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Barking Up the Right Tree: Are Small Groups Rational Agents?

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Abstract

Both mainstream economics and its critics have focused on models of individual rational agents even though most important decisions are made by small groups. Little systematic work has been done to study the behavior of small groups as decision-making agents in markets and other strategic games. This may limit the relevance of both economics and its critics to the objective of developing an understanding of how most important decisions are made. In order to gain some insight into this issue, this paper compares group and individual economic behavior. The objective of the research is to learn whether there are systematic differences between decisions made by groups and individual agents in market environments characterized by risky outcomes. A quantitative measure of deviation from minimally-rational decisions is used to compare group and individual behavior in common value auctions.

1. Introduction

A central feature of mainstream twentieth century economics is its reliance on models of individual rational decision-making. Criticism of economics usually focuses on conclusions about empirical failure of rational agent models. Much of this criticism comes from cognitive psychology or from economists with backgrounds in cognitive psychology or behavioral science. Indeed, critical discourse on rational choice models is often framed as a contest between economic theory and the falsifying evidence from cognitive psychology. An example that illustrates this point is provided by Hogarth and Reder (1987), the published record of a conference on economics and psychology.

A problem shared by economics, its critics, and its defenders is that they all appear to be "barking up the wrong tree" in focusing on the use of, or criticisms of, models of *individual* rational agents.[1] This statement follows from observing that most important economic, political, legal, scientific, cultural, and military decisions are made by groups. Decision-making groups have many forms including families, management teams, boards of directors, central bank boards, juries, appellate courts, committees of various types, and legislatures. Decision-making responsibility may be assigned to groups, rather than individuals, because of a belief that (a) important pieces of information are possessed by different individual members of groups and/or (b) groups are inherently more rational than individual decision-makers. Whether groups make better decisions than individuals in some or all environments and, if they do, whether this reflects an advantage from having more information available, are empirical questions.

Many researchers in psychology and management science have previously studied group decision-making. Our research involves three important departures from previous work in that we conduct the experiments in an environment in which (a) groups compete in strategic market games, (b) the distinct information possessed by individual group members is varied as an experimental treatment, and (c) the extent to which a group's decisions depart from rationality is quantitatively measured.

We compare group and individual decision-making in the context of bidding in common value auctions. Auction market bids are commonly decided by groups. For example, oil companies typically use committees of geologists and managers to formulate bidding strategies (Capen, Clapp, and Campbell, 1971; Hoffman, Marsden, and Saidi, 1991). Many general contractors bring several people together to build a bid package (Dyer and Kagel, 1996). In this strategic decision-making environment, are there grounds for expecting groups to perform better (or perhaps worse) than individuals?

In a common value auction, the value of the auctioned item is the same to all bidders but the bidders do not know that value at the time they make their bids. If all N bidders in the market have unbiased estimates of the item's value, and use the same monotonically increasing bidding strategy, then the high bidder will be the one with the most optimistic estimate. But the highest of N unbiased estimates is biased upwards and, if bidders do not take into account this property of order statistics, then winning bidders can on average pay more for auctioned items than they turn out to be worth. This phenomenon is known as the "winner's curse" (Capen, Clapp, and Campbell, 1971).

The winner's curse cannot occur if all bidders are rational (Cox and Isaac, 1984, 1986), and therefore evidence of the winner's curse in market settings is considered by Thaler (1988, 1992) to be an anomaly. But avoidance of the winner's curse is not an easy task: it requires bidders to be able to distinguish between the expected value of the auctioned item, conditioned only on the prior information available (their value estimates), and the expected value of the item conditioned on winning the auction.

Authors of numerous papers on experiments with common value auctions (e.g., Thiel, 1975; Bazerman and Samuelson, 1983a,b; Kagel and Levin, 1986; Kagel, *et al*., 1989; Lind and Plott, 1991; Cox, Dinkin, and Swarthout, 2001) have reported that bidders often suffer from the winner's curse. But all of these previous experiments have involved bids decided by individuals. The implications of this research for group bidding behavior are unknown.

One reason why firms and other organizations bring several people together to decide on a bid may be their conjecture that group members have different information available about the auctioned item or, if the information is common to all group members, that it may be open to individual interpretations. Alternatively, firms may have bids decided on by groups because of a belief that groups are more rational than individuals in the strategic environment of the common value auction. If groups have more information than individuals, and groups utilize their information no less rationally than do individuals, then it would obviously follow that group performance would be better than individual performance in auctions. But the actual relative performance of groups and individuals in common value auctions is an empirical question that we address with our experiments.

We report results from experiments designed to provide comparisons of individual and group bidding behavior. If group bidding differs from individual bidding, this could result from groups having more information or, alternatively, better or worse judgment. This distinction is examined by crossing an information density (signal sample size) treatment with the bidding entity (groups or individuals) treatment in the experimental design.

2. Previous Research on Group vs. Individual Decisions

Kerr, MacCoun, and Kramer (1996) review literature on decisions of small groups to find out whether they are less or more subject to judgmental errors than individuals. Kerr, et al. concluded that the data imply that group decisions can attenuate, amplify, or simply reproduce the decision biases of individuals and suggested that these findings can be explained by the nature of the decision task.

A task is defined as intellective if there is a normative criterion for evaluating the quality of a decision, and as judgmental if no such criterion exists (Laughlin, 1980; Laughlin and Ellis, 1986; McGrath, 1984). Intellective tasks are further divided on the basis of their "demonstrability"; highly demonstrable tasks are those where the argument prescribed by the normative model is self-evidently correct (Gigone and Hastie, 1993; Laughlin and Ellis, 1986). This leads to the prediction that groups will outperform individuals on highly demonstrable tasks (Laughlin, et al., 1976; Laughlin and Ellis, 1986; Davis, 1992). Cason and Mui (1997) study individual and group decisions in the dictator game and explore the group polarization hypothesis (Isenberg, 1986) that group decision-making selects extreme rather than modal individual outcomes. Blinder and Morgan (2005) report that groups make better decisions than individuals in two macro economy "steering" tasks. Bornstein (1992) reports that groups offer less and are willing to accept less in the ultimatum game and Bornstein and Yaniv (1998) suggest that the subgame perfect equilibrium argument ("player 2 should accept any positive offer since anything is better than nothing"), when voiced, had a decisive effect on group decisions. Cooper and Kagel (forthcoming) report that two person groups play more strategically than individuals in signaling games.

Although a few of the group behavior experiments cited in the preceding paragraph involve strategic games, none involve markets. We experiment with group and individual behavior in the context of a market for which there is a quantitative measure of deviation from minimally rational decisions.

3. Rational Bidding in Common Value Auctions

There may be various reasons why groups have responsibility for making decisions, not the least of which is the possibility that each individual will bring some distinct information to the process. In section 3.2 we develop a formal representation of the advantage of having more information about the value of the auctioned item. But first consider the information environment commonly used in previous research on common value auctions with individual bidders.

3.1 Implications of an Individual Estimate of Value

Consider a first-price sealed-bid auction in which bidders do not know the value of the item being sold when they bid and the value *v* of the item is the same for all bidders. Suppose that each bidder receives an independent signal s_i that provides an unbiased estimate of the item's value. The expected value of the item conditional on the bidder's signal is written as $E(v \mid s_i)$. The expected value of the auctioned item conditional on the bidder's own signal being the highest of *N* signals (i.e., equal to the highest order statistic, y_N) is written as $E(v \mid s_i = y_N)$. For bids by $N > 1$ bidding entities, one has

(1) $$E(v \mid s_i) = s_i > E(v \mid s_i = y_N)$$

by well-known properties of order statistics. Statement (1) implies that if bidders naively submit bids equal to their common value estimates then they will have an expected loss from winning the auction; that is, they will suffer from the winner's curse.

The comparison between the unconditional and conditional expected values in statement (1) can be quantified by considering the case where the common value of the auctioned item is uniformly distributed on $[v_l, v_h]$ and each individual agent's signal is independently drawn from the uniform distribution on $[v-\theta, v+\theta]$. For this case, one has

(2) $$E(v \mid s_i = y_N) - E(v \mid s_i) = -\frac{N-1}{N+1}\theta,$$

for all $s_i \in [v_\ell + \theta, v_h - \theta]$. Statement (2) implies that if bidders naively submit bids equal to their common value estimates then they will have an expected loss in the amount $\theta(N-1)/(N+1)$. This expected loss is increasing in the number of bidders *N*.

3.2 The Advantage from More Information

Next consider the case where each bidder has $S > 1$ signals (or estimates) of the value of the auctioned item that are independently drawn from the uniform distribution on $[v-\theta, v+\theta]$. The signal sample midrange m_i provides an unbiased estimate of the value of the auctioned item when the signals are drawn from a uniform distribution. The expected value of the auctioned item conditional on the bidder's signal sample midrange is denoted by $E(v \mid m_i)$. The expected value of the auctioned item conditional on the bidder's own signal sample midrange being the highest of N signal sample midranges (i.e., equal to the highest order statistic of sample midranges, z_N) depends on the sample's range r_i and is denoted by $E(v \mid r_i, m_i = z_N)$. With signals drawn from the uniform distribution, one has

$$
\begin{aligned}
E(v \mid r_i, m_i = z_N) - E(v \mid m_i) &= -\frac{N-1}{N+1}\theta + \frac{N-1}{2(N+1)} r_i \\
&= -\frac{N-1}{N+1}\left(\theta - \tfrac{1}{2} r_i\right)
\end{aligned} \tag{3}
$$

Comparison of the right hand side of equation (2) with the second line of equation (3) reveals that bidders with $S > 1$ signals will have smaller expected losses from naive bidding than will bidders with a single estimate of value.

Equation (3) provides a measure of the size of the winner's curse that may be exhibited by winning bidder *i* in a market with *N* bidders:

$$
EVCurse = b_i^w - E(v \mid r_i^w, m_i^w = z_N) \tag{4}
$$

where b_i^w is the winning bid, v is the common value of the auctioned item, r_i^w is the winning bidder's signal sample range, m_i^w is the winning bidder's signal sample midrange, and z_N is the *Nth* order statistic of sample midranges (or signals, for signal sample size 1). Since *EVCurse* is the size of the expected loss (or profit, if it is negative) from winning the auction, it provides a quantitative criterion for determining the extent of deviation from minimally-rational bidding in common value auctions.

In order *not* to have an expected loss from winning, a bidder with signal sample with midrange m and range r must bid no more than the amount $E(v \mid r_i^w, m_i^w = z_N)$. As shown by equation (3), a bidder must discount it's naive estimate of the common value (its signal or its signal sample midrange) by at least the amount $(\theta - \frac{1}{2}r)(N-1)/(N+1)$ in order to have nonnegative expected profit from bidding (where it is understood that *r* = 0 for signal samples of size 1). The size of this minimum rational discount (*MRD*) is *independent* of the value of the signal sample midrange m_i so long as $m_i \in [v_\ell + \theta, v_h - \theta]$. This condition is essentially always satisfied by the signals drawn in our experiments in which $\theta = 1800$ and $[v_\ell, v_h] = [2500, 22500]$. The size of *MRD* is monotonically *increasing* in the size of the market (or number of bidders) *N* except in the improbable extreme case where the signal sample range *r* equals 2θ, the range of the support for the probability distribution of signals. In contrast, the size of *MRD* is monotonically *decreasing* in the signal sample range *r*. The reason for negative monotonicity of *MRD* in *r* is intuitively clear because *r* provides a measure of how informative the signal sample is: (a) if $r = 2\theta$ then *MRD* = 0 because in that case the bidder knows the value of the auctioned item with certainty (it is equal to the value of the smallest signal plus *r*); and (b) if *r* = 0 then *MRD* equals $\theta(N-1)/(N+1)$, the same amount as in the customary single signal case (see equation (2)), because in that case *S* > 1 signals don't provide any more information about the value of the auctioned item than would a single signal.

The preceding analysis of the information content of signal samples shows that having *S* > 1 signals should make it easier to avoid the winner's curse than it is with a single signal. But bidding behavior may be inconsistent with this prediction. It is known from previous experiments with individual subjects with single signals s_i that bidders do not sufficiently increase their discounts from s_i as market size *N* increases. As a result, the winner's curse has high incidence in *N* = 7 treatments but not in *N* = 3 treatments (Kagel and Levin, 1986; Cox, Dinkin, and Swarthout, 2001). There may be a similar problem with variable signal sample range in multiple signal treatments. A question that can be addressed with our multiple signal treatments is whether bidders sufficiently increase their discounts from signal sample midrange as the sample range decreases so as to avoid the winner's curse in multiple signal treatments. Further questions are concerned with the effects of interactions among market size, signal sample size, and composition of the bidding unit (individual or group).

Deviations from minimally-rational bidding can be measured by linear regressions relating winning bids to the signal sample midranges and ranges of the winning bidders, as we do in section 6. Bids that yield zero expected profit are given by the following equation when $m_i \in [v_\ell + \theta, v_h - \theta]$:

$$(5) \qquad b^{Zero} = -\frac{N-1}{N+1}\theta + m_i + \frac{N-1}{2(N+1)} r_i \,.$$

Bids that are lower than b^{Zero} have non-negative expected profit *regardless of what rival bidders are bidding*. In contrast, bids that are higher than b^{Zero} are not economically rational because they have non-positive expected profit, that is, they exhibit the winner's curse.[2] Of course, a bid may be less than b^{Zero} but still higher than the Bayesian-Nash equilibrium bid for the bidder's signal sample. But that would not imply that the bid is irrational unless the bidder knew that all other bidders were bidding according to the Bayesian-Nash equilibrium bid function. If rival bidders are bidding above the Bayesian-Nash equilibrium bid function then a bidder's rational best reply may be to also bid higher than bids specified by the equilibrium bid function. But it would never be rational to bid higher than b^{Zero} because: (a) such bids have non-positive expected profit regardless of what rival bidders are bidding; and (b) such bids have negative expected profit if rival bidders are bidding no more than b^{Zero}. In short, a bidder who bids above b^{Zero} will have negative expected profits unless there are "bigger fools" to save him from having the high bid by making bids with negative expected profits themselves. Therefore, it is comparison with b^{Zero} that provides a strong test for rational bidding. Any bid above b^{Zero} is characterized by the winner's curse, which is not rational bidding.

4. Experimental Design: Signals, Bidders, and Markets

Our design crosses: (a) bidding entity composition with (b) variable signal sample with (c) variable market size. The rationale for several features of the design and protocol are as follows.

4.1 Rationale for Varying the Signal Sample Size

Group bidding may differ from individual bidding either because (a) groups are inherently more or less rational than individuals or (b) individual members of groups have distinct estimates of the value of the auctioned item. Exploration of the differences between individual and group bidding requires that one separate the effects of the composition of the bidding unit *per se* from the effects of signal sample size. We cross the bidding unit composition treatment with the signal sample size treatment.

4.2 Rationale for Varying the Market Size

We also "cross" a market size treatment (3 or 7 bidding units) with the bidding unit composition and signal sample size treatments. The reason for varying the market size in this way is that previous researchers have found that once- or twice-experienced *individual* bidders in markets of size 3, where each individual has a signal sample size of 1, do *not* suffer the winner's curse whereas in markets of size 7 individual bidders with the same experience and signal information do suffer from the winner's curse so badly that most of them go bankrupt (see, for example, Kagel and Levin, 1986). We address the following questions with our experimental design: (1) Do group bidders fare the same or differently than individual bidders in the 3-bidder and 7-bidder market sizes? (2) Does the answer to question (1) depend on whether the group bidders have the same or larger signal sample sizes than the individual bidders? (3) Do group and/or individual bidders with larger signal sample sizes fare the same or differently than they do with a signal sample size of 1 in the 3-bidder or 7-bidder market sizes?

4.3 Rationale for Using Groups Consisting of Five Subjects

Some of the literature on group behavior has questioned whether a 3 person group is large enough to elicit true "group" behavior. In order to avoid potential criticisms that we did not use large enough groups in our experiments, we need to use groups of at least size 4. Since some of our groups might try to make decisions by voting on proposals, we want to avoid a group size that is an even number so as to always admit the possibility of a decisive majority vote. We use groups of size 5.

4.4 Rationale for Using Experienced Subjects

Reports of results from previous common value auction experiments with individual bidders have focused on the behavior of experienced subjects, where "experience" means having participated in one or more previous common value auction experiments. The reason for this is that most subjects fall victim to the winner's curse in *all* experimental treatments when they are first-time bidders but such inexperienced behavior is not considered to be very interesting. We use subject experience as a treatment to allow comparison of our results with those in the literature.

4.5 Information and Repetition

Both individuals and groups have opportunities to learn from experience about the implications of not discounting their signal sample estimates of the common value. This will occur both within treatment sessions and between treatments at different subject experience levels. Within-session learning can occur because treatment sessions consist of at least 30 rounds of bidding with information feedback. After each round of bidding is concluded, all subjects are informed of the amount of the winning bid and the common value of the auctioned item, and therefore about the profit or loss realized by the high bidder.

5. Experiment Procedures

Experiment sessions with individual bidders were conducted in the Economic Science Laboratory (ESL). Sessions with group bidders were conducted in the breakout rooms of the Decision Behavior Laboratory (DBL). ESL and DBL are adjacent laboratories in McClelland Hall at the University of Arizona. Each group or individual had its own personal computer that was connected to a local area network running customized auction software. Subjects were recruited from the undergraduate student population.

Treatments were implemented in three-day sequences of two-hour sessions. Subject instructions contained a detailed description of the information environment of the common value auctions. Subjects were informed in non-technical terms that in each auction round the computer would draw a value *v* for the auctioned item from the discrete uniform distribution on the integers greater than or equal to 2,500 experimental dollars and less than or equal to 22,500 experimental dollars. They were informed that the common value would not be revealed but that it would be the midpoint of a uniform distribution from which their value estimates, or signals, would be independently drawn. Subjects were informed in non-technical terms that after the computer drew a common value *v* for a round it would draw all signals independently from the uniform distribution on [*v*-1800, *v*+1800].

On day 1 of the three-day sequence, the inexperienced subjects first participated in 10 periods of practice auctions. After each practice auction, the subjects' computer monitors displayed the common value, all subjects' bids, and the amount won or lost by the high bidder. The subjects were each given a capital endowment of 1,000 experimental dollars in order to allow them to make at least one sizable overbid without becoming bankrupt. At the end of the practice rounds, the subjects' profits and losses were set to zero and they began the 30 monetary payoff rounds with new 1,000 experimental dollar capital endowments. The actual number of monetary-payoff rounds to be completed was not announced. During the monetary payoff rounds the information reported at the end of each auction included only the common value and the high bid, not the bids by other bidders. We decided not to report all bids in order to make collusion difficult and to adopt procedures that correspond to minimal reporting requirements in non-laboratory auctions. The procedures were the same on day 2 as on day 1. Procedures were the same on day 3 except that only the common value and high bid (rather than all bids) were reported in the practice rounds to further inhibit any attempts at collusion by the twice-experienced subjects.

Signals were presented to the subjects on sheets of paper. In treatments with signal sample size of 1, each subject was given a single sheet of paper with signals for 10 practice rounds and 40 monetary-payoff rounds. In the group-bidding treatments with signal sample size of 1, each member of a group had a sheet of paper with signals that were identical to the signals of other members of the same group but distinct from the signals of members of other groups. In treatments with signal sample size of 5: (a) each subject in an individual bidder experiment had 5 sheets of paper with independently-drawn signals; and (b) each subject in a group bidding experiment had 1 sheet of paper with independently-drawn signals. Since the groups each had 5 members, each group in a treatment with signal sample size 5 had access to the same information as an individual subject in the individual-bidder treatment with the same signal sample size. The groups were informed that they were free to use their signal sample sheets within their own breakout rooms during an experiment session any way that they wanted to. The experimenters collected all sheets of signals at the end of each session.

Signals, common values, and bids were denominated in experimental dollars, with a clearly specified exchange rate into U.S. dollars, for two reasons. The less important reason was that this made it easy to require that all bids be integers, thus avoiding the bid entry errors produced by subjects' having to use decimal points in their responses. The more important reason was to eliminate extraneous sources of variation across treatments. We held constant the experimental-dollar capital endowments, sequence of common values, and (the relevant) signals across the market size, signal sample size, and group/individual bidder experimental treatments. Thus the only source of variability across treatments came from the behavioral responses to the treatments. Without use of a variable exchange rate from experimental dollars into U.S. dollars, the monetary incentives would have been different for individual subjects in the individual-bidder and group-bidder experiments and the (Nash equilibrium) expected profits of bidders would have varied inversely with the square of the market size.

The U.S. dollar incentives in the experiment were non-trivial. Consider for example, the group bidder treatment with market size 7 and signal sample size 1 (treatment (5, 1, 7) in section 6 and Tables 2 and 3). The exchange rate was 9 experimental dollars per 1 U.S. dollar. If in some auction round all bidders were to have bid naively and submitted bids equal to their signals, then the group with the high bid would have had an expected loss of 150 U.S. dollars from just this one "winning" bid.

Many inexperienced individual and group bidding entities made winning bids that turned out to be so high that they attained large negative cumulative payoffs. A nontrivial number of once-experienced and twice-experienced subjects also incurred negative balances. When a bidder's cumulative payoffs were negative at the end of a session the loss was forgiven (the bidder was permitted to "go bankrupt"). Dismissing negative balance subjects from further participation was not an option in our experiment because: (a) we needed to keep market size constant, and therefore could not simply dismiss negative balance subjects during a session; and (b) experience was a treatment, and hence we could not substitute new subjects for bankrupt ones between sessions. In the data analysis reported in section 6 we delete observations for periods within a session with negative balance bidders. Again, all bids by all bidders within a treatment session are deleted for all periods following the bankruptcy of any single bidder.

Forgiving losses between sessions did not change the bidding strategies that are rational. The only way bidders could protect against loss of their endowments, and have prospects of earning higher payoffs, was to submit bids less than b^{zero} given by equation (5). Forgiving losses between sessions, and permitting subjects to begin anew at a subsequent session, is arguably a laboratory idealization of experience in the national economy. Recent studies have reported that only about 3% of publicly held companies in Chapter 11 bankruptcy are liquidated within 5 years (Alderson and Betker, 1999; Eberhart, Altman, and Aggarwal, 1999; Hotchkiss, 1995); others have debts forgiven and continue operating.

6. Bidding in the Auctions: Group vs. Individual Behavior

Subjects in group treatments were informed that they were free to use their signal sheets in any way that they wished. Signals appeared to be freely shared within groups with 5 signals; some put their sheets together with tape or staples, and marked the low and high signals in each period. Others called out their signals for one member to record on one of the signal sheets. Groups engaged in much discussion of how to proceed, often mapping out several periods with their decision strategy prior to entering a bid in the first practice period. All groups used at least one calculator. Ex post examination of the written-on sheets, revealed that many groups averaged their signals. One group even brought a laptop on the 3rd day and used a spreadsheet model. All of the groups appeared peer-oriented. Upon debriefing, groups commented on how important it was for them to "achieve consensus" before entering a bid.

Inspection of data from the experiment indicates that both individuals and groups are very subject to the winner's curse when they are inexperienced. High rates of incidence of losses from the winner's curse with inexperienced subjects can swamp experimental treatment effects. The more interesting data are for experienced subjects. Tables 1-3 report data from the final day's bidding in each treatment.

The salient monetary rewards earned by subjects on the final day are reported in Table 1, as are the experimental/U.S. dollar exchange rates used in the treatments. There were large differences between the lowest and highest earnings in all treatments. Non-bankrupt bidder averages are shown in the third column of Table 1. As explained in section 5, our experimental design involves manipulation of the exchange rate so as to keep the monetary incentives *per individual* approximately the same, regardless of market or group size.

Tables 2 and 3 report random effects regressions in which the bidding entity (individual or group bidder) is the observation unit. The dependent variable is the amount of the bid and independent variables are signal sample midrange and range. In order to identify treatment effects, we interact midrange and range with dummy variables for the (G, S, N) treatments where: G denotes the size of the bidding Group (1 for individuals or 5 for five-person groups); S denotes the Signal sample size (1 or 5); and N denotes the Number of bidding entities in the auction (3 or 7). The coefficient estimates are reported as deviations from the theoretical values in equation (5): estimated intercepts are reported as deviations from $-\theta(N-1)/(N+1)$; estimated midrange slope coefficients are reported as deviations from 1; and estimated range slope coefficients are reported as deviations from $(N-1)/2(N+1)$.

<u>6.1 Comparison of the Performance of Individual and Group Bidders</u>

First consider the parameter estimates reported in Table 2 for all bidders. The first two columns of Table 2 report the central comparison for market size 3 (*i.e.* N = 3): a treatment using individual bidders (*i.e.* G

= 1) and signal sample size 1 (*i.e.* S = 1) is compared with a treatment using group bidders (*i.e.* G = 5) and signal sample size 5 (*i.e.* S = 5). Comparison of the estimated intercept and slope deviations from the values in equation (5) provides a measure of the departure from rational bidding by the bidders in an experiment. Equation (5) shows that bidders with a single signal in an N = 3 market need to discount their signals by at least 900 ($=\theta(N-1)/(N+1)$ for N = 3 and θ = 1800) in order to avoid the winner's curse. The reported intercept deviation of +66 in the (G, S, N) = (1,1,3) column means that bidders in this individual bidder treatment with signal sample size 1 discounted their signals by only 834; hence they nominally failed to discount their signals sufficiently to avoid the winner's curse but this deviation was insignificantly different from 0 by a one-tailed 5% *t*-test. In comparison, bidders in the (5,5,3) group bidder treatment with signal sample size 5 had a nominal intercept deviation of +275 but this deviation was also insignificantly different from 0. The midrange slope deviations for both types of bidding entities and the range slope deviation for group bidders are all less than 1.5% of their theoretical values and insignificantly different from zero by a two-tailed 5% *t*-test.

The third and fourth columns of Table 2 compare the performance of bidders in individual and group bidding treatments with a market size of 7. The intercept deviation for individual bidders with signal sample size of 1 (treatment (1, 1, 7)) is +371 whereas it is +268 for groups with signal sample size of 5. In this comparison, group bidders with more information are nominally farther from winner's curse bidding than are individuals with less information about the value of the auctioned item although neither deviation is significantly different from 0 (because of large standard errors).

6.2 Comparison of the Performance of Individual and Group Winners

It is germane to understanding the effects of bidding entity composition and item value information on the rationality of bidding behavior to analyze all bid data, as we do in Table 2. But it is more central to understanding the incidence of the *winner's* curse to analyze the winning bids, as we do in Table 3.

Both individual and group high bidders with single signals do not deviate significantly from minimally-rational bidding in either three bidder or seven bidder markets, as is clear from inspecting the results reported in Table 3 for treatments (1,1,3), (5,1,3), (1,1,7), and (5,1,7). Comparisons involving multiple signals tell a different story.

The first two columns of Table 3 report the central comparison for winning bidders in market size 3. The reported intercept deviation of +31 in the (1,1,3) treatment is positive but not significant. In contrast, the intercept deviation for treatment (5,5,3) is +544, and significantly positive. In this specific way, group high bidders with more information are less rational than individual high bidders in three bidder markets. The direction of the market size 7 comparison is the same; while the intercept deviation in treatment (1,1,7) is +284 it is much larger and significantly positive, at +1411, in treatment (5,5,7). Therefore group high bidders with more information are less rational than individual high bidders with less information in seven bidder markets as well as three bidder markets.

The intercept deviations for group high bidders with single signals are positive for the three bidder (treatment (5,1,3)) and negative for the seven bidder (treatment (5,1,7)) markets. Individual high bidders with more information are rational in three bidder markets (treatment (1,5,3)) but not in seven bidder markets (treatment (1,5,7)); in the latter treatment the intercept deviation is +713 and, not surprisingly, significantly positive.

The range deviation estimates reported in the third row of Table 3 provide insight into how more information about auctioned item values (signal sample size of 5 rather than 1) leads winning bidders into irrational bidding strategies, especially when they bid as groups rather than individuals. The right hand side of equation (2) shows the minimum rational discount (*MRD*) from the naïve estimate of item value that is needed to avoid the winner's curse when the bidder has a single signal. The size of the *MRD* is an increasing function of market size N. As has been emphasized in previous literature (e.g., Kagel and Levin, 1986; Cox, Dinkin, and Swarthout, 2001), many individual bidders with single value signals make too small signal discounts when $N > 3$. The right hand side of the first line of equation (3) shows two components of *MRD* in the multiple signal environment. The first component is the reduction in amount bid that corresponds to the *MRD* in single signal environments. The second component is the partially offsetting increase in amount bid because of better information about item value in multiple signal environments with signal sample range *r* greater than 0. The pattern of deviations in treatments (5,5,3), (5,5,7), and (1,5,7) reveals that significantly positive deviations in intercepts are associated with significant deviations in range slopes (and insignificant deviations in midrange slopes). The positive intercept deviations reveal that high bidders in these three treatments generally did not discount their signals enough to avoid the winner's curse. This inconsistency with rational bidding was compounded by the irrational use of better information about the value of the auctioned item that is revealed by the significant deviations of the slope parameters for signal sample range from the theoretical values in equation (5). These range-slope parameter deviations indicate that high bidders did not rationally change their bid discounts when signal sample range decreased (or the informativeness of the signal sample decreased). The range-slope deviations are significant for group bidders in both three bidder and seven bidder markets but only for the larger, seven bidder markets for the individual bidders. This range-slope comparison reinforces the above comparison of significant intercept deviations for individual and group bidders. Individual bidders with signal sample size 5 deviate significantly from minimally-rational bidding in seven bidder markets but not in three bidder markets, whereas group bidders deviate significantly from minimally-rational bidding in both the smaller and larger markets.

7. Summary and Conclusions

Are group winning bidders more or less subject to the winner's curse than individual high bidders in common value auctions? Our research suggests that the answer depends upon the defining characteristics of groups. If groups are characterized as decision-making entities consisting of individuals with distinct information, then comparison of winning bids from treatments involving groups, with signal sample size of 5, with treatments involving individuals, with signal sample size of 1, supports the conclusion that groups are less rational than individuals. On the other hand, if groups consist of individuals that have common information then comparison of high bids from treatments involving groups, with signal sample size of 1, with treatments involving individuals, with signal sample size of 1, does *not* support a conclusion that groups are less or more rational than individuals.

We think that it is a surprising feature of our results that *more* information about the value of the auctioned item causes both individuals and groups to deviate *further* from rational bidding and that this "curse of information" is worse for groups than for individuals. Our experiment data do not support analysis that has appeared in previous literature. Hoffman, et al. (1991) explained the prevalence of joint bids for offshore oil leases as *not* resulting from anti-competitive efforts to reduce competition in the auction but, instead, as a result of firms' efforts to avoid the winner's curse because "…with several signals to compare, firms can better identify and filter out exceptionally high signals" (p. 103). Our experiment data contradict this analysis in that we find that our groups' performance deteriorates significantly when they have "several signals to compare."

Endnotes

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1. It is important to point out in this context that all except one of the first author's previous papers involving rational agent models have used individuals as decision-makers.

2. Of course, for the special case of signal sample size of 1, the sample midrange equals the signal and the sample range equals 0.

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Table 1. Salient Earnings for Twice-Experienced Subjects

(*G*, *S*, *N*)[a]	Exch. Rate	Average[b]	Low	High
1, 1, 3	200	$ 17.64	$ 0	$ 38.33
5, 5, 3	150	$ 17.09	$ 0	$ 29.26
	(30)	($85.43)	($ 0)	($146.33)
1, 1, 7	43	$ 32.72	$ 0	$ 54.67
5, 5, 7	45	$ 23.24	$ 0	$ 39.66
	(9)	($116.18)	($ 0)	($198.33)
1, 5, 3	200	$ 17.08	$ 0	$ 28.70
5, 1, 3	200	$ 25.28	$ 0	$ 39.58
	(40)	($126.40)	($ 0)	($197.90)
1, 5, 7	43	$ 24.91	$ 0	$ 58.47
5, 1, 7	45	$ 46.94	$ 0	$ 123.63
	(9)	($234.71)	($ 0)	($618.44)

a. (*G*, *S*, *N*) = Group size, Signal sample size, Number of bidders.
b. Figures in parentheses are earnings for the whole group.

Table 2. Bidding Behavior by Twice-Experienced (All) Bidders

	(*G,S,N*) *TREATMENTS*							
	(1,1,3)	(5,5,3)	(1,1,7)	(5,5,7)	(1,5,3)	(5,1,3)	(1,5,7)	(5,1,7)
Intercept Deviation	+66 (723.7)	+275 (708.7)	+371 (509.9)	+268 (567.3)	-252 (878.8)	-6 (585.6)	+368 (431.9)	+741 (482.0)
Midrange Deviation	-0.014 (0.023)	-0.020 (0.019)	***-0.036#*** (0.017)	-0.005 (0.015)	-0.017 (0.024)	-0.016 (0.018)	***-0.035#*** (0.012)	***-0.132#*** (0.016)
Range Deviation	…	+0.163 (0.166)	…	+0.246 (0.134)	+0.333 (0.206)	…	+0.150 (0.104)	…
Number of Observations	156	223	338	386	127	244	708	365
R^2 = 0.86								

Significantly different from the theoretical value by a two-tailed 5% *t*-test.
Standard errors are in parentheses.

Table 3. Bidding Behavior by Twice-Experienced Winners

	(*G,S,N*) *TREATMENTS*							
	(1,1,3)	(5,5,3)	(1,1,7)	(5,5,7)	(1,5,3)	(5,1,3)	(1,5,7)	(5,1,7)
Intercept Deviation	+31 (203.9)	***+544**** (230.7)	+284 (225.4)	***+1411**** (266.4)	-270 (351.2)	+98 (157.4)	***+713**** (187.7)	-49 (195.9)
Midrange Deviation	-0.009 (0.009)	-0.004 (0.007)	-0.004 (0.012)	+0.014 (0.008)	-0.004 (0.008)	***-0.020#*** (0.007)	-0.007 (0.006)	+0.010 (0.01)
Range Deviation	…	***+0.113#*** (0.061)	…	***-0.116#*** (0.091)	+0.352 (0.104)	…	***+0.211#*** (0.06)	…
Number of Observations	52	74	48	55	49	81	101	52
R^2 = 0.99								

* Significantly greater than the minimum rational discount by a one-tailed 5% *t*-test.
# Significantly different from the theoretical value by a two-tailed 5% *t*-test.
Standard errors are in parentheses.