CHARITY AUCTIONS IN THE EXPERIMENTAL LAB

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ABSTRACT

To transform donations "in kind" into cash, charities of all sizes use auctions and raffles. Despite this, neither the theory nor the practice of efficient fund-raising – and, in particular, charity auctions – has received sufficient attention from economists, especially the fact that participation in fund-raisers is endogenous. We describe, in detail, the design and implementation of an experiment to examine 15 charity auction mechanisms. While some of the mechanisms have already received attention from both theorists and empiricists, ours is the first comprehensive examination of all existing mechanisms and the first to explore the potential of a few new formats. Our analysis focuses on participation differences among the formats and how theory and supplemental survey data can help explain some of these differences.

1. INTRODUCTION

Nonprofit organizations employ more than 15% of all service sector workers in the United States (Benz, 2005) and depend on charitable

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donations to provide more than 20% of all cash revenue (Andreoni, 2004). AU :1 In 2004, these revenues amounted to $250 billion (Giving-USA, 2005) or a AU :2 little more than 2% of GDP. Both the size of the nonprofit sector and its reliance on donations are more pronounced than in other industrialized economies. In much of Western Europe, for example, the size of the nonprofit sector and their reliance on donations are much closer to 10% (Benz, 2005; Andreoni, 2004). In more concrete terms, American cultural, educational, and religious institutions count on private philanthropic support more than their counterparts elsewhere. However, this support does not come cheap. In 2001, for example, 200 major charities spent almost $2.5 billion on their efforts to raise funds. Despite this, neither the theory nor the practice of efficient fund-raising has received as much attention from economists as they should.

Charities frequently use fund-raisers to transform ''in-kind'' donations into cash. The scale of these fund-raisers ranges from local church raffles that produce a few hundred dollars to the annual Napa Valley Wine Auction, which raises almost $10 million (Engers & McManus, 2006) or the Robin Hood Foundation auction that raised $71 million on one night in 2007. A brief examination of eBay's special site for charity auctions, Giving Works that by itself has raised more than $80 million since 2000, reveals wide variation in both the items sold and the nearly 7,000 nonprofits who benefit from their sale. There is much less variation, however, in the mechanisms charities use to auction these items. The familiar oral ascending or English, silent and first-price sealed-bid auctions dominate the landscape.

The motivation for the analysis we present here is very specific: the reliance of the current literature on ''fixed N'' analyses of charity auctions. With one exception (Carpenter, Holmes, & Matthews, 2007) in the small theoretical literature and another in the empirical literature (Carpenter, Holmes, & Matthews, 2008), existing studies of charity auctions focus entirely on situations in which all bidders participate. This is obviously problematic when one realizes that both bidding behavior and the number of bidders are likely to affect auction revenues. Furthermore, to the extent that sellers may desire greater participation for other reasons (e.g., better advertising for the businesses that donate in-kind goods, greater prestige for the bidders who desire public recognition, and more publicity for the charitable works of the organization), a better understanding of mechanism-specific entry preferences is also important.

The potential significance of endogenous entry is highlighted in the left panel of Fig. 1, which illustrates the relationship between participation rates and revenues raised in our field study of 80 auctions conducted 20 at a time

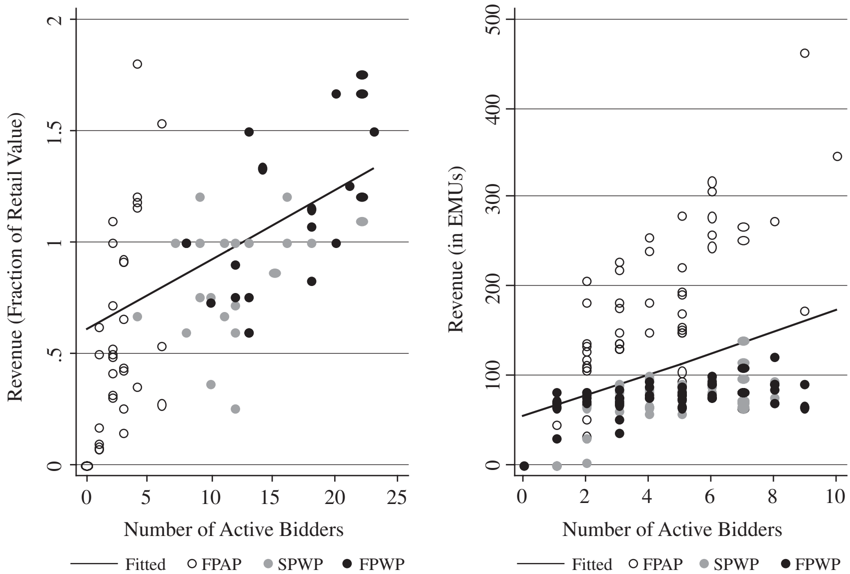

Fig. 1. Revenue versus the Number of Active Bidders in the Field and in the Lab by Mechanism (FPAP is First-Price All-Pay, SPWP is Second-Price Winner-Pay, and FPWP is First-Price Winner-Pay).

at four local preschools (Carpenter et al., 2008). As the figure clearly shows, there are both quantifiable differences in entry across mechanisms and a strong positive relationship between participation and revenue: Each additional bidder is associated with a 4.4% increase in the fraction of an item's retail value raised in the auction. The first-price sealed-bid auction had both higher participation rates and higher revenue than either second-price sealed-bid or all-pay auctions. Especially conspicuous is the low participation in the all-pay format and the resulting large variance in revenue. Because revenue in the field seemed to depend as much on participation as on bidding behavior, we decided to focus our attention on mechanism-specific entry decisions in a new experimental design.

The present chapter describes a large set of laboratory experiments that examine the participation rates and revenue generating properties of three broad categories of fund-raising mechanisms. The first set are those that have received some attention in the empirical literature, in particular, raffles, first-price sealed-bid winner-pay and first-price sealed-bid all-pay auctions. The second set are motivated by the growing theoretical literature on auctions but have received little or no attention in the lab or field, for example, second-price sealed-bid winner-pay, *k*th price sealed-bid all-pay, English, Dutch, and silent auctions. The final set are new mechanisms developed as a result of our experience conducting charity auctions in the field. We find that participation differences exist between mechanisms and that these differences persist even when we control for one's private value and a proxy for cognitive ability. We then use a bit of existing theory and our extensive survey data to better understand why some mechanisms are more popular than others.

We begin, in Section 2, by reviewing the literature on charity auctions and endogenous entry. In Section 3, we describe each of the 15 mechanisms under investigation. In Section 4, we describe the details of our experimental design. In Section 5, we discuss summary statistics describing our participants from the post-experiment survey and test for randomization into treatment in Section 6. In Sections 7 and 8, we analyze the participation choices of the potential bidders and in Section 9 offer a few final thoughts. Three sets of instructions and the full survey appear in the Appendixes A and B.

2. PREVIOUS WORK ON CHARITY AUCTIONS

The theoretical literature on auctions is extensive (see Klemperer, 2004, for an overview) and numerous experimental studies have tested the theoretical predictions either in the lab (e.g., Isaac, Salmon, & Zillante, 2005; Kagel, 1995) or in the field (e.g., Hossain & Morgan, 2003; Isaac, Salmon, & Zillante, 2007; List & Lucking-Reiley, 2000, 2002; Lange, Price, & List, 2004; Lucking-Reiley, 1999). The literature on charitable fund-raising is also well developed (e.g., Andreoni, 1989, 1998; List & Lucking-Reiley, 2002). The intersection of these two literatures, charity auctions, has only recently gained significant attention by economists (e.g., Carpenter et al., 2008; Carpenter, Holmes, & Matthews, 2009; Davis, Razzolini, Reilly, & Wilson, 2006; Engers & McManus, 2006; Goeree, Maasland, Onderstal, & Turner, 2005; Schram & Onderstal, 2009). The distinction between charity and noncharity auctions is an important one because the externality that all participants can expect to receive from the winning bid in a charity auction substantially alters standard predictions about optimal bids and expected revenues.

The first puzzle we examine is the disjunction between what is observed in the field where lotteries and winner-pay auctions dominate and recent theoretical models of charity auctions which predict that these mechanisms should be ‘‘revenue dominated’’ by others; more specifically, Engers and McManus (2006) and Goeree et al. (2005) predict that charities would do better with all-pay auctions, in which all bidders forfeit their bids, than any of the winner-pay mechanisms now in use. The basic intuition for this result is not difficult. To paraphrase Goeree et al. (2005), if all bidders derive some benefit from the revenues that accrue to the nonprofit, winner-pay formats compel bidders to sacrifice positive externalities when they outbid their competitors, and this results in lower revenues.

Davis et al. (2006) find support for this prediction in the lab. Specifically, they find that lotteries – which could be viewed as inefficient all-pay auctions in the sense that all ‘‘bidders’’ forfeit their bids but the bidder who has purchased the most tickets is only the most likely, rather than the certain, winner – generate more revenues than ascending auctions. Furthermore, Davis et al. (2006) show that this outcome is robust with respect to the distribution of bidder values, the attachment of bidders to the charity, and repeated play. Morgan (2000) and Morgan and Sefton (2000) also focus on lotteries as fund-raising mechanisms and find (both theoretically and experimentally) that when raffle proceeds are used to fund charitable organizations, the revenues raised are higher than with fund-raising through voluntary contributions; here, the chance of winning the raffled item alleviates the free-rider problem commonly associated with the standard voluntary contributions mechanism.

Schram and Onderstal’s (2009) experiment, in which altruistic private values are induced in the lab, provides even more direct evidence: The all-pay mechanism was observed to revenue dominate the lottery that in turn revenue dominated the first-price sealed-bid mechanism. In Orzen (2008), which Schram and Onderstal (2009) cite, lotteries and two variations of the all-pay are compared, but, in this experiment, values were common, not private. Lastly, Isaac and Schneir (2005) use both the lab and the field to testbed features of the silent charity auction; in particular, they focus on the impact of minimum bid increments on efficiency, revenue, and the presence of jump-bidding.

The vast majority of work in auction theory has assumed a fixed number of bidders. A subset of studies (both theoretical and empirical) has attempted to endogenize the entry decision (e.g., Bajari & Hortacsu, 2003; Chakraborty & Kosmopoulou, 2001; Samuelson, 1985; Engelbrecht-Wiggans, 1993; McAfee & McMillan, 1987; Levin & Smith, 1994; Menezes & Monteiro, 2000; Palfrey & Pevnitskaya, 2008; Pevnitskaya, 2004; Reiley, 2004; Smith & Levin, 1996, 2001) with the primary points of departure being the amount and timing of information and the risk tolerance of the participant pool.

Although these studies have provided a firm scaffolding on which to model endogenous entry, the majority of this research has focused on social welfare, efficiency, and the optimality of entry fees and reserve prices rather than the impact of mechanism choice on bidder participation. However, there are a few exceptions. In a theoretical piece, Smith and Levin (1996) show that when entry is treated endogenously and bidders exhibit decreasing absolute risk aversion, the second-price auction may generate more revenue than the first-price auction. Work by Pevnitskaya (2004) and Palfrey and Pevnitskaya (2008) suggests that bidding will be less aggressive with endogenous entry because only risk-tolerant bidders will self-select into the auction. Ivanova-Stenzel and Sonsino (2004) conduct an experiment in which subjects are allowed to choose between a standard first-price sealed-bid auction and a modified two-bid auction in which the subjects submit a high bid and a low bid such that the winner pays her low bid if it was higher than all other bids; they find strong subject preferences for the two-bid format. Lastly, in a series of studies, Ivanova-Stenzel and Salmon (2004, 2008a, 2008b, 2009) examine bidder preferences for sealed-bid and ascending auctions and show that subjects strongly prefer the ascending format. Furthermore, these preferences cannot be explained by loss aversion or ''clock aversion'' (i.e., impatience or distaste for the dynamic nature of the ascending mechanism), but more likely result from risk aversion (Ivanova-Stenzel & Salmon, 2008b) or differences in bidder value; high value bidders prefer ascending auctions while low value bidders seek out first-price sealed-bid auctions (Ivanova-Stenzel & Salmon, 2009). The authors find that while participation is higher in the ascending format than the first-price sealed-bid framework, revenue raised and efficiency are statistically indistinguishable across mechanisms, although bidder surplus is slightly higher in the ascending framework (Ivanova-Stenzel & Salmon, 2008a; Ivanova-Stenzel & Salmon, 2009). Notable however is that none of the above-mentioned studies explore endogenous entry in the charity auction setting.

As mentioned above, the potential effects of endogenous entry on mechanism design in charity auctions are highlighted in Carpenter et al. (2008), the first field study to test the proposition that the all-pay auction revenue dominates other winner-pay formats. In 80 auctions conducted 20 at a time at four local preschools, we found that first-price sealed-bid auctions raised more revenue and were more efficient than either second-price sealed-bid or all-pay auctions. The unusual circumstances and design features of the experiment, which allowed us to collect data from active and inactive bidders, lead to a tentative explanation for the differences in outcomes in the lab and field: *participation in charity auctions is endogenous* *and mechanism-specific*. In particular, the ratio of active to potential bidders was much smaller in the all-pay auctions, and this was sufficient to drive revenues below the revenues produced in the first-price sealed-bid auctions. In a companion paper (Carpenter et al., 2007), we construct a hybrid model, based on Engers and McManus (2006) and the work of Menezes and Monteiro (2000), of endogenous participation that provides a theoretical framework for our field results.

While our field work highlighted endogenous participation as an important component of mechanism design, we were unable to fully explain the reason(s) for the differences in field participation. There are at least two explanations for participation differentials, each with its own implications for charities or, for that matter, mechanism design. The first is that some formats are less familiar or harder to "solve" than others. In our experience, for example, even professional microeconomists find it difficult to derive optimal all-pay bids on the spur of the moment if they are unfamiliar with auction theory. If this is the reason for the differential, however, charities that switch from winner-pay to all-pay mechanisms could eventually extract more revenue, as bidders become more comfortable. Our panel design in both the lab and the field allows us to explore this possibility.

The second explanation is that the participation differential is a consequence of bidder preferences or norms. The potential bidder in our field experiment who told us that he resented the "forced contribution" under the rules of the all-pay – an objection that did not extend to the raffle that the preschool itself held on the same day – seemed to be motivated by a context-specific and perhaps idiosyncratic norm: He seemed to feel that the raffle, in which everyone has a chance to win, was more fair. A bidder with loss averse preferences, on the contrary, will be more wary of bid forfeiture in the all-pay for another reason. In these cases, however, the participation and consequent revenue differentials will be more persistent, because the problem is not familiarity. Our exit surveys help us to explore these potential explanations.

3. AUCTION MECHANISMS

We extend the current empirical literature in several directions, each of which we describe in more detail below. First, whereas previous studies have been limited to small (and often different) sets of mechanisms – so that some comparisons are indirect, and assume that results are transitive across experiments – we consider the broadest possible set of 15 formats, one that includes almost all of those tested in the past and some that have never been tested in the lab. Second, and as a consequence of what we have learned in the field, our choice of design is intended to introduce endogenous participation in the lab. As a result, we will be able to provide a richer characterization of sample selection than we did in Carpenter et al. (2008).

In each treatment, all bidders, whether they subsequently decide to participate or not, received a private value v_i, determined as the realization of a random variable with uniform distribution over the interval [0,100]. The other common feature is that each bidder received a benefit β for each experimental monetary unit (EMU) she contributes to the "charity," and a benefit $\alpha \leq \beta$ for each EMU that another bidder contributes where, following Engers and McManus (2003), the difference $\gamma = \beta - \alpha$ is "warm glow." Our implementation employed $\alpha = 0.10$ and $\gamma = 0.05$. To streamline the descriptions of each mechanism, suppose that there are $M < N$ active bidders and that their bids are ordered $b_1 < b_2 < \ldots < b_M$, where it is at least possible that some b_i are zero. The values of these bids may differ across formats.

The first three mechanisms that we examine are those that have received the most attention in the literature:

- First-price sealed-bid winner-pay: Each active bidder submits a sealed bid. The prize is awarded to bidder M, who pays the value of her bid b_M, for a pay-off of $v_M - (1-\gamma)b_M + \alpha b_M$. No other active bidder pays anything, so that the pay-offs for all other bidders, active and nonactive, is αb_M Auction revenues are b_M.
- First-price sealed-bid all-pay: Each active bidder submits a sealed bid. The prize is awarded to bidder M, who pays the value of her bid b_M, but all other active bidders must pay the values of their own bids, too. Bidder M's pay-off is therefore $v_M - (1-\gamma)b_M + \alpha\sum_{j=1}^{M} b_j$. Each of the other active bidders receives $-b_i + \alpha\sum_{j=1}^{M} b_j$, and each nonactive bidder receives $\alpha\sum_{j=1}^{M} b_j$. Revenues are $\sum_{j=1}^{M} b_j$.
- Raffle: Each active bidder spends b_i on "tickets" that cost r each, and one ticket is drawn at random to determine the winner. If the winner is bidder k, where k and M need not be the same, she receives $v_k - (1-\gamma)b_k + \alpha\sum_{j=1}^{M} b_j$. Each of the other active bidders $i \neq k$ receives $-b_i + \alpha\sum_{j=1}^{M} b_j$, and each of the nonactive bidders receives $\alpha\sum_{j=1}^{M} b_j$. Revenues are $\sum_{j=1}^{M} b_j$.
- The next four have appeared in the theoretical literature but have been tested less often. Some have never been tested in the charity context:
- Second-price sealed-bid winner-pay: Each active bidder submits a sealed bid. The prize is awarded to bidder M but she pays only b_{M-1}, the value

of the second highest bid. Bidder *M*'s pay-off is therefore $v_M - b_{M-1} + (\alpha + \gamma)b_{M-1}$. All other bidders, active and nonactive, receive αb_{M-1} Revenues are b_{M-1}.

- First-price ascending oral (English button): A computer screen "clock" starts at some very low value and becomes the bid of the first active bidder to "claim" it. The clock then ticks upward a small amount (0.10), and the new value can be claimed by some (other) bidder. If no one claims a value within some preannounced interval, the prize is awarded to the bidder who claimed the previous value, b_M. The winner's pay-off is $v_M - (1-\gamma)b_M + \alpha b_M$. All other bidders, active and nonactive, receive αb_M. Revenues are b_M.
- All-pay button: This mechanism proceeds just as the English "button" auction except that all bidders pay their bids. The winner's pay-off is $v_M - (1-\gamma)b_M + \alpha\sum_{j=1}^{M} b_j$. All other active bidders receive $-b_i + \alpha\sum_{j=1}^{M} b_j$, nonactive bidders receive $\alpha\sum_{j=1}^{M} b_j$, and revenues are $\sum_{j=1}^{M} b_j$.
- Oral descending (Dutch): A computer screen "clock" starts at some very high bid value and ticks downward. The first bidder to stop the clock wins the auction and pays the listed price, b_M, for a pay-off of $v_M - (1-\gamma)b_M + \alpha b_M$. All other bidders, active and nonactive, receive αb_M. Revenues are b_M.
- Silent auction(s): Bidders submit increasing bids until a predetermined ending point and each active bidder sees the entire bid history evolve in real time. The winner is the bidder who has submitted the highest bid b_M, and she receives $v_M - (1-\gamma)b_M + \alpha b_M$. All other bidders, active and nonactive, receive αb_M. Revenues are b_M. There are also two variants of the basic silent format. In the first, the "no-sniping" variation, the auction ends 30 seconds after the last bid. In the second, the bidders are given heterogeneous times to be active in the auction. Elsewhere (Carpenter et al., 2009), we examine whether this is an explanation of "jump" bidding.

The next, which to our knowledge has never been tested in either the charity or the noncharity context, finds its inspiration in the work of Goeree et al. (2005) on "*k*th price all-pay" charity auctions that should, in theory, do even better than the *k*–1st price all-pay:

- Last-price sealed-bid all-pay: Each bidder submits a sealed bid. The prize is awarded to bidder *M*, who pays the value of the *lowest* bid submitted b_1, *as do all of the other active bidders*. Bidder *M*'s pay-off is $v_M - (1-\gamma)b_1 + \alpha M b_1$. Each of the other active bidders receives $-b_1 + \alpha M b_1$, and each of the nonactive bidders receives $\alpha M b_1$. Revenues are $M b_1$.

To maximize the benefits of our research to nonprofits, however, it will be important to see whether what we have learned in either the field or the lab can be used to develop new, perhaps hybrid, mechanisms that perform even better than these. Based on our initial experience in the field and standard results in behavioral economics, the final two mechanisms are as follows:

- First-price/lottery hybrid: To become active bidders, participants must first submit an entry fee r, but those who do so are simultaneously entered in an "s–lottery." The winner of the lottery receives srM, for some preannounced s between 0 and 1, and the charity receives $(1-s)rM$. If $s = 1/2$, as in our implementation, this is the familiar "50–50 lottery." At the same time, active bidders submit bids under the rules of the first-price sealed-bid mechanism. If bidder M wins both the auction and the lottery, she receives $(v_M + srM) - (1-\gamma)(b_M + r) + \alpha(b_M + (1-s)rM)$. If she wins the auction but not the lottery, she receives $v_M - (1-\gamma)(b_M + r) + \alpha(b_M + (1-s)rM)$. An active bidder who wins the lottery but not the auction receives $srM - (1-\gamma)r + \alpha(1-s)rM$. Last, an active bidder who wins neither receives $-(1-\gamma)r + \alpha(1-s)rM$. Auction revenues are $b_M + (1-s)rM$.
- "Bucket" auction(s): A computer "bucket" circulates in predetermined order. Subjects "bid" by adding a small fixed increment to the bucket and the auction is over when M–1 of the other participants drop out, and so, the winner is the *last* person to have contributed to the bucket. If bidder L is the last contributor and her total contribution is b_L, her pay-off is $v_L - (1-\gamma)b_L + \alpha\sum_{j=1}^{M} b_j$. Each of the other active bidders receives $-b_i + \alpha\sum_{j=1}^{M} b_j$, each nonactive bidder receives $\alpha\sum_{j=1}^{M} b_j$ and revenues are $\sum_{j=1}^{M} b_j$. There are also two bucket variations. Instead of the prize going to the last person to bid, in the first variant, it goes to the person who contributed the most. In the second variant (the poker bucket), the bidding proceeds according to the "seeing" and "raising" protocol of poker.

4. EXPERIMENTAL DESIGN

Based on the work by Kagel (1995) which reports auction sizes of between 3 and 10 bidders, we decided that 10 potential bidders would be needed for each 1.5-hour session. The number of active bidders averaged 4.8, which is in the middle of this range. We calibrated the final expected earnings to be \$25 per participant including a \$10 show-up fee (the actual average was \$25.15). To run the experiment, we used zTree by Fischbacher (2007). To recruit participants, we used the Orsee recruitment program and advertised

Session count ->	1	2	3	4	5
Bucket (Basic)	1	9	11	13	14
Bucket (Largest Contribution)	46	47	48	72	74
Bucket (Poker)	40	41	42	73	75
Dutch (Individual Counters)	25	37	61	62	63
English Button	23	39	64	65	66
First Price All Pay	2	3	4	8	10
All Pay Button	26	27	29	30	71
Last Price All Pay	21	28	55	56	57
First Price Winner Pay	5	6	7	12	15
First Price - Lottery Hybrid	18	35	49	50	51
Raffle	16	38	67	68	69
Second Price Winner Pay	31	32	33	34	70
Silent (With bid history)	17	20	22	58	59
Silent (Heterogeneous time)	24	43	44	45	60
Silent (No Sniping)	19	36	52	53	54

Fig. 2. Experimental Session Log (Shading Indicates Sessions Run at UMass-Amherst).

mainly via email. Because of the number of participants needed, we ran approximately half of the sessions at Middlebury College and the other half at the University of Massachusetts-Amherst. Fig. 2 details the sessions and their locations.

Subjects were provided with a comprehensive set of instructions and ample time to read and ask clarifying questions about the protocol (see Appendix A for a sample of the instructions[1]). At the beginning of the first round, subjects were asked to take a quiz designed to test their basic numeracy and comprehension skills. They were asked four multiple choice questions about how their pay-offs were calculated that required some multiplication and addition. After they took the quiz, they were shown the answers in an effort to eliminate any lingering confusion. Because the questions were mostly a test of numeracy, the number of correct answers will be used as a proxy for our subjects' cognitive ability.

A two-stage design allowed us to partially attenuate earned income effects (i.e., "playing with house money") and to endogenize participation. At the start of the experiment, each subject was asked to solve a number of "word scrambles" or anagrams in a predetermined period (12 minutes), similar in spirit to Gneezy, Niederle, and Rustichini (2003) or Hoff and Pandey (2006). Subjects were paid a piece rate of 10 EMUs per correct response and the scramble difficulty; the rate and the time limit were chosen so that mean earnings would be about $15 with little variance. While we wanted subjects to earn their endowments for the auctions, we did not want there to be a lot of variation in the endowments that might cause income effects. Indeed, it turned out to be relatively easy to get 10 scrambles right, but it was hard to get more than 16 right. Fig. 3 illustrates the distribution of endowments earned in the first stage of the experiment. The mean is 14.00 correct responses and the standard deviation is 1.81. Although the majority of participants ended up in our targeted range, two people did extremely poorly (0 correct and 2 correct) because of confusion.

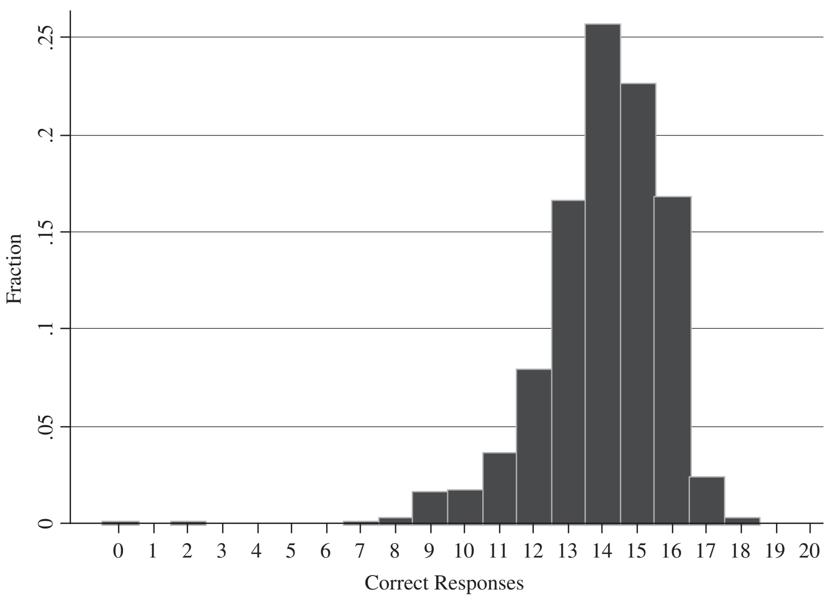

Fig. 3. The Distribution of Earned Endowments in the First Stage (Each Correct Response was Worth 10 EMUs).

After the 12-minute endowment stage, the auctions (or raffles) began. At the beginning of each of the 10 trials in a session, subjects chose to either participate in the auction whose rules were again explained in detail, and in which all bids were paid from the cash accumulated in the first stage or do another word scramble. So that participants did not condition their choice of whether to participate or not on the observed choices of the others, participation choices were conveyed privately and those participants who chose not to participate in the auction remained in the computer lab and solved a word scramble for a fixed piece rate of 15 EMUs per correct response. The opportunity cost of participating was the same for each mechanism.

Subjects learned their private values before the participation decision, but they did not know how many other participants selected into the auction. This was done because we expected that there might be an interesting interaction between auction mechanism and private value that justified complicating the design. Furthermore, theory suggests that participation will depend on one's value.

Along with their private values, participants were also told how hard (on a scale of 1–5) the alternative word scramble would be for the round. The difficulty measure allows us to identify selection separately from bidding behavior (i.e., there is no reason to believe that the difficulty of the scramble will affect one's bid amount). We initially selected a sequence of difficulty levels randomly and then used this sequence of difficulty levels for every session. This allowed us to separate the effect on participation of scramble difficulty from the mechanism effect. Subjects were then asked how many bidders they expected to enter the auction and what they thought that their (subjective) chances were to get the puzzle (of stated difficulty) correct.

As we noted earlier, our interest in the possible effects of learning on both participation and, conditional on this, the decisions of active bidders prompted us to run 10 trials during each session. Between auction trials, participants received feedbacks that might have facilitated learning (e.g., the winning bid and the share of active bidders). However, to prevent as much as possible one trial from spilling over to affect the results of others (e.g., trying to make up losses in earlier tirals), each participant was re-endowed at the beginning of each auction with the amount they earned in the first stage of the experiment and only one trial, choosen randomly, was paid.

Before leaving, we conducted a survey of the sociodemographic characteristics of our participants and got their reactions to the experiment (see Appendix B).

5. PARTICIPANT CHARACTERISTICS

We ran 75 sessions (five sessions per treatment). This translates into 745 participants.[2] We actively recruited nonstudents to increase the variation in our demographics. Table 1, which provides an overall summary and summaries by location, reports the characteristics of our participants. The mean age of our participants was a little more than 24 years and exactly half of our participants were female. However, our Middlebury participants were significantly older ($p<0.01$) and more female ($p<0.10$) than at UMass. We were able to recruit just a few townspeople (1%) and faculty (6%), but these numbers were statistically the same at each location. We were more successful in attracting staff members at Middlebury ($p<0.01$), and as a result students make up a significantly larger share of the UMass participants ($p<0.01$). Unfortunately, we were unable to get much racial diversity. Overall, 75% of the participants were Caucasian and 81% were born in the United States, and the distributions do not vary significantly by location. There were some significant differences in the educational achievements by location. More of the UMass participants were either still in college or had only partially completed their bachelor's degree ($p<0.05$), but there were more participants with graduate degrees in Amherst ($p<0.10$). Finally, as one might expect given UMass is a large state school and Middlebury is a small liberal arts school, there were more participants from households that earn less than $25,000 at UMass ($p<0.01$) and more participants from households that earn more than $150,000 per year in Middlebury ($p<0.01$).

We asked three questions about previous experience in experiments and auctions. The overall mean number of previous experiments (not necessarily economic experiments) was 0.52 (72% of the participants had never participated in an experiment before), but the number was significantly higher in Middlebury, which makes sense because the pool of potential subjects is smaller and ours was one of the first large-scale experiments conducted in the new Resource Economics experimental lab at UMass. The Middlebury participants also had more experience in both charity ($p<0.01$) and noncharity ($p<0.01$) auctions. Indeed, very few (8%) of the UMass participants had ever participated in a real charity auction.

Consistent with the format used by Dohmen et al. (2009), we asked relatively straightforward questions about our participants' attitudes toward risk, loss, and competitiveness. For example, we asked, "In general, do you see yourself as someone who is willing, even eager, to take risks, or as someone who avoids risks whenever possible?". The mean response was

Table 1. Summary Statistics (Overall and by Location).

	Overall ($N = 745$)	Middlebury ($N = 365$)	Umass ($N = 380$)	F-stat∣ p-Value
Age	24.20 (9.96)***	26.32 (12.45)	22.16 (6.09)	1.48∣0.11
Female (fraction)	0.50 (0.50)*	0.53 (0.50)	0.46 (0.50)	0.83∣0.63
Subject pool (fraction)				
Townsperson	0.01 (0.11)	0.01 (0.12)	0.01 (0.10)	1.17∣0.29
Faculty	0.06 (0.23)	0.04 (0.21)	0.07 (0.25)	1.36∣0.17
Staff	0.14 (0.35)***	0.21 (0.41)	0.07 (0.25)	1.44∣0.13
Student	0.79 (0.41)***	0.73 (0.45)	0.85 (0.35)	1.08∣0.37
Race (fraction)				
African-American	0.03 (0.16)	0.02 (0.15)	0.03 (0.18)	0.72∣0.75
Asian-American/Asian	0.13 (0.34)	0.14 (0.35)	0.12 (0.33)	0.55∣0.91
Latino/Hispanic	0.03 (0.17)	0.02 (0.15)	0.04 (0.19)	1.04∣0.41
White/Caucasian	0.75 (0.43)	0.76 (0.43)	0.74 (0.44)	0.72∣0.75
Other/mixed	0.06 (0.23)	0.05 (0.23)	0.06 (0.24)	1.21∣0.26
Born in the United States (fraction)	0.81 (0.39)	0.79 (0.41)	0.83 (0.38)	1.06∣0.39
Schooling (fraction)				
High school degree	0.07 (0.25)	0.08 (0.38)	0.06 (0.23)	0.78∣0.69
Some college	0.68 (0.47)**	0.63 (0.48)	0.72 (0.45)	1.41∣0.14
College degree	0.14 (0.35)***	0.19 (0.40)	0.09 (0.29)	1.15∣0.31
Graduate degree	0.11 (0.31)*	0.09 (0.29)	0.13 (0.34)	1.52∣0.10
Household income (fraction)				
Less than \$25,000	0.24 (0.43)***	0.15 (0.35)	0.34 (0.47)	3.31∣<0.01
\$25,001–\$50,000	0.13 (0.34)	0.14 (0.34)	0.12 (0.33)	1.13∣0.33
\$50,001–\$75,000	0.15 (0.36)*	0.18 (0.38)	0.13 (0.33)	1.04∣0.41
\$75,001–\$100,000	0.16 (0.37)	0.16 (0.37)	0.16 (0.37)	1.46∣0.12
\$100,001–\$125,000	0.11 (0.31)	0.12 (0.32)	0.10 (0.30)	1.01∣0.44
\$125,001–\$150,000	0.07 (0.25)	0.07 (0.26)	0.06 (0.24)	1.07∣0.38
More than \$150,000	0.14 (0.35)***	0.19 (0.39)	0.09 (0.29)	1.71∣0.05
Previous experiment participation (no.)	0.52 (1.14)***	0.73 (1.41)	0.33 (0.76)	1.77∣0.04
Past participation in a charity auction (fraction)	0.16 (0.37)***	0.24 (0.43)	0.08 (0.27)	1.94∣0.02
Past participation in a noncharity auction (fraction)	0.43 (0.49)***	0.50 (0.50)	0.36 (0.48)	0.95∣0.50
General risk taker (1 = low, 10 = high)	5.18 (2.58)	5.15 (2.50)	5.21 (2.67)	0.94∣0.52
Financial risk taker (1 = low, 10 = high)	3.48 (2.42)*	3.33 (2.26)	3.63 (2.56)	0.73∣0.74
General loss averter (1 = low, 10 = high)	3.87 (2.38)	3.97 (2.35)	3.78 (2.41)	1.69∣0.05
Financial loss averter (1 = low, 10 = high)	3.01 (2.28)	3.01 (2.24)	3.01 (2.31)	1.31∣0.20

Table 1. (*Continued*)

	Overall ($N=745$)	Middlebury ($N=365$)	Umass ($N=380$)	F-stat| p-Value
General competitiveness (1 = low, 10 = high)	6.10 (2.83)	6.13 (2.70)	6.06 (2.95)	1.55|0.09
Sports competitiveness (1 = low, 10 = high)	6.14 (3.12)	5.96 (3.09)	6.31 (3.14)	0.87|0.59
Sunk cost sensitivity (fraction):				
Commit fallacy one	0.34 (0.47)***	0.29 (0.45)	0.39 (0.49)	1.33|0.18
Commit fallacy two	0.55 (0.50)**	0.50 (0.50)	0.59 (0.49)	0.54|0.91
Commit fallacy three	0.24 (0.43)	0.24 (0.42)	0.24 (0.43)	0.85|0.61

Note: Means and (standard deviation). The F-statistic and p-value in the last column are from the linear regression of each characteristic on treatment indicators.
* A significant difference (t-test) between locations at the 10% level.
** A significant difference (t-test) between locations at the 5% level.
*** A significant difference (t-test) between locations at the 1% level.

5.18, which is directly in the middle of the 1 (low) to 10 (high) scale, and neither the responses to this or any of the other similar questions varied significantly by location.[3] What is interesting, however, is that in the broader population of participants, people demonstrated some of the common trends seen in similar experiments. For example, people are significantly more averse to losses in both the general and the financial domains ($p<0.01$ for both).

Lastly, we asked three vignette questions to determine the extent to which people are sensitive to sunk costs. In the first vignette, the participant has to decide whether or not she would buy another movie ticket after losing the first one. Overall, 34% of the participants said that they would not buy another ticket and the percentage was 10% higher at UMass ($p<0.01$). There was also a significant difference in the rate of committing the sunk cost fallacy in the second vignette. Here, participants were told that they had made reservations, and paid a deposit to a hotel in Montreal, but then decided that they could have more fun by going somewhere else. In this case, 55% of the people said that they would still go to Montreal and, again, the response rate differed by almost 10% ($p<0.01$). The last vignette was a little more complicated in that they could choose among five responses. In this scenario, the participant had bought wine for $20 a bottle in the past but could now sell it on eBay for $75 a bottle. When asked how much it cost to drink one of the bottles, only 24% of the people said $20. The rate of responding with $20 did not vary significantly by location.

6. RANDOMIZATION TO TREATMENT

The obvious test of whether we achieved randomization to treatment in our experiment is to regress each of the characteristics in Table 1 on treatment indicators and test whether any of the point estimates are significantly different from another. For the sake of brevity, we employ a slightly cruder method. In the last column of Table 1, we report just the *F*-statistics and *p*-values from these regressions. Our test is whether the treatment indicators are jointly significant or not.[4]

It appears that, based on four-fifths of the characteristics, our randomization worked well. In 28 of the 35 characteristics, the *F*-statistic is relatively low and insignificant at the conventional 10% level. However, the other fifth of the characteristics show more of a pattern. For example, it appears that having a gaduate degree and mechanism are related. This is likely due to the fact that more of the last-price all-pay and first-price raffle hybrids occurred at UMass where there were more graduate students. Similarly, there appears to also be a relationship between income and format, but, again, this is not much of a surprise because there were more students from households earning less than $25,000 at UMass and more from families earning more than $150,000 at Middlebury. In particular, the fact that most of the silent auctions and (again) last-price all-pay suctions were run at UMass accounts for this result. Differential participation of UMass participants, who had significantly less experience in experiments and auctions, in the silent, Dutch, and English auctions explains the significant *F*-statistics on previous experiment and charity auction experience. Both of the last two cases are less obvious but apparently due to the fact that more of the silent and (nonbasic) bucket auctions were run at UMass. While not perfect, our randomization worked pretty well and our full set of survey responses allows us to correct for any biases that might result from differential selection into one treatment or another.

7. ENDOGENOUS PARTICIPATION DIFFERENCES

Our main focus here is on endogenous participation. With 745 subjects eligible to participate in 10 separate auctions, we have 7,450 observations of the participation decision. Table 2, a summary of the mean levels of participation by mechanism, supports the notion that substantial differences exist between formats. For example, the first-price lottery hybrid and the basic silent auction garnered nearly 60% participation while the first-price all-pay,

Table 2. Participation, by Format.

Format	Participation Rate	Standard Deviation
First-price winner-pay	0.462	0.499
First-price lottery hybrid	0.586	0.493
Second-price winner-pay	0.464	0.499
First-price all-pay	0.424	0.495
Last-price all-pay	0.456	0.498
All-pay button	0.424	0.495
English	0.522	0.500
Dutch	0.478	0.500
Raffle	0.480	0.500
Silent (basic)	0.559	0.497
Silent (no sniping)	0.526	0.500
Silent (heterogeneous times)	0.502	0.500
Bucket (basic)	0.486	0.500
Bucket (highest contributor)	0.418	0.494
Bucket (poker)	0.454	0.498

the all-pay button, and the bucket (most) generated participation rates closer to 40%.

Table 3 presents the results of a random effects probit analysis of the individual's decision to enter an auction. Column (1) includes only the mechanism dummies in the estimation and we use the basic silent auction as the omitted category because it is clearly one of the most commonly used charity formats (*Wall Street Journal*, May 8, 2002, p. D2). The evidence is again clear; there exist significant (in both economic and statistical senses) mechanism-specific differences in one's willingness to participate. Relative to the basic silent auction, subjects are significantly less likely to enter the first-price winner-pay, second-price winner-pay, first-price all-pay, last-price all-pay, all-pay button, Dutch, raffle, and all three varieties of the bucket auction. There appear to be no significant differences among the silent mechanisms or between the basic silent and either the English button or the first-price lottery hybrid.

Pairwise comparisons of the probit coefficients highlight some interesting relationships among the formats (we omit the presentation of these results for brevity). If high participation is the seller's goal, then the first-price lottery hybrid is the clear winner; subjects are significantly more likely to enter a first-price lottery auction than almost any other format (the only exception is the silent basic in which participation rates in the two mechanisms are statistically indistinguishable). The direct comparison between the first-price lottery

Table 3. Testing for Participation Differences.

	(1)		(2)	
First-price winner-pay (I)	−0.104**	(0.044)	−0.145***	(0.052)
First-price lottery hybrid (I)	0.030	(0.046)	0.005	(0.056)
Second-price winner-pay (I)	−0.100**	(0.045)	−0.116**	(0.054)
First-price all-pay (I)	−0.146***	(0.043)	−0.177***	(0.050)
Last-price all-pay (I)	−0.110**	(0.044)	−0.141***	(0.052)
All-pay button (I)	−0.143***	(0.043)	−0.206***	(0.049)
English (I)	−0.040	(0.045)	−0.062	(0.055)
Dutch (I)	−0.087*	(0.045)	−0.124**	(0.053)
Raffle (I)	−0.084*	(0.045)	−0.131**	(0.053)
Silent (no sniping) (I)	−0.036	(0.046)	−0.054	(0.055)
Silent (heterogeneous times) (I)	−0.062	(0.045)	−0.064	(0.055)
Bucket (basic) (I)	−0.079*	(0.045)	−0.099*	(0.054)
Bucket (highest contributor) (I)	−0.149***	(0.043)	−0.173***	(0.051)
Bucket (poker) (I)	−0.111**	(0.044)	−0.133**	(0.052)
Male (I)			0.007	(0.022)
Age			0.002*	(0.001)
Private value			0.007***	(0.000)
Endowment			−0.002***	(0.001)
Puzzle difficulty			0.198***	(0.006)
Numeracy			−0.020	(0.013)
Experienced bidder (I)			0.066	(0.041)
Relatively risk averse (I)			−0.064**	(0.025)
Relatively loss averse (I)			−0.046**	(0.023)
Sunk cost sensitive (I)			−0.012	(0.026)
Competitive (I)			0.019	(0.023)
Mechanism is unfair (I)			−0.032	(0.027)
Mechanism is complex (I)			0.031	(0.036)
Observations	7,450		7,450	

Notes: Marginal effects from probit estimates; (standard errors). Estimates include individual random effects.
* $p<0.10$.
** $p<0.05$.
*** $p<0.01$.

hybrid and the standard first-price winner-pay may provide some intuition for the relative success of the hybrid. While the auction winner is determined in exactly the same way in both formats, recall that the first-price lottery hybrid requires an additional (fixed) entry fee with 50% of the entry revenue awarded to one randomly chosen participant (who may or not be the winner of the auction). The significantly greater willingness to participate in the first-price lottery hybrid than in the standard first-price winner-pay (the coefficient difference is 0.34, $p<.01$) suggests that subjects find the possibility of winning by pure luck appealing, appealing enough to outweigh the additional participation cost imposed by the entry fee.

Comparisons among the most commonly discussed formats in the literature – first-price winner-pay, second-price winner-pay, first-price all-pay, all-pay button, English, and Dutch – suggest minimal differences in participation rates. The two exceptions are between the first-price all-pay and the English ($p<.05$) and the all-pay button and the English ($p<.05$); subjects find the two all-pay formats much less attractive to enter than the standard winner-pay English auction. It is likely that the all-pay component has a depressing effect on participation.

Despite our deliberate attempt to randomize into treatment, one might wonder if the results are driven by demographic differences between sessions. Column (2) of Table 3 adds auction-specific and demographic controls to the analysis. Notable is that the marginal effects of the mechanisms become larger (not smaller) in magnitude. Furthermore, although not shown, the pairwise comparisons remain virtually unchanged with the addition of the controls. This suggests that even after controlling for demographic characteristics of the subject pool, participation is endogenous; auction formats are still significant predictors of one's willingness to enter an auction.

In terms of the additional covariates in Column (2), we find that older subjects are more likely to participate, as are subjects with higher values and those who have participated in more than 10 auctions outside the experiment. Not surprisingly, an increase in the puzzle difficulty leads to greater auction participation as the expected value of the puzzle payout decreases. Subjects with higher endowments are less likely to enter an auction, most likely a reflection of their greater aptitude for puzzles. Risk averse subjects are 6% less likely to participate while loss averse subjects are 5% less likely to enter an auction. Gender, sunk cost sensitivity, and competiveness played no significant role in the decision to participate.[5] Neither, to our surprise, did the perceived fairness or complexity of the format.[6]

8. RETURNING TO EARLIER WORK: A STRUCTURAL APPROACH

For a subset of our mechanisms, we can test whether the participants entered the auctions as basic theory might predict. Motivated by the large participation differences found in the field between the first-price winner-pay, the second-price winner-pay, and the first-price all-pay mechanisms (Carpenter et al., 2008), we developed a model of participation thresholds (Carpenter et al., 2007), expressed in terms of minimum private values, which, in principle, can be estimated with our lab data. The underlying question is whether the modeled structure of participation choices is present in our lab data where all the important parameters have been induced and, therefore, controlled.

Using the notation introduced in Section 3 (e.g., α is the common return and γ is warm glow), we begin by describing the theoretical thresholds (drawn from Carpenter et al., 2007) that bidders should have used to decide when to enter auctions and when to stay out. In that model, we consider the case of $N \geq 2$ potential risk neutral bidders whose private values, v, are drawn independently from some distribution over the unit interval and who know these values before they must decide whether to participate.

Following Samuelson (1985) and Menezes and Monteiro (2000), we assume that potential bidders confront some cost of participation that may simply reflect the resources needed to formulate a bid or may even be partially determined by innate bidder preferences. The cost, $0 \leq c^j < 1$, where $j =$ f(irst price), s(econd price), a(ll pay), may therefore vary from one mechanism to the next. Within this framework, symmetric Bayes–Nash equilibria are identified for bid functions $\sigma^j\,(v_i)$ that are assumed to be differentiable above some participation threshold $0 \leq \underline{v} < 1$.

With all of the details available in Carpenter et al. (2007), we do no more than restate a few main results here. In the case of the first-price winner-pay format, for example, the threshold bidder is someone for whom

$$F(\underline{v})^{N-1}\,\underline{v} = c^f$$

This condition defines an implicit function in which the participation threshold $\underline{v}$ depends on the costs of participation c^f, the number of potential bidders N, and, implicitly, the shape of the distribution function $F(v)$. Furthermore, the underlying intuition for the condition is straightforward: At the threshold, a bidder is indifferent between bidding zero for a good worth $\underline{v}$ to her and paying the participation cost c^f. The expected benefit of this bidding strategy is just $\underline{v}$ times the probability of winning, that is, the probability that everyone else has a lower bid, which is equal to $F(\underline{v})^{N-1}$.

In the special case of a uniform distribution over the unit interval, the threshold is simple to derive: $F(v) = v$ and, after simplification, the condition can be rewritten as follows:

$$\underline{v} = (c^f)^{\frac{1}{N}}$$

Notice that the comparative statics are intuitive: The threshold rises and participation rates fall either when potential bidders have better outside options or when there are more potential bidders.

Unfortunately, the threshold for the second-price winner-pay format is somewhat more complicated:

$$F(\underline{v})^{N-1}\,\underline{v} + \alpha(N-1)F(\underline{v})^{N-2}(1 - F(\underline{v}))\sigma^s(\underline{v}) = c^s$$

where $\sigma^s(\underline{v}) \neq 0$ is the optimal threshold bid in the second-price auction, as further described in Carpenter et al. (2007). There are at least two properties of this threshold that call for attention. First, unlike its first-price and all-pay equivalents, the second-price threshold is sensitive to the common rate of return α. Second, when participation costs are the same, the second-price threshold is lower, and it should draw more bidders. The explanation is found in a comparison of the threshold conditions, the difference in which is the term $\alpha(N-1)F(\underline{v})^{N-2}(1 - F(\underline{v}))\sigma^s(\underline{v})$, which is the benefit that accrues to the threshold bidder in the second-price auction when there is just one other bidder and, as a result, she determines both what the winner pays and the common return.

The threshold condition for the all-pay is the same as that for the first-price winner-pay, which implies that when participation costs are the same, so are participation rates. We provide a more detailed discussion in Carpenter et al. (2007), but the intuition is that because the optimal threshold bids under both the first-price and the all-pay formats is zero, the difference between the benefits of participation and nonparticipation for a bidder on the threshold is just $F(\underline{v})^{N-1}\,\underline{v}$. As the cost of participation is c^a, the threshold bidder will just be indifferent when

$$F(\underline{v})^{N-1}\,\underline{v} = c^a$$

which, in the uniform case, implies $\underline{v} = (c^a)^{(1/N)}$.

The crisp predictions of the model could, in principle, be put to direct test. Given the complicated form of the second-price threshold and the fact that bidders do not have the same option value, structural estimation is difficult. Instead, we estimate a model that we believe allows for inferences about the structure of participation decisions.

Specifically, we start by imputing thresholds for each participant and each period. To do this, we first need some sense of the participation costs that individual bidders face before each auction. To do this, we use the endowment stage data to calculate what fraction $p_{i,k}$ of the word scrambles of level k individual i solved correctly. As the scrambles before each auction paid 15 EMUs – or, scaled down to the unit interval, 0.15 – when solved, the expected value of the outside option is therefore $c_{i,k} = 0.15p_{i,k}$ for a level k puzzle. We then calculated the first-price and all-pay thresholds directly, as $\underline{v} = c_{i,k}^{(1/10)}$, where $N = 10$ is the session size, and used numerical methods to solve jointly for the threshold and threshold bid in the less tractable second-price format.

To illustrate, consider a subject who solved two-thirds of the level 3 puzzles correctly in the endowment stage and who must now decide whether to enter an auction whose private value is 75 EMUs or do another level 3 scramble. We estimate the expected costs of participation to be $0.10 = 0.15 \times (\frac{2}{3})$ and the threshold for either a first-price or all-pay auction to be $0.7943 = (0.10)^{(1/10)}$ or, scaling up to the [0,100] lab interval, 79.43 EMUs. As the threshold exceeds her private value, our model predicts that she should not enter the auction.

More generally, we define an indicator for each indvidual and period, "Value > Threshold," or VGT for short, to be 1 whenever a potential bidder's randomly assigned value exceeds her imputed threshold and 0 otherwise. Combined, the participation and VGT indicators allow the sample to be divided into four categories: entered when should have, did not enter when should not have, entered when should not have, and last, did not enter when should have. Within the framework of our model, the last two can be counted as "errors." The overall rate for our sample is 32%, but the two sorts of errors are not equally likely: entering when one should not is three times more common than not entering when one should.

To understand the data better, consider Fig. 4, which includes frequency-weighted scatter plots for each of the three mechanisms of the number of bidders who entered a particular auction and the number of those for whom VGT = 1, that is, the number who, within the framework of our structural model, should have entered. We also plot, in each diagram, a 45-degree line and a simple best fit (least squares) line. Several properties are common to all three mechanisms. First, under the parameters of our experiment, it was seldom the case that five or more should have entered and, consistent with the internal logic of our model, this happened more often under the second-price rules because its threshold is lower, ceteris paribus, than the common

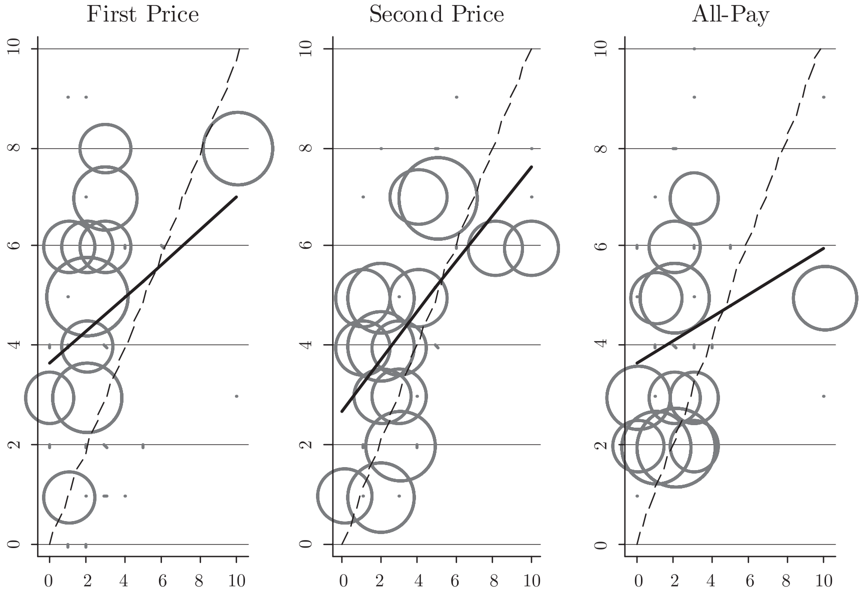

Fig. 4. The Numbers who Enter versus Numbers who Should Enter by Mechanism (Bubble Size Depends on the Number Of Identical Observations).

first-price and all-pay thresholds. Second, the number who do enter is positively correlated with the number who should but inasmuch as the scatter is not clustered around the 45-degree line, it does not seem that the two are equal. Third, it appears that ‘‘overexuberance’’ – a characteristic of auctions above the 45-degree line, in which the number who enter exceeds the number who should – explains much of this difference.

There are some important differences across formats, too. In particular, there are two features of the second-price mechanism that merit attention. First, the correlation between ‘‘should enter’’ and ‘‘did enter’’ is closer to one for the second-price than either the first-price or the all-pay auctions: in visual terms, the best fit line is closer to the 45-degree line. Second, there is also less variation around the best fit line under the second-price format. In short, participation in second-price auctions appears both more consistent with our structural model and more predictable. Last, we note that there are more extreme cases of ‘‘overexuberance’’ under the first-price mechanism.

In more formal terms, we consider a test of the structural participation model based on the random effects probit:

$$\begin{aligned}\text{Participate}^*_{i,t} = {} & \beta_0 + \beta_1 \text{VGT}_{i,t} + \beta_2 \text{SPWP} + \beta_3 \text{FPAP} \\ & + \beta_4 \text{VGT}_{i,t} \times \text{SPWP} + \beta_5 \text{VGT}_{i,t} \times \text{FPAP} \\ & + \beta_6 \text{NUM}_i + \beta_7 \text{NUM}_i \times \text{SPWP} + \beta_8 \text{NUM}_i \times \text{FPAP} \\ & + \beta_9 \text{LOSS}_i + \beta_{10} \text{LOSS}_i \times \text{SPWP} + \beta_{11} \text{LOSS}_i \times \text{FPAP} \\ & + \beta_{12} \text{COMP}_i + \beta_{13} \text{COMP}_i \times \text{SPWP} \\ & + \beta_{14} \text{COMP}_i \times \text{FPAP} + \alpha_i + u_{i,t}\end{aligned}$$

$$\text{Participate}_{i,t} = \begin{cases} 1 \text{ if } \text{Participate}^*_{i,t} > 0 \\ 0 \text{ if } \text{Participate}^*_{i,t} \leq 0 \end{cases}$$

where i indexes individuals, t indexes periods, $u_{i,t} \sim$ iid $N(0,1)$, $\alpha_i \sim N(0, \sigma_a^2)$ and is independent of $u_{i,t}$, SPWP and FPAP are the basic treatment indicators, $\text{VGT}_{i,t}$ is the "should enter" indicator defined above, NUM_i is the measure of the ith bidder's numeracy, and LOSS_i and COMP_i are indicators that are equal to 1 when the bidder is, respectively, relatively loss averse and competitive. AU :5

Some features of this specification call for comment. First, VGT and private value are correlated but not identical, and the relevant coefficients are more than "value effects." Some bidders with high values will also have high participation costs, for example, and the latter affects their participation threshold and, therefore, the value at which VGT flips from 0 to 1. The value of VGT is also mechanism-specific: a private value that should induce participation in a second-price auction will sometimes not be sufficient to induce it in a first-price or all-pay auction.

This said, the relevant test of our structural model is not the joint hypothesis $\beta_2 = \beta_3 = \ldots \beta_{14} = 0$ and $\Phi(\beta_0 + \beta_1) - \Phi(\beta_0) > 0$ but rather $\beta_2 = \beta_3 = \ldots \beta_{14} = 0$ and $\Phi(\beta_0 + \beta_1) - \Phi(\beta_0) = 1$: in other words, someone who should enter does so for sure, independent of treatment because all of the relevant structure is embodied in the thresholds, and individual characteristics other than value and threshold. We already know, of course, that 32% of all participation decisions are "mistaken." The question here is whether or not these mistakes are random or not.

The indicators and interaction terms complicate both the calculation and the presentation of marginal effects, and what we present in Table 4 is

Table 4. Estimated Participation Marginal Effects, by Format.

	FPWP		SPWP		FPAP	
Value > threshold (I)	0.374***	(0.045)	0.539***	(0.044)	0.251***	(0.059)
Numeracy	−0.008	(0.044)	−0.013	(0.038)	−0.091*	(0.047)
Relatively loss averse (I)	−0.132**	(0.066)	0.030	(0.063)	−0.077	(0.070)
Competitive (I)	−0.134*	(0.075)	−0.000	(0.066)	0.153**	(0.070)

Notes: Estimates include individual random effects; (standard errors).
* $p<0.10$.
** $p<0.05$.
*** $p<0.01$.

intended to summarize our main results. Consider, for example, perhaps the most basic question, whether or not bidders who should enter do so. Recall that the construction of the VGT variable allows for mechanism-specific threshold differences but that our econometric model allows for additional, "nonstructural" treatment effects. Under the second-price mechanism, for example, we estimate the effect to be as follows:

$$\Phi\left(\widehat{\beta}_0+\widehat{\beta}_1+\widehat{\beta}_2+\widehat{\beta}_4+(\widehat{\beta}_6+\widehat{\beta}_7)\,\overline{\mathrm{NUM}}+(\widehat{\beta}_9+\widehat{\beta}_{10})\overline{\mathrm{LOSS}}+(\widehat{\beta}_{12}+\widehat{\beta}_{13})\overline{\mathrm{COMP}}\right)$$
$$-\,\Phi\left(\widehat{\beta}_0+\widehat{\beta}_2+(\widehat{\beta}_6+\widehat{\beta}_7)\,\overline{\mathrm{NUM}}+(\widehat{\beta}_9+\widehat{\beta}_{10})\overline{\mathrm{LOSS}}+(\widehat{\beta}_{12}+\widehat{\beta}_{13})\overline{\mathrm{COMP}}\right)$$

and report both the result (0.539) and the standard error (0.044) in the first row (VGT) and second column (SPWP) of Table 4. In broader terms, Table 4 reports the marginal effects of VGT, numeracy, loss aversion, and competitiveness (rows) by format (columns).

The first row of Table 4 has two important implications. First, the VGT indicator is statistically and economically significant under all three formats: even if this reflects, at least in part, the positive correlation between private value and "should enter," those who should enter are more likely to do so. Second, however, chi-square tests (in each case, $\chi^2>100$ and $p<0.01$) also reveal that the effect is, in a statistical sense, smaller than one. If our structural model were correct, however, the effect would equal one: those who should enter would enter, and vice versa. The difference between "should" and "do" is most apparent in the all-pay auction, in which our estimates suggest that those who should enter are only 25% more likely to do so. There is, in short, limited support for the participation logic outlined in Carpenter et al. (2007), but as the other rows in Table 4 hint, there is evidence that other influences are (also) at work.

Consider the effects of bidder competitiveness on participation. Whatever its conditional (on participation) effect on bids – intuition suggests that competitive bidders will be more aggressive than standard models predict – our data suggests that such bidders are also much more likely (0.153, $p<0.01$) to enter an all-pay auction, but much less likely (-0.134, $p<0.10$) to enter a first-price auction. Given the small differences in overall participation rates, it seems reasonable to conclude that there are more low (i.e., below threshold) value but competitive bidders in all-pay auctions. The practical implications for auctioneers are immediate: The choice of auction format affects not just the number of active bidders but their nature, both of which have revenue consequences.

However, the explanation for the differential effects of competitiveness is not obvious. All three mechanisms are, in effect, normal form games without much "thrill of the chase." It is possible, however, that competitive individuals were drawn to the all-pay format because it requires all bidders "to have some skin in the game."

To the extent that the all-pay mechanism is differentially attractive to "hot blooded" and therefore, perhaps, unpredictable bidders, it is reasonable to suppose that more numerate bidders will be more reluctant to enter than our structural model predicts. The second row of Table 4 confirms that this is indeed the case: a numerate bidder is 9.1% ($p<0.10$) less likely to enter an all-pay auction. On the contrary, such a bidder is no more or less likely to enter a first- or second-price winner-pay auction. This is another result with practical consequences: Auctioneers expend considerable effort creating the "right atmosphere" for a particular choice of format, but should also consider the indirect relationship between format and bidder types and, therefore, atmosphere. In this case, the all-pay mechanism does not just attract "hot" bidders but repels "cold" ones.

We had a strong prior that loss averse bidders would also be more reluctant to participate in all-pay auctions, but while the marginal effect (-0.07) is plausible, it is statistically insignificant. The real surprise is found in the first column where our results indicate that loss averse bidders will be 13.2% less likely to participate in first-price winner-pay auctions than bidders who are not, and the difference is statistically significant at better than the 5% level.

9. CONCLUDING REMARKS

Despite the importance of fund-raising for the vast number of philanthropic organizations that exist, very little attention has been given to endogenous participation, either in the field or in the lab. In fact, only Carpenter et al. (2008) has explored the possibility that format choice can affect participation (and thus revenue generation) in charity auctions. This study fills that void in its detailed description of a large-scale laboratory experiment in which the participation decision is closely examined for 15 different fund-raising formats.

From Fig. 1, we can see that our new lab results support the field work of Carpenter et al. (2008); there are mechanism-specific participation differences that researchers must account for in their analysis of mechanism design. While the participation results are more subtle in the lab (right panel), the first-price all-pay mechanism continues to yield lower participation (Tables 2 and 3), and most imortantly, overall auction revenue continues to depend critically on the number of participants. In addition, we find that these participation differences are robust to the inclusion of demographic controls. If maximizing participation is a goal of the charity, the first-price lottery hybrid or the basic silent auction appears to be the best choices. The formats in which everyone must forfeit his or her bid (e.g., the all-pays and the buckets) seem to reduce participation.

UNCITED REFERENCES

Andreoni (2006).

NOTES

1. We chose to append only a few versions of the instructions because the full set for all the 15 mechanisms fills about 75 pages. Any of the omitted instructions are available upon request.

2. Despite running 71 sessions with 10 participants, we were forced, because of no-shows, to run three nine-person sessions (one basic bucket, one basic silent, and one all-pay button) and one second-price winner-pay that had only eight participants.

3. Except the fact that there are slightly more financial risk takers at UMass ($p < 0.10$).

4. We use linear probability models in the case of dichotomous characteristics.

5. An individual was deemed to be sunk cost sensitive if he or she answered "no" to the movie ticket question and "yes" to the Montreal hotel question on the last page of the questionnaire. An individual was considered "competitive" if he or she perceived his or her own competitiveness to be greater than 7 on a scale of 1–10, both generally and in sports.

6. The mechanism is considered "unfair" if the individual answered 0–2 (out of 10) when asked "Do you think that participants in this fundraising mechanism are treated fairly?". The mechanism is "complex" if the individual answered 4 or greater (out of 5) when asked, "How difficult was it to understand the rules of this experiment?".

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APPENDIX A. SAMPLE INSTRUCTIONS

A.1. First-price winner-pay

A.1.1. Introduction

Today you are participating in a decision-making experiment. You will earn $10 just for showing up. The instructions are straightforward, and if you follow them, you may be able to make a considerable amount of money. During the experiment, all decisions will be framed in terms of EMUs. At the conclusion of the experiment, all the EMUs that you have accumulated will be converted into real dollars at the rate of 10 EMUs per real dollar (i.e., we will divide your EMUs by 10). You will be paid in cash at the end of the experiment.

Please read these instructions carefully, as understanding the rules is essential for doing well. You may refer to these instructions at any time during the experiment. If you have any questions while these instructions are being read, please raise your hand and we will attempt to answer them. *You are not allowed to communicate with other participants during the experiment, even to clarify instructions; doing so may be grounds for dismissal from the experiment, forfeiture of earnings, and being banned from future experiments. The same is true of opening other computer programs or modifying the computer set-up during the experiment.*

The experiment consists of three phases, all conducted using the computer: In the first, you will earn an amount of money, your "endowment,"; in the second, you will be able to use those earnings to take part in an auction, if you so choose; and in the last phase, you will complete a brief survey. Your final pay-off will depend on your performance in the first phase and your own actions as well as the actions of the other participants in the second phase.

A.1.2. Experiment Phase One: Endowment

During the first part of the experiment, the "endowment phase," you will be asked to solve a series of word scrambles – puzzles in which the letters of a word are mixed up. It is your task to unscramble them. On your computer screen, you will see one scrambled word at a time, with a blank below each given letter. In each blank, enter the letter that you think belongs in that space in the correct, unscrambled word – see the example below for clarification. *In each blank, please enter only one letter, with no spaces, and use only the letters given in the original scramble. Failure to do so will result in an error message, which you will have to correct before moving on. Note that you can use the tab key to quickly move from one cell to the next.*

You will have a total of 12 minutes to correctly solve as many scrambles as you can, and for each that you solve correctly, you will earn an additional 10 EMUs. The puzzles increase in difficulty as you progress, and you will have only one chance to solve each puzzle. You may leave a puzzle blank, but once you click the "Submit and Continue to Next Puzzle" button, you will not be able to return to that puzzle. There are a total of 25 scrambles. You will not know how many you have solved correctly until the phase is over.

Once you have reached the end of the puzzles, please sit quietly and wait for other participants to finish. At the end of the phase, the number of puzzles you solved correctly and the total EMUs you earned will be shown to you. This amount of EMUs constitutes your endowment and will be used to participate in the second phase of the experiment.

A.1.3. Experiment Phase Two: Auction

A.1.3.1. Motivation. In the second phase of the experiment, we simulate a charity auction. Charity auctions are different from regular, for-profit, auctions because everyone associated with the charity benefits from the money that is raised. In noncharity auctions, only winners benefit. To simulate this difference, participants in these charity auction simulations will earn benefits from three sources: they earn benefits from winning the auction, they earn benefits from the total amount of money raised by the auction, and they earn benefits from their own contributions. The second source of benefits represents the fact that everyone benefits when money is contributed to charity, and the third source represents the fact that people often feel good about themselves for giving money.

A.1.4. Deciding whether to Participate and Bidding

In the second phase of the experiment, there will be 10 periods. At the beginning of each period, you will decide whether you want to participate in an auction or try to solve another word scramble. In the auction, you will have the opportunity to bid on a single unit of a fictitious good. Although the good is fictitious, it will have some real "value" to you – you can think of this as being the amount of money that the experimenter would pay you for the item if you obtained it in the auction. Each participant will learn his or her value for the item at the beginning of each period, but will not know any of the other participants' values. *Other participants will have different values.* Your value for the good will change each period, and how this value is determined is described in detail below.

If you choose to participate in the auction, you will submit a bid for the fictitious commodity. The computer will show you your value for the period and will prompt you to enter a bid. You will make one bid per auction and you will not know the bids of the other participants when you choose your own bid. The person who bids the most will win the auction. If you win the auction, you will have to pay your bid out of your endowment, and so, your bid must be greater than or equal to zero but less than your endowment. Bids and values will both be denominated in EMUs. When you make a bid, you will not know how many others are participating in the auction – in each auction, there could be as few as 0 or as many as 10 total bidders, depending on the decisions of the other participants. How auction gains are determined is described in the next section.

As indicated above, participation in the auction is a choice. Before you decide to enter a bid or solve a scramble, you will be shown the value you will have for the fictitious good in the auction and the difficulty of the scramble you will have to solve. If you choose not to participate in the auction, you will have 2 minutes to solve the word scramble. If you solve it within the time limit, you will earn 15 EMUs; if you do not, you will earn 0 EMUs. The difficulty of the puzzle will change randomly at the beginning of each period, *but the difficulty is the same for all scramble solvers within a period.*

A.1.5. Auction Rules and Determining Profits

The highest bidder wins the auction. The revenue generated by the auction is the amount paid by the auction winner. As mentioned in Section 3.1, this revenue has value for all participants, regardless of whether they participate in the auction or try the scramble: *each person earns 0.10 times the total auction revenue* – the second source of benefits referred to above. The amount the winning bidder contributes to the auction revenue has an additional value for him or her, so that *the winner earns an additional 0.05 times the amount (s)he pays*. This is the third source of benefits mentioned in Section 3.1.

We can work through an example to illustrate the pay-offs. Suppose that six people have entered the auction – let's call them Arthur, Barbara, Charles, Diane, Ethan, and Frances – and that four others have attempted the scramble. Suppose, too, that Diane bids the most and therefore has won the auction. To calculate how much Diane gains or loses from this win, we need to know how much she values the object and how much she bid. Suppose, for the sake of argument, that the object is worth 75 EMUs to her, she bid 50.

Diane's direct gain, the difference between what the object is worth and what she paid for it, is 75–50 or 25.

Because the winning bid is 50, all 10 participants, will receive an additional benefit worth 0.10×50 or 5 EMUs because the charity raised 50 EMUs of revenue from the auction.

And last but not least, Diane's good feeling is worth 0.05 of her contribution or $0.05 \times 50 = 2.5$ EMUs to her.

Altogether, Diane's direct and additional gains are therefore equal to $25 + 5 + 2.5 = 32.5$ EMUs. If she started the auction with an endowment of, say, 120 EMUs, she would leave it with $120 + 32.5 = 152.5$ EMUs.

What about someone like Arthur, who did not win the auction? Let's suppose that Arthur's endowment was 110 EMUs, that the object was worth 40 EMUs to him, and that he bid 15 EMUs. Arthur's direct gain is 0 EMUs (i.e, he gains nothing) because he bids 15 EMUs but does not win the object. The first of his two additional gains is the same as Diane's, or $0.10 \times 50 = 5$ EMUs, while the second is $0.05 \times 0 = 0$ EMUs because he did not win, and therefore, his bid does not determine the auction revenue.

Altogther, Arthur's net gain is $0 + 5 + 0$ or 5 EMUs. As he entered the auction with an endowment of 110 EMUs, he leaves with 115 EMUs.

Finally, what about those who attempted the word scrambles? Let's consider the hypothetical cases of Gerry, who does not solve his scramble, and Hannah, who does solve her scramble.

Gerry does not earn the 15 EMUs for solving the scramble, but he does receive the $0.10 \times 50 = 5$ EMUs that each of the bidders and nonbidders received in this auction. If he started with the auction with an endowment of 120 EMUs, he ends it with 125 EMUs.

Hannah earns 15 EMUs for her scramble and the $0.10 \times 50 = 5$ EMUs that all participants receive, and so, her combined gain is 20 EMUs. If she started the auction with an endowment of 130 EMUs, for example, she ends it with 150 EMUs.

In algebraic terms, the earnings of any participant can be summarized as follows:

$$\text{Winning bidder earnings} = [\text{Endowment} + (\text{Value} - \text{Bid})] + (0.10 \times \text{Bid}) + (0.05 \times \text{Bid})$$

The total earnings for an auction participant who does not win are as follows:

$$\text{Earnings of other bidders} = \text{Endowment} + (0.10 \times \text{Winning bid})$$

The earnings of people who choose to try the scramble instead of participating in the auction are as follows:

if you get it right:

$$\text{Earning of scrambler} = (\text{Endowment} + 15) + (0.10 \times \text{Winning bid})$$

if you get it wrong:

$$\text{Earning of srambler} = \text{Endowment} + (0.10 \times \text{Winning bid})$$

A.1.6. Determination of Final Dollar Pay-offs

After 10 rounds of the auction have been played, the computer will randomly pick one round to count toward your final earnings from the experiment. Because the computer will pick one round randomly, each auction period is completely independent of the others (i.e., you do *not* accumulate gains or losses from one period to the next). *However, if you make losses in the auction phase, they will be deducted from the money you earn in the first, endowment phase*. The computer will report to you the randomly chosen round and your final pay-off in EMUs. After the questionnaire stage is complete, the computer will report your earnings in dollars. All data collected in the experiment will be anonymous and used only for academic research. You will be paid privately, and no other participant will be told what you earned in the experiment.

A.1.7. Auction Details

A.1.7.1. How are the Values Generated? Values are chosen randomly from the interval 0 to 100 EMUs. Your value is independent of the values of all other experiment participants and of your value from other rounds: Knowing your value in a given round tells you nothing about the values of other experiment participants, and knowing your values in previous rounds tells you nothing about your value in the current round. All values between 0 and 100 are equally likely.

A.1.7.2. Tie-Breakers. In the event of a tie – when two or more people make the highest bid – the computer randomly determines a winner from among the group of high bidders. Each high bidder has the same chance of winning as the others.

A.2. English Button

A.2.1. Introduction

Today you are participating in a decision-making experiment. You will earn $10 just for showing up. The instructions are straightforward, and if you follow them, you may be able to make a considerable amount of money. During the experiment, all decisions will be framed in terms of EMUs. At the conclusion of the experiment, all the EMUs that you have accumulated will be converted into real dollars at the rate of 10 EMUs per real dollar (i.e., we will divide your EMUs by 10). You will be paid in cash at the end of the experiment.

Please read these instructions carefully, as understanding the rules is essential for doing well. You may refer to these instructions at any time during the experiment. If you have any questions while these instructions are being read, please raise your hand and we will attempt to answer them. *You are not allowed to communicate with other participants during the experiment, even to clarify instructions; doing so may be grounds for dismissal from the experiment, forfeiture of earnings, and being banned from future experiments. The same is true of opening other computer programs or modifying the computer set-up during the experiment.*

The experiment consists of three phases, all conducted using the computer: In the first, you will earn an amount of money, your ‘‘endowment,’’; in the second, you will be able to use those earnings to take part in an auction, if you so choose; and in the last phase, you will complete a brief survey. Your final pay-off will depend on your performance in the first phase and your own actions as well as the actions of the other participants in the second phase.

A.2.2. Experiment Phase One: Endowment

During the first part of the experiment, the "endowment phase," you will be asked to solve a series of word scrambles – puzzles in which the letters of a word are mixed up. It is your task to unscramble them. On your computer screen, you will see one scrambled word at a time, with a blank below each given letter. In each blank, enter the letter that you think belongs in that space in the correct, unscrambled word – see the example below for clarification. *In each blank, please enter only one letter, with no spaces, and use only the letters given in the original scramble. Failure to do so will result in an error message, which you will have to correct before moving on. Note that you can use the tab key to quickly move from one cell to the next.*

You will have a total of 12 minutes to correctly solve as many scrambles as you can, and for each that you solve correctly, you will earn an additional 10 EMUs. The puzzles increase in difficulty as you progress, and you will have only one chance to solve each puzzle. You may leave a puzzle blank, but once you click the "Submit and Continue to Next Puzzle" button, you will not be able to return to that puzzle. There are a total of 25 scrambles. You will not know how many you have solved correctly until the phase is over.

Once you have reached the end of the puzzles, please sit quietly and wait for other participants to finish. At the end of the phase, the number of puzzles you solved correctly and the total EMUs you earned will be shown to you. This amount of EMUs constitutes your endowment and will be used to participate in the second phase of the experiment.

A.2.3. Experiment Phase Two: Auction

A.2.3.1. Motivation. In the second phase of the experiment, we simulate a charity auction. Charity auctions are different from regular, for-profit, auctions because everyone associated with the charity benefits from the money that is raised. In noncharity auctions, only winners benefit. To simulate this difference, participants in these charity auction simulations will earn benefits from three sources: they earn benefits from winning the auction, they earn benefits from the total amount of money raised by the auction, and they earn benefits from their own contributions. The second source of benefits represents the fact that everyone benefits when money is contributed to charity, and the third source represents the fact that people often feel good about themselves for giving money.

A.2.3.2. Deciding whether to Participate and Bidding. In the second phase of the experiment, there will be 10 periods. At the beginning of each period, you will decide whether you want to participate in an auction or try to solve another word scramble. In the auction, you will have the opportunity to bid on a single unit of a fictitious good. Although the good is fictitious, it will have some real "value" to you – you can think of this as being the amount of money that the experimenter would pay you for the item if you obtained it in the auction. Each participant will learn his or her value for the item at the beginning of each period, but will not know any of the other participants' values. *Other participants will have different values*. Your value for the good will change each period, and how this value is determined is described in detail below.

If you choose to participate in the auction, you will submit a bid for the fictitious commodity. The computer will show you your value for the period and will prompt you to enter a bid. Bidding in the auction will be done through a "price clock," the counts upwards from 0 EMUs. You will actively be bidding in the auction and commit to pay the displayed price until you click the "Drop Out" button. In other words, your bid will be equal to the displayed price at which you click the "Drop Out" button. The auction ends automatically when only one bidder is left. This bidder wins the fictitious good and pays the price at which the second highest bidder dropped out. You will have to pay your bid out of your endowment, and so, your bid must be greater than or equal to zero but less than your endowment. Bids and values will both be denominated in EMUs. When you make a bid, you will not know how many others are participating in the auction – in each auction, there could be as few as 0 or as many as 10 total bidders, depending on the decisions of the other participants. How auction gains are determined is described in the next section.

As indicated above, participation in the auction is a choice. Before you decide to enter a bid or solve a scramble, you will be shown the value you will have for the fictitious good in the auction and the difficulty of the scramble you will have to solve. If you choose not to participate in the auction, you will have 2 minutes to solve the word scramble. If you solve it within the time limit, you will earn 15 EMUs; if you do not, you will earn 0 EMUs. The difficulty of the puzzle will change randomly at the beginning of each period, *but the difficulty is the same for all scramble solvers within a period.*

A.2.3.3. Auction Rules and Determining Profits. The highest bidder (i.e., the last person to drop out) wins the auction. The revenue generated by the auction is the amount paid by the auction winner. As mentioned in Section 3.1, this revenue has value for all participants, regardless of whether they AU :7

participate in the auction or try the scramble: *each person earns 0.10 times the total auction revenue* – the second source of benefits referred to above. The amount the winning bidder contributes to the auction revenue has an additional value for him or her, so that *the winner earns an additional 0.05 times the amount (s)he pays*. This is the third source of benefits mentioned in Section 3.1.

We can work through an example to illustrate the pay-offs. Suppose that six people have entered the auction – let's call them Arthur, Barbara, Charles, Diane, Ethan, and Frances – and that four others have attempted the scramble. Suppose, too, that Diane bids the most and therefore has won the auction. To calculate how much Diane gains or loses from this win, we need to know how much she values the object and how much she bid and the amount of the second highest bid. Suppose, for the sake of argument, that the object is worth 75 EMUs to her, she dropped out at 55, and that the second highest bidder dropped out at 50. Diane will therefore have to pay 50 EMUs.

Diane's direct gain, the difference between what the object is worth and what she paid for it, is $75-50$ or 25.

Because the revenue generated is 50, all 10 participants, will receive an additional benefit worth 0.10×50 or 5 EMUs because the charity raised 50 EMUs of revenue from the auction.

And last but not least, Diane's good feeling is worth 0.05 of her contribution or $0.05 \times 50 = 2.5$ EMUs to her.

Altogether, Diane's direct and additional gains are therefore equal to $25 + 5 + 2.5 = 32.5$ EMUs. If she started the auction with an endowment of, say, 120 EMUs, she would leave it with $120 + 32.5 = 152.5$ EMUs.

What about someone like Arthur, who did not win the auction? Let's suppose that Arthur's endowment was 110 EMUs, that the object was worth 40 EMUs to him, and that he bid 15 EMUs. Arthur's direct gain is 0 EMUs (i.e., he gains nothing) because he bids 15 EMUs but does not win the object. The first of his two additional gains is the same as Diane's, or $0.10 \times 50 = 5$ EMUs, while the second is $0.05 \times 0 = 0$ EMUs because he did not win, and therefore, his bid does not determine the auction revenue.

Altogether, Arthur's net gain is $0 + 5 + 0$ or 5 EMUs. As he entered the auction with an endowment of 110 EMUs, he leaves with 115 EMUs.

Finally, what about those who attempted the word scrambles? Let's consider the hypothetical cases of Gerry, who does not solve his scramble, and Hannah, who does solve her scramble.

Gerry does not earn the 15 EMUs for solving the scramble, but he does receive the $0.10 \times 50 = 5$ EMUs that each of the bidders and nonbidders received in this auction. If he started with the auction with an endowment of 120 EMUs, he ends it with 125 EMUs.

Hannah earns 15 EMUs for her scramble and the $0.10 \times 50 = 5$ EMUs that all participants receive, and so, her combined gain is 20 EMUs. If she started the auction with an endowment of 130 EMUs, for example, she ends it with 150 EMUs.

In algebraic terms, the earnings of any participant can be summarized as follows:

$$\begin{aligned}\text{Wining bidder earnings} = {} & [\text{Endowment} + (\text{Value} - \text{Second highest bid}] \\ & + (0.10 \times \text{Second highest bid}) \\ & + (0.05 \times \text{Second highest bid})\end{aligned}$$

The total earnings for an auction participant who does not win are as follows:

$$\text{Earnings of other bidders} = \text{Endowment} + (0.10 \times \text{Second highest bid})$$

The earnings of people who choose to try the scramble instead of participating in the auction are as follows,

if you get it right:

$$\text{Earnings of scrambler} = (\text{Endowment} + 15) + (0.10 \times \text{Second highest bid})$$

if you get it wrong:

$$\text{Earnings of scrambler} = \text{Endowment} + (0.10 \times \text{Second highest bid})$$

A.2.3.4. Determination of Final Dollar Pay-offs. After 10 rounds of the auction have been played, the computer will randomly pick one round to count toward your final earnings from the experiment. Because the computer will pick one round randomly, each auction period is completely independent of the others (i.e., you do *not* accumulate gains or losses from one period to the next). *However, if you make losses in the auction phase, they will be deducted from the money you earn in the first, endowment phase*. The computer will report to you the randomly chosen round and your final pay-off in EMUs. After the questionnaire stage is complete, the computer will report your earnings in dollars. All data collected in the experiment will be anonymous and used only for academic research. You will be paid privately, and no other participant will be told what you earned in the experiment.

A.2.4. Auction Details

A.2.4.1. How are the Values Generated? Values are chosen randomly from the interval 0 to 100 EMUs. Your value is independent of the values of all other experiment participants and of your value from other rounds: Knowing your value in a given round tells you nothing about the values of other experiment participants, and knowing your values in previous rounds tells you nothing about your value in the current round. All values between 0 and 100 are equally likely.

A.2.4.2. Tie-Breakers. In the event of a tie – when two or more people make the highest bid – the computer randomly determines a winner from among the group of high bidders. Each high bidder has the same chance of winning as the others.

A.3. Basic Bucket

A.3.1. Introduction

Today you are participating in a decision-making experiment. You will earn $10 just for showing up. The instructions are straightforward, and if you follow them, you may be able to make a considerable amount of money. During the experiment, all decisions will be framed in terms of EMUs. At the conclusion of the experiment, all the EMUs that you have accumulated will be converted into real dollars at the rate of 10 EMUs per real dollar (i.e., we will divide your EMUs by 10). You will be paid in cash at the end of the experiment.

Please read these instructions carefully, as understanding the rules is essential for doing well. You may refer to these instructions at any time during the experiment. If you have any questions while these instructions are being read, please raise your hand and we will attempt to answer them. *You are not allowed to communicate with other participants during the experiment, even to clarify instructions; doing so may be grounds for dismissal from the experiment, forfeiture of earnings, and being banned from future experiments. The same is true of opening other computer programs or modifying the computer set-up during the experiment.*

The experiment consists of three phases, all conducted using the computer: In the first, you will earn an amount of money, your "endowment,"; in the second, you will be able to use those earnings to take part in an auction, if you so choose; and in the last phase, you will complete a brief survey. Your final pay-off will depend on your performance in the first phase and your own actions as well as the actions of the other participants in the second phase.

A.3.2. Experiment Phase One: Endowment

During the first part of the experiment, the "endowment phase," you will be asked to solve a series of word scrambles – puzzles in which the letters of a word are mixed up. It is your task to unscramble them. On your computer screen, you will see one scrambled word at a time, with a blank below each given letter. In each blank, enter the letter that you think belongs in that space in the correct, unscrambled word – see the example below for clarification. *In each blank, please enter only one letter, with no spaces, and use only the letters given in the original scramble. Failure to do so will result in an error message, which you will have to correct before moving on. Note that you can use the tab key to quickly move from one cell to the next.*

You will have a total of 12 minutes to correctly solve as many scrambles as you can, and for each that you solve correctly, you will earn an additional 10 EMUs. The puzzles increase in difficulty as you progress, and you will have only one chance to solve each puzzle. You may leave a puzzle blank, but once you click the "Submit and Continue to Next Puzzle" button, you will not be able to return to that puzzle. There are a total of 25 scrambles. You will not know how many you have solved correctly until the phase is over.

Once you have reached the end of the puzzles, please sit quietly and wait for other participants to finish. At the end of the phase, the number of puzzles you solved correctly and the total EMUs you earned will be shown to you. This amount of EMUs constitutes your endowment and will be used to participate in the second phase of the experiment.

A.3.3. Experiment Phase Two: Auction

A.3.3.1. Motivation. In the second phase of the experiment we simulate a charity auction. Charity auctions are different from regular, for-profit, auctions because everyone associated with the charity benefits from the money that is raised. In noncharity auctions, only winners benefit. To simulate this difference, participants in these charity auction simulations will earn benefits from three sources: they earn benefits from winning the auction, they earn benefits from the total amount of money raised by the auction, and they earn benefits from their own contributions. The second source of benefits represents the fact that everyone benefits when money is contributed to charity, and the third source represents the fact that people often feel good about themselves for giving money.

A.3.3.2. Deciding whether to Participate and Bidding. In the second phase of the experiment, there will be 10 periods. At the beginning of each period, you will decide whether you want to participate in an auction or try to solve another word scramble. In the auction, you will have the opportunity to bid on a single unit of a fictitious good. Although the good is fictitious, it will have some real "value" to you – you can think of this as being the amount of money that the experimenter would pay you for the item if you obtained it in the auction. Each participant will learn his or her value for the item at the beginning of each period, but will not know any of the other participants' values. *Other participants will have different values*. Your value for the good will change each period, and how this value is determined is described in detail below.

If you choose to participate in the auction, you will submit bids for the fictitious commodity. This will be done by adding money to a "bucket" that holds all the bids. Each participant will be able to bid by paying money, at least 5 EMUs at a time, into the bucket. The bucket will be passed from one participant to another in an order that is randomly set at the beginning of the period. Once you have placed money in the bucket, it cannot be taken back and must be paid out of your endowment, and so, you cannot put more than your endowment into the bucket.

At any time during the auction when it is your turn to add money to the bucket, you can "pass," which means you pass the bucket to the next participant without adding anything. Once you pass you will be removed from the bidding for the period. The auction will end when there are two people left in the auction and one passes. *The winner of the auction will be the person who last put money into the bucket, even if that person has not added the most in total*. Bids and values will both be denominated in EMUs. How auction gains are determined is described in the next section.

As indicated above, participation in the auction is a choice. Before you decide to enter a bid or solve a scramble, you will be shown the value you will have for the fictitious good in the auction and the difficulty of the scramble you will have to solve. If you choose not to participate in the auction, you will have 2 minutes to solve the word scramble. If you solve it within the time limit, you will earn 15 EMUs; if you do not, you will earn 0 EMUs. The difficulty of the puzzle will change randomly at the beginning of each period, *but the difficulty is the same for all scramble solvers within a period.*

A.3.3.3. Auction Rules and Determining Profits. After all but one of the bidders have passed, the auction will end and the last person to add to the bucket will win. The revenue generated by the auction is the total amount in the bucket – the amount paid by all participants. As mentioned in Section 3.1, this revenue has value for all participants, regardless of AU :8 whether they participate in the auction or try the scramble: *each person earns 0.10 times the total auction revenue* – the second source of benefits referred to above. The amount each bidder contributes to the bucket has an additional value for them, so that *each bidder earns an additional 0.05 times the amount (s)he placed in the bucket*. This is the third source of benefits mentioned in Section 3.1.

We can work through an example to illustrate the pay-offs. Suppose that six people have entered the auction – let's call them Arthur, Barbara, Charles, Diane, Ethan, and Frances – and that four others have attempted the scramble. Suppose, too, that after Diane added some EMUs to the bucket, Ethan, Francis, Arthur, Barbara, and Charles all passed, so that Diane has won the auction. To calculate how much Diane gains or loses from this win, we need to know how much she values the object, how much she contributed to the bucket, and how much all of the others contributed. Suppose, for the sake of argument, that the object is worth 50 EMUs to her, she contributed 10, and that the five other bidders put a total of 90 EMUs in the bucket.

Diane's direct gain, the difference between what the object is worth and what she paid for it, is $50-10$, or 40.

Because 100 EMUs have been contributed to the bucket – the 10 that Diane contributed and the 90 that Arthur, Barbara, Charles, Ethan, and Frances combined contributed – each of them, and each of the four nonbidders, will receive an additional benefit worth 0.10×100 or 10 EMUs because the charity raised 100 EMUs of revenue from the auction.

And last but not least, Diane's good feeling is worth 0.05 of her contribution or $0.05 \times 10 = 0.5$ EMUs to her.

Altogether, Diane's direct and additional gains are therefore equal to $40 + 10 + 0.5 = 50.5$ EMUs. If she started the auction with an endowment of, say, 120 EMUs, she would leave it with $120 + 50.5 = 170.5$ EMUs.

What about someone like Arthur, who did not win the auction? Let's suppose that Arthur's endowment was 110 EMUs, that the object was worth 40 EMUs to him, and that he added 30 EMUs to the bucket. (Even if Arthur contributes more than Diane, he does not win the auction if he is not the *last* one to add to the bucket.)

Arthur's direct gain is -30 EMUs (i.e., he suffers a direct loss) because he bids 30 EMUs but does not win the object. The first of his two additional gains is the same as Diane's, or $0.10 \times 100 = 10$ EMUs, while the second is $0.05 \times 30 = 1.5$ EMUs because he put 30 EMUs in the bucket.

Altogether, Arthur's net gain is $-30 + 10 + 1.5$ or -18.5 EMUs. As he entered the auction with an endowment of 110 EMUs, he leaves with 91.5 EMUs.

Finally, what about those who attempted the word scrambles? Let's consider the hypothetical cases of Gerry, who does not solve his scramble, and Hannah, who does solve her scramble.

Gerry does not earn the 15 EMUs for solving the scramble, but he does receive the $0.10 \times 100 = 10$ EMUs that each of the bidders and nonbidders received in this auction. If he started with the auction with an endowment of 120 EMUs, he ends it with 130 EMUs.

Hannah earns 15 EMUs for her scramble and the $0.10 \times 100 = 10$ EMUs that all participants receive, and so, her combined gain is 25 EMUs. If she started the auction with an endowment of 130 EMUs, for example, she ends it with 155 EMUs.

In algebraic terms, the earnings of any participant can be summarized as follows:

$$\begin{aligned}&\text{Winning bidder earnings}\\&\quad= [\text{Endowment} + (\text{Value} - \text{Amount placed in bucket})] + 0.10\\&\qquad\times (\text{Total amount in bucket}) + 0.05 \times (\text{Amount placed in bucket})\end{aligned}$$

where "Amount placed in bucket" is the amount added by just this bidder, and "Total amount in bucket" is the amount added by all bidders combined. The total earnings for an auction participant who is not the last one to add to the bucket are as follows:

$$\begin{aligned}&\text{Earnings of other bidders}\\&\quad= [\text{Endowment} - \text{Amount placed in bucket})] + 0.10\\&\qquad\times (\text{Total amount in bucket}) + 0.05 \times (\text{Amount placed in bucket})\end{aligned}$$

The earnings of people who choose to try the scramble instead of participating in the auction are as follows:

if you get it right:

$$\text{Earnings of scrambler} = (\text{Endowment} + 15) + 0.10 \times (\text{Total amount in bucket})$$

if you get it wrong:

$$\text{Earnings of scrambler} = \text{Endowment} + 0.10 \times (\text{Total amount in bucket})$$

A.3.3.4. Determination of Final Dollar Pay-offs. After 10 rounds of the auction have been played, the computer will randomly pick one round to count toward your final earnings from the experiment. Because the computer will pick one round randomly, each auction period is completely independent of the others (i.e., you do *not* accumulate gains or losses from one period to the next). *However, if you make losses in the auction phase, they will be deducted from the money you earn in the first, endowment phase*. The computer will report to you the randomly chosen round and your final pay-off in EMUs. After the questionnaire stage is complete, the computer will report your earnings in dollars. All data collected in the experiment will be anonymous and used only for academic research. You will be paid privately, and no other participant will be told what you earned in the experiment.

A.3.4. Auction Details

A.3.4.1. How are the Values Generated? Values are chosen randomly from the interval 0 to 100 EMUs. Your value is independent of the values of all other experiment participants and of your value from other rounds: Knowing your value in a given round tells you nothing about the values of other experiment participants, and knowing your values in previous rounds tells you nothing about your value in the current round. All values between 0 and 100 are equally likely.

A.3.4.2. How Much and How Little Can I Add to the Bucket? You can add as little as 5 EMU, and as much as you like as long as the total amount you have placed in the bucket does not exceed your endowment. The bucket will start out empty. If all active bidders pass the bucket before anyone adds money to it, the auction ends, there is no winner, and auction revenues and all auction participants' gains are zero. If this is the randomly chosen round for payment, all the auction participants will just earn their phase one endowments.

APPENDIX B. THE SURVEY

B.1. Experiment Summary and Concluding Questionnaire

While we determine how much we owe you, please complete a short questionnaire to be used in our analysis of the experimental data. The questionnaire should take less than 10 minutes to complete. All responses will be kept confidential and will not be stored with any personally identifiable information. By completing this survey, you consent to having the anonymous information used solely for purposes of academic research.

1. How old are you? [years]
2. What is your sex? [female, male]
3. From which group were you recruited? [student, staff, faculty, not directly affiliated with the College]
4. Which of these racial/ethnic groups describes you best? [white/Caucasian, African-American, Asian-American/Asian, Latino/Hispanic, other/mixed]
5. Were you born in the United States? [yes, no]
6. If you were not born in the U.S., how many years have you lived here? [years]
7. What is the zip code of your permanent residence? [5 digits]
8. What is your occupation? [text input]
9. How much schooling have you had? [less than high school, high school degree, some college, college degree, graduate degree]
10. What is your annual household income? [less than $25k, $25k-$50k, $50k-$75k, $75k-$100k, $100k-$125k, $125k-$150k, more than $150k]
11. In how many economic experiments (besides this one) have you participated? [number]
12. Have you ever participated in the charity auction? [yes, no]
13. Have you ever participated in a noncharity auction? [yes, no]
14. Approximately how many auctions have you participated in over the past 2 years (including online auctions like eBay)? [none, 1–10, more than 10]
15. How difficult was it to understand the rules of this experiment [5 point likert]
16. Briefly, how did you decide whether or not to participate in a given round? [text input]
17. Briefly, how did you decide what to bid in the auction (or how much money to spend on tickets in the raffle)? [text input]
18. In the first round in which you bid or bought raffle tickets, how difficult was it to decide how much money to spend? [5 point likert]
19. In the last round in which you bid or bought raffle tickets, how difficult was it to decide how much money to spend? [5 point likert]
20. In your opinion, how many rounds (between 1 and 10) would it take the typical person to fully understand this fund-raising mechanism? [number between 1 and 10]

21. Do you think that participants in this fund-raising mechanism are treated fairly? [10 point likert]
22. We are interested in your opinion as to the ability of different mechanisms to raise money for charity. Please consider some other mechanisms that you might not have participated in today. In each case we will describe the mechanism and then ask you how well you think it will perform based on three criteria: revenue for the charity, fairness to participants, and complexity. (Move the slider bar to the left or right to indicate your ranking.)
23. The standard auction in which an auctioneer calls out prices and the highest bidder wins and pays his or her bid. [revenue rank, fairness rank, complexity rank]
24. The all-pay auction in which the highest bidder wins but all participants have to pay their bids whether they win or lose. [revenue rank, fairness rank, complexity rank]
25. The silent auction in which participants write bids on a sheet of paper and the highest bidder wins and pays his or her bid. [revenue rank, fairness rank, complexity rank]
26. The raffle in which participants buy tickets and the winning ticket is drawn at random. [revenue rank, fairness rank, complexity rank]
27. The mechanism you participated in today if it is not listed above. [revenue rank, fairness rank, complexity rank]
28. We would also like to ask you a few questions about your personal preferences and attitudes.
29. In general, do you see yourself as someone who is willing , even eager, to take risks, or as someone who avoids risks whenever possible? [10 point likert]
30. Concerning just personal finance decisions, do you see yourself as someone who is willing, even eager, to take risks, or as someone who avoids risks whenever possible? [10 point likert]
31. In general, do you see yourself as someone who, when faced with an uncertain situation, worries a lot about possible losses, or someone who seldom worries about them? [10 point likert]
32. Concerning just personal finance decisions, are you someone who, when faced with an uncertain situation, worries a lot about possible losses, or someone who seldom worries about them? [10 point likert]
33. In general, how competitive do you think that you are? [10 point likert]
34. Concerning just sports and leisure activities, how competitive do you think that you are? [10 point likert]

35. Lastly, we would also like to ask you to predict how you would behave in a few hypothetical situations.
36. Imagine that you've decided to see a movie in town and have purchased a $10 ticket. As you're waiting outside to theatre for a friend to join you, you discover that you've lost the ticket. The seats are not marked and the ticket cannot be recovered because the person who sold it doesn't remember you. Would you buy another $10 ticket? [yes, no]
37. Imagine that a month ago, you and a friend made a nonrefundable $100 deposit on a hotel room in Montreal for the coming weekend. Since the reservation was made, however, the two of you have been invited to spend the same weekend at another friend's cottage in Vermont. You'd both prefer to spend the weekend at the cottage but if you don't go to Montreal, the $100 deposit will be lost. Would you still go to Montreal? [yes, no]
38. Finally, imagine that some time during the summer of 2009 you purchased several bottles of the same wine at a price of $20 each, in anticipation of some later celebration. The celebration never happened, however, and, until now, the bottles were forgotten. You find out, however, that the wine can now be sold for $75 per bottle. You nevertheless decide to drink one of the bottles. Which of the following best captures your own feeling of the cost, to you, of drinking the bottle? [−$55, $0, $20, more than $20 but less than $75, $75]

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