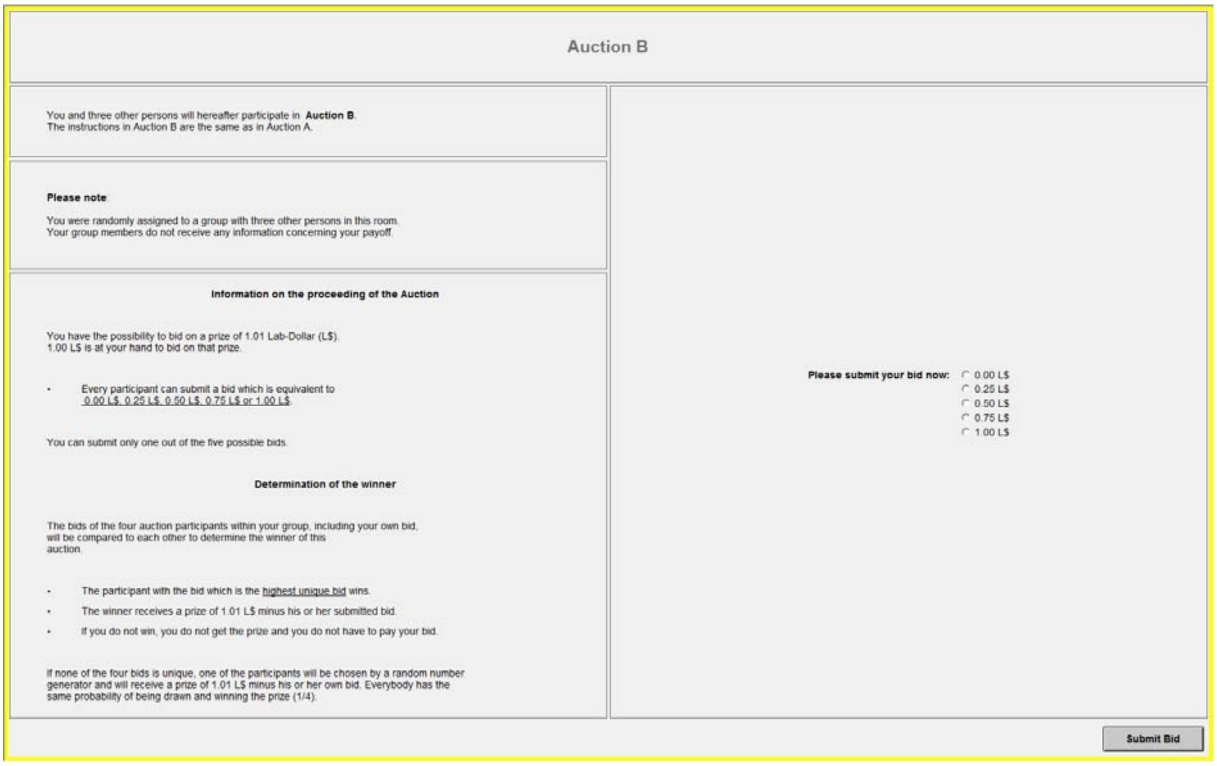
Auction A – Looser of a Tie



Auction A – Results Winner

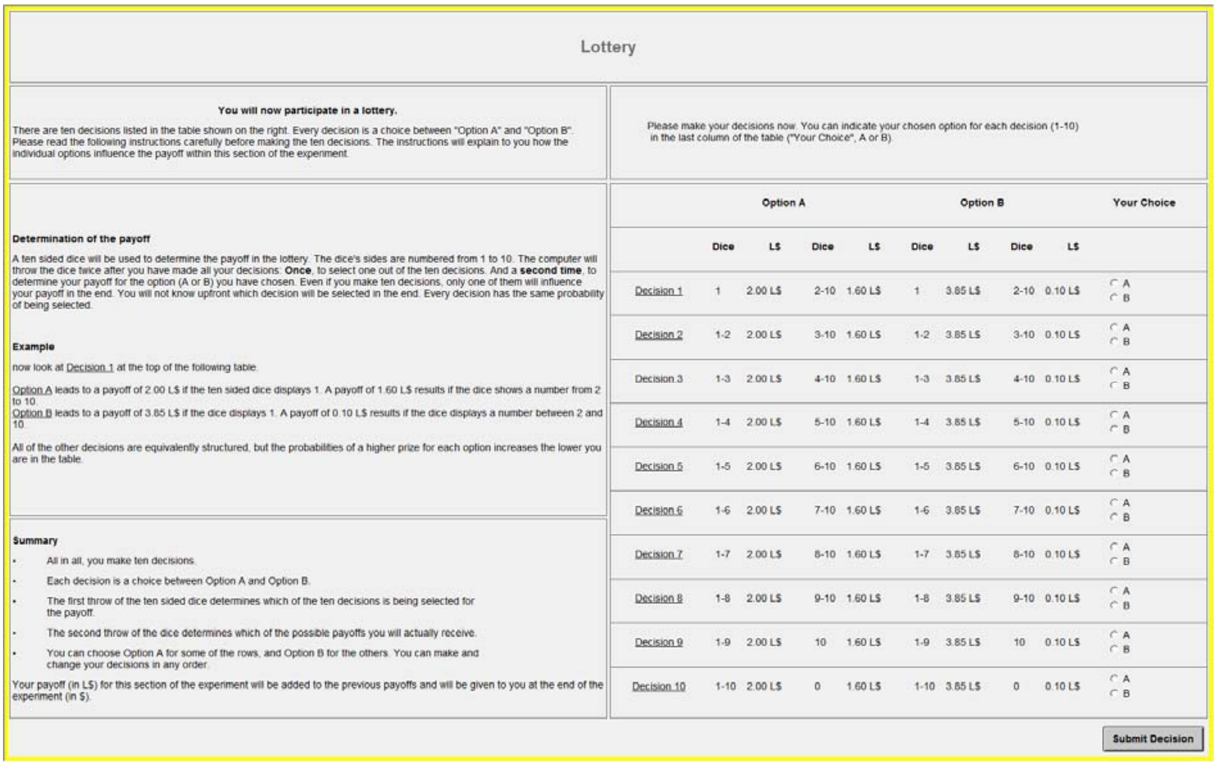
Auction A – Results Looser

Auction B – Bid



Note: Instructions for Auctions B to E are equivalent to Auction A. Auctions F to J differ only concerning the determination of the winner: “The participant with the bid which is the lowest unique bid wins” (LUBA).

Lottery



Lottery

You will now participate in a lottery.

There are ten decisions listed in the table shown on the right. Every decision is a choice between "Option A" and "Option B". Please read the following instructions carefully before making the ten decisions. The instructions will explain to you how the individual options influence the payoff within this section of the experiment.

Determination of the payoff

A ten sided dice will be used to determine the payoff in the lottery. The dice's sides are numbered from 1 to 10. The computer will throw the dice twice after you have made all your decisions: **Once**, to select one out of the ten decisions. And a **second time**, to determine your payoff for the option (A or B) you have chosen. Even if you make ten decisions, only one of them will influence your payoff in the end. You will not know upfront which decision will be selected in the end. Every decision has the same probability of being selected.

Example

now look at Decision 1 at the top of the following table.

Option A leads to a payoff of 2.00 L$ if the ten sided dice displays 1. A payoff of 1.60 L$ results if the dice shows a number from 2 to 10.
Option B leads to a payoff of 3.85 L$ if the dice displays 1. A payoff of 0.10 L$ results if the dice displays a number between 2 and 10.

All of the other decisions are equivalently structured, but the probabilities of a higher prize for each option increases the lower you are in the table.

Summary

- All in all, you make ten decisions.
- Each decision is a choice between Option A and Option B.
- The first throw of the ten sided dice determines which of the ten decisions is being selected for the payoff.
- The second throw of the dice determines which of the possible payoffs you will actually receive.
- You can choose Option A for some of the rows, and Option B for the others. You can make and change your decisions in any order.

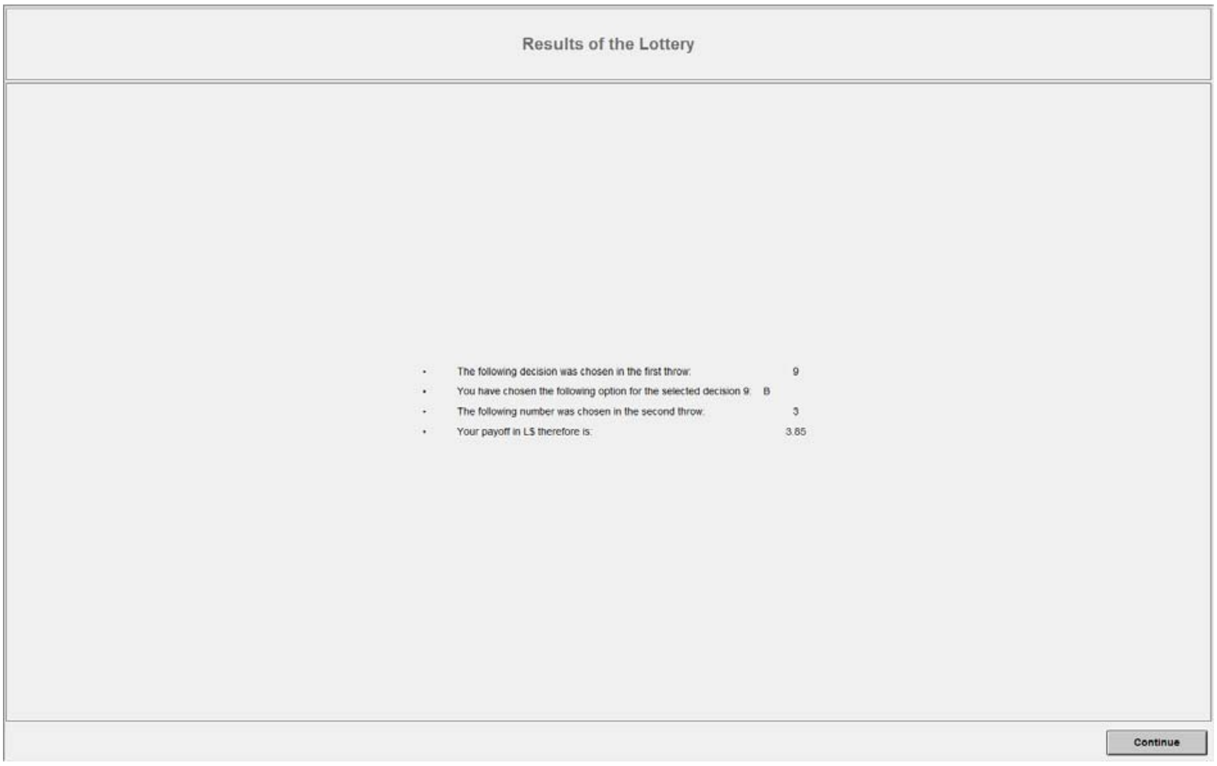
Your payoff (in L$) for this section of the experiment will be added to the previous payoffs and will be given to you at the end of the experiment (in $).

Please make your decisions now. You can indicate your chosen option for each decision (1-10) in the last column of the table ("Your Choice", A or B).

	Option A				Option B				Your Choice
	Dice	L$	Dice	L$	Dice	L$	Dice	L$	
Decision 1	1	2.00 L$	2-10	1.60 L$	1	3.85 L$	2-10	0.10 L$	A / B
Decision 2	1-2	2.00 L$	3-10	1.60 L$	1-2	3.85 L$	3-10	0.10 L$	A / B
Decision 3	1-3	2.00 L$	4-10	1.60 L$	1-3	3.85 L$	4-10	0.10 L$	A / B
Decision 4	1-4	2.00 L$	5-10	1.60 L$	1-4	3.85 L$	5-10	0.10 L$	A / B
Decision 5	1-5	2.00 L$	6-10	1.60 L$	1-5	3.85 L$	6-10	0.10 L$	A / B
Decision 6	1-6	2.00 L$	7-10	1.60 L$	1-6	3.85 L$	7-10	0.10 L$	A / B
Decision 7	1-7	2.00 L$	8-10	1.60 L$	1-7	3.85 L$	8-10	0.10 L$	A / B
Decision 8	1-8	2.00 L$	9-10	1.60 L$	1-8	3.85 L$	9-10	0.10 L$	A / B
Decision 9	1-9	2.00 L$	10	1.60 L$	1-9	3.85 L$	10	0.10 L$	A / B
Decision 10	1-10	2.00 L$	0	1.60 L$	1-10	3.85 L$	0	0.10 L$	A / B

Submit Decision

Lottery – Results



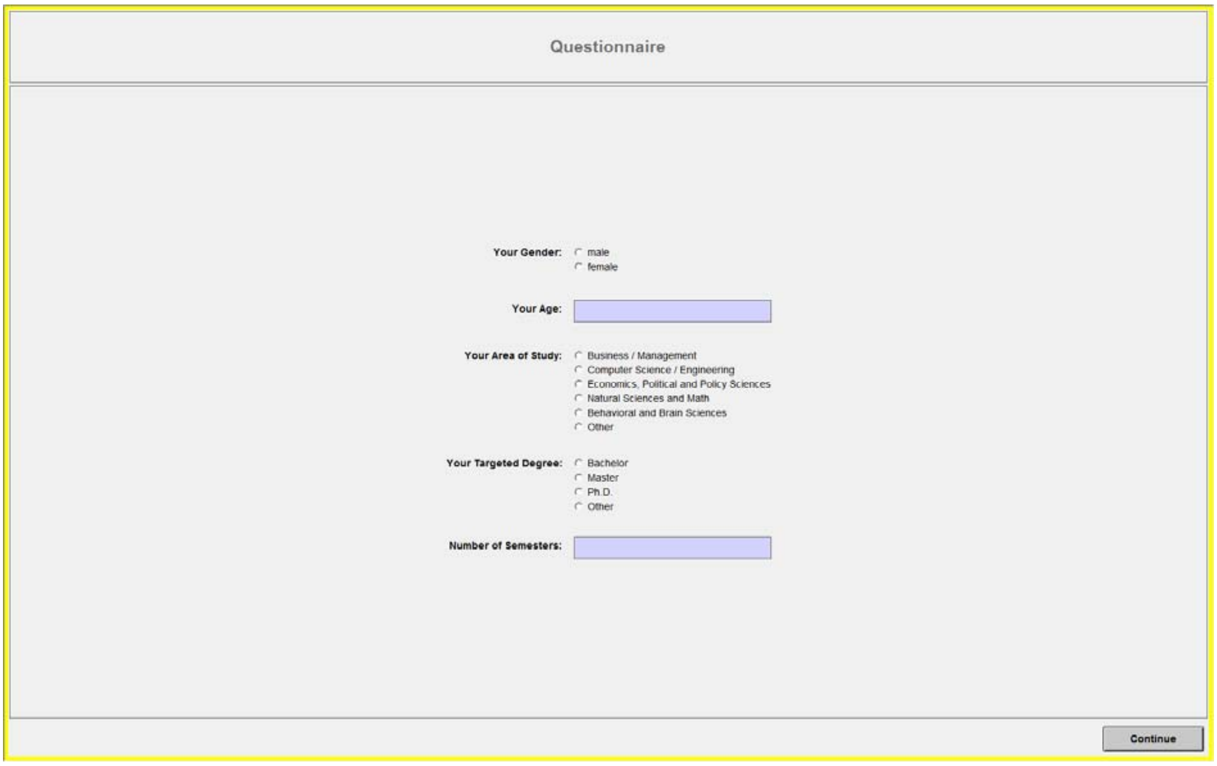
Results of the Lottery

- The following decision was chosen in the first throw: 9
- You have chosen the following option for the selected decision 9: B
- The following number was chosen in the second throw: 3
- Your payoff in L$ therefore is: 3.85

Continue

Total Results

Questionnaire



Treatment 2 – LUBA, HUBA

Note: We reversed the order of auctions in treatment 2. The participants first played the LUBA (Auction A to E), followed by the HUBA (Auction F to J). The instructions are equivalent to treatment 1.

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