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# The Role of Confidence in Truthful Revelation of Private Values

Gregory M. Parkhurst and Clifford Nowell

Recent research shows that disparities between willingness to pay (WTP) and willingness to accept (WTA) disappear with market experience and training. In effect, preferences can be refined by eliminating subjects' misconceptions regarding elicitation procedures. We use a stated measure of confidence as a proxy for misconceptions and test the influence of confidence on truthful revelation of induced values in WTP and WTA auctions using the Becker-DeGroot-Marschak (BDM) mechanism. The results indicate that confidence matters for buyers and sellers. With confidence, WTA and WTP measures converge, and people with greater confidence choose the dominant bidding strategy more frequently.

**Key Words:** BDM, Becker-DeGroot-Marschak mechanism, confidence, induced value, truthful revelation, willingness to accept, willingness to pay

*All you need in this life is ignorance and confidence; then success is sure.*

—Mark Twain

Economists have been debating the source of disparities between willingness to pay (WTP) and willingness to accept (WTA) for more than thirty years (for an overview of the literature, see Horowitz and McConnell (2002) and Sayman and Oncular (2005)). A common explanation for this violation of neoclassical theory is the “endowment effect” (Kahneman, Knetsch, and Thaler 1990)—one’s WTP for a good is less than the amount of compensation required to agree to surrender possession of it. Other researchers view the disparity as a byproduct of strategic bias (Knez, Smith, and Williams 1985, Loomes, Starmer, and Sugden 2003) or of misconceptions regarding the elicitation procedure that can be mitigated through training (Plott and Zeiler 2005, 2011) or market experience (List 2004, 2011). We use a laboratory experiment to examine the influence of role confidence on truthful revelation of induced values.

According to the theory of strategic bias, in experiments that elicit WTA to relinquish property rights to a good or service, people set a minimum WTA that exceeds their true valuation of the good. And when the experiment elicits WTP, people set a maximum WTP that is less than their true valuation (Knez, Smith, and Williams 1985, Loomes, Starmer, and Sugden 2003). In efforts to eliminate strategic bias, researchers have used incentive-compatible mechanisms to elicit values (Kahneman, Knetsch, and Thaler 1990, Shogren et al. 2001, Knetsch, Tang, and Thaler 2001, Noussair, Robin, and Ruffieux 2004). However, strategic bias can persist even when the study uses incentive-compatible mechanisms in

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which the weakly dominant strategy is to truthfully reveal one's value (Brown 2005).

The second-price Vickrey auction (Vickrey 1961) and the Becker-DeGroot-Marschak (BDM) mechanism (Becker, DeGroot, and Marschak 1964) are two methods that are commonly used in experimental laboratories to elicit values for individuals' WTP and WTA for environmental and neoteric goods. These approaches are attractive because both are characterized by a weakly dominant strategy of truthful revelation of an individual's valuation (Noussair, Robin, and Ruffieux 2004).<sup>1</sup> However, because these mechanisms are rarely encountered outside of the laboratory (Bohm, Linden, and Sonnegard 1997, Lucking-Riley 2000, Lusk 2003), people participating in such economic experiments likely are not familiar with the allocation rules on which they are based.

If participants in the experiments do not understand the elicitation mechanism, their misconceptions may be revealed as strategic bias (Corrigan and Rousu 2008). And if the participants are confused or lack confidence in their understanding of the process, they will tend to revert to familiar processes (Samuelson and Zeckhauser 1988). Several studies have shown that incorporating procedures that trained away misconceptions generated comparable values for WTA and WTP for some ordinary goods (Plott and Zeiler 2005, 2011, Isoni, Loomes, and Sugden 2011, Kovalchik et al. 2005). Unfortunately, though, the training procedures can bias the results through the researchers' influence on the preference ordering of the subjects (Sugden 2009).

Misconceptions also can be disciplined away through market experience (Coursey, Hovis, and Schulze 1987) and training.<sup>2</sup> Several studies provide evidence of convergence of WTP and WTA after endogenous market experience through repeated rounds of bidding in experiments (Coursey, Hovis, and Schulze 1987, Shogren et al. 1994, Morrison 2000, Loomes, Starmer, and Sugden 2003, 2010, List 2003, 2004) or through exogenous market experience acquired outside of the lab (List 2011). Market experience obtained through repeated rounds can refine preferences but may also shape them because participants may respond to price signals from prior periods (Loomes, Starmer, and Sugden 2003, Isoni, Loomes, and Sugden 2011, Braga, Humphrey, and Starmer 2009).

The unanswered question is whether we can control for role-specific market misconceptions without shaping preferences. In this study, we use an induced-value experiment involving the BDM pricing method. Induced values impose preferences on experiment participants by dictating the value of the good (Smith 1976). Thus, the BDM's random pricing mechanism creates independence between participants' actions and market outcomes and does not create reference-dependent preferences (Cason and Plott 2012).<sup>3</sup> In addition, evidence from prior experiments suggests that induced-value experiments are not subject to endowment effects (Kahneman, Knetsch, and Thaler 1990).

<sup>1</sup> The BDM mechanism and Vickrey auctions are not incentive-compatible even when the resale value of the good being considered is known with certainty if the utility function is not independent of the price distribution (Horowitz 2006).

<sup>2</sup> We follow the logic that repeated rounds of bidding for a single good create market experience—that the market “disciplines” misconceptions away (List 2003). Training, on the other hand, involves methods by which the experiment monitor verbally assists subjects in correcting their misconceptions through paid or unpaid practice (Plott and Zeiler 2005, Shogren et al. 1994).

<sup>3</sup> In our data, the coefficient on the lagged market price is insignificant ( $p = 0.86$ ) when we regress the bids on the resale value and lagged market price.

One potential proxy for participants' understanding of an experiment's elicitation mechanism is their level of comfort as a buyer or seller. Kahneman (2011, p. 212) noted that "confidence is a feeling, which reflects the coherence and the cognitive ease of processing." This definition suggests that there is a positive correlation between one's stated comfort with a role and confidence in an experimental setting. The better the subject feels he or she understands the institutional mechanism and the more easily the subject processes the incentives and makes decisions, the more comfortable she or he is likely to be in the specific role.

Kahneman (2011, p. 212) also noted that "declarations of high confidence mainly tell you that an individual has constructed a coherent story in his mind, not necessarily that the story is true." Engelmann and Hollard (2010) expressed a similar view and indicated that the endowment effect disappears as an individual gains a greater understanding of the costs and benefits associated with making transactions through forced trades. Forced trade appears to reduce participants' uncertainty and increase their confidence in a beneficial outcome. Thomas and Menon (2007) showed that market decisions are more consistent among individuals with relatively higher confidence levels. Kovalchik et al. (2005) found that confidence was positively correlated with correct responses, although some overconfidence was evident.

Overconfidence is characterized by people who believe they have a greater ability or knowledge than they actually do (De Long et al. 1991) and is commonly associated with cognitive limitations in the ability to process information or with a tendency to use heuristics and biases in decision-making (Griffin and Tversky 1992). Studies have examined the role of overconfidence in individuals' ability to predict their likelihood of correctly answering trivia questions (Kovalchik et al. 2005, Klayman et al. 1999), correlations between success in the stock market, overconfidence, and trading volumes (Barber and Odean 2001), the quality of auditors' predictions (Du, Shelton, and Whittington 2012), and associations between confidence and entrepreneurial entry into high-risk industries (Camerer and Lovallo 1999). These studies have been useful in establishing some of the factors that influence people's tendency to be overconfident.

Studies have shown that overconfidence tends to increase with the difficulty of the task (Griffin and Tversky 1992, Klayman et al. 1999), with the degree of competition (Moore and Cain 2007), and when information is not adequately specific, is delivered slowly, or is provided in a noisy environment (Pulford and Colman 1997). Overconfidence is attenuated when people gain experience (they understand themselves better) (Gervais and Odean 2001), when they are provided with timely feedback (Grossman and Owens 2012, Du, Shelton, and Whittington 2012, Pulford and Colman 1997), and when the tasks are less difficult (Tsai, Klayman, and Hastie 2008). We expect minimal overconfidence in the experiment in our study because the BDM method is repeated over several rounds and thus provides subjects with experience with a simple task—choosing whether to buy a good at a stated price—and immediate, precise market feedback. In several prior studies of the role of overconfidence, researchers used the BDM mechanism to establish a baseline for accuracy that was used to compare to predicted (or stated) confidence of success (see Tsai, Klayman, and Hastie 2008, Yates, Lee, and Bush 1997).

We test the influence of confidence on truthful revelation of induced values in WTP and WTA auctions using the BDM mechanism. Each subject's

stated personal perception of comfort (on a scale of zero to ten) in the role of buyer or seller is used as a proxy for confidence. The subjects were provided with a strategic information sheet that illustrated the returns generated in the experimental market for various prices in response to a valuation level to eliminate misconceptions. Our results indicate that confidence matters when eliciting values for both WTA and WTP. When the level of participants' confidence is high, measures of WTA and WTP converge. In addition, people with greater confidence choose the dominant bidding strategy more frequently for both WTA and WTP in BDM auctions.

## Model

Consider a risk-averse agent who optimizes utility over two goods, a composite good (money) and coffee mugs that have assigned induced values. The two goods are perfect substitutes with a constant marginal rate of substitution of 1. The economic agent faces a one-period optimization decision in which the price of the coffee mug is determined using the BDM elicitation mechanism. However, the economic agent may have misconceptions about how the price of the coffee mug is formulated. The agent's utility function is given by

$$(1) \quad U(M, V) = (M + C \times V)^\beta$$

where  $M$  is money,  $C$  is the number of traded coffee mugs,  $V$  is the assigned induced value for the coffee mug, and  $\beta$  is a positive real number less than unity. For simplicity, we limit  $C \in \{0, 1\}$ .

To accommodate the potential for strategic bias and to capture the distinctly different impacts of strategic bias on sellers and buyers, we assign a different optimization problem to the sellers and the buyers. For risk-averse buyers, the marginal rate of substitution between coffee mugs and money is less than or equal to the price ratio. We represent the buyer's budget constraint as

$$(2) \quad I = M + C(V - f(\varphi)S + \eta)$$

where  $M$ ,  $C$ , and  $V$  are as previously defined,  $I$  is income,  $S$  is a constant positive number, and  $f(\varphi)$  is a function of confidence ( $\varphi$ ) that captures the extent to which strategic bias persists due to misconceptions by participants. Furthermore,  $f(\varphi)$  is decreasing with confidence ( $\varphi$ ) such that  $f(\varphi) \in [0, 1]$ . We define  $f(\varphi^H)$  as equal to zero and  $f(\varphi^L)$  as equal to one. In this formulation,  $\eta$  is a random component that captures all other uncontrolled misconceptions and  $E(\eta)$  equals zero.<sup>4</sup> The buyer's maximum WTP for a coffee mug is

$$(3) \quad WTP = V - f(\varphi)S.$$

That is, individuals who have the minimum level of confidence in their understanding of the pricing mechanism will understate their true WTP by  $S$ . Individuals who have the maximum level of confidence in their understanding of the pricing mechanism will truthfully reveal WTP.

<sup>4</sup> Individuals' ambiguous valuations of the good or lack of relevant information about the value of the good could cause their bids to deviate from their true valuations of it. In this experiment, we control for ambiguity in valuations by imposing individual preferences through induced values. See Brown (2005) for other types of misconceptions that can exist.

Assuming that a confident understanding of the pricing mechanism is a result of training and experience, this representation of WTP would explain the tendency for underbidding to disappear with repeated rounds and training.

For risk-averse sellers, the marginal rate of substitution between coffee mugs and money must be greater than or equal to the price ratio. The seller's budget constraint is represented as

$$(4) \quad I = M + C(V + h(\varphi)P + \eta)$$

where  $M$ ,  $C$ ,  $V$ , and  $I$  are as previously defined,  $P$  is a constant positive number representing the desired profit margin, and  $h(\varphi)$  is a function of confidence ( $\varphi$ ) that captures the extent to which strategic bias persists due to misconceptions. Furthermore,  $h(\varphi)$  is decreasing with confidence ( $\varphi$ ) such that  $h(\varphi) \in [0, 1]$ . We define  $h(\varphi^H)$  as equal to zero and  $h(\varphi^L)$  as equal to one. Once again,  $\eta$  is a random component and  $E(\eta)$  equals zero.<sup>5</sup> We represent minimum WTA for the coffee mugs as

$$(5) \quad WTA = V + h(\varphi)P.$$

Individuals with the minimum level of confidence in their understanding of the pricing mechanism will overstate their true WTA by  $P$ . Individuals with the maximum level of confidence in their understanding of the pricing mechanism will truthfully reveal their WTA.

Based on the presented theory, we suggest two propositions:

*Proposition 1:* When confidence is greatest, people fully understand the pricing mechanism and the disparity between WTA and WTP will disappear.

*Proposition 2:* When confidence is greatest, people fully understand the auction mechanism and will be more likely to play the weakly dominant strategy than people with less confidence.

## Experimental Design

We created our experimental design by adapting the procedures in Kahneman, Knetsch, and Thaler (1990). We recruited 53 participants from introductory general education courses in the School of Business and Economics at Weber State University to participate in six sessions, three as buyers and three as sellers. Subjects were told that the experiment would take approximately one hour and that average earnings would be between \$10 and \$15.<sup>6</sup> The earnings were paid in cash at the end of the experiment and the amount of each participant's earnings remained private.

Participants were asked to arrive at a designated classroom at a specified time. They were given a written set of instructions and overview of the experiment that was also read out loud by the experiment monitor. Participants were then each randomly assigned as either a seller or a buyer. Sellers were given a Weber

<sup>5</sup> See Brown (2005) for examples of misconceptions.

<sup>6</sup> The average earning for buyers was \$12.70 with a maximum of \$18.00 and a minimum of \$9.00. The average earning for sellers was \$13.31 with a maximum of \$18.00 and a minimum of \$10.00.

State University School of Business and Economics commemorative coffee mug. Sellers and buyers were then assigned to separate rooms to receive additional instructions and documents and to complete the experiment.<sup>7</sup>

In each room, experiment monitors gave the participants verbal instructions regarding their role in the market (buyer or seller) and handed out written market information sheets. The verbal instructions explained the BDM method for price determination, illustrated the information on the market sheet, and described how participants were to indicate the prices at which they would be willing to engage in a transaction. Participants were then allowed to ask questions. Next, they filled out a quiz on the elicitation mechanism, and their responses were reviewed by the monitor to insure their understanding.<sup>8</sup> A second question-and-answer period followed the quiz. Both groups, buyers and sellers, were aware that the commemorative coffee mug was a prop only and that they would not be allowed to keep it and could not purchase it at the end of the experiment.<sup>9</sup>

Participants were asked to complete a personal information form at three points during the experiment. The first form asked for information regarding their academic year, their major, whether they had been a business owner, how long they had owned a business, their years of experience as a buyer and as a seller, and their level of comfort with their role as either a buyer or a seller in the experiment on a 1–10 scale.<sup>10</sup> It was administered after all of the instructions and question-and-answer periods had been completed but before any bidding in the experimental auction. The second personal information form was completed immediately after the fourth round of bidding and the third form was completed immediately after the final round of bidding. Those forms asked only about the participants' comfort in their role of buyer or seller.

The 53 participants had various educational backgrounds. A little more than half (52 percent) had declared business majors. In terms of academic years, 11 percent were freshmen, 28 percent were sophomores, 38 percent were juniors, and 23 percent were seniors. Seventeen percent of the participants had owned a business with an average ownership tenure of 32 months. Average experience as a buyer was 11.5 years and as a seller was 4.25 years.

As shown in Table 1, participants initially reported (on the first form) an average comfort rating of 7.69 for buyers and 6.52 for sellers. When the second form was provided, the average comfort level was 8.65 for buyers and 6.82 for sellers. At the end of the auction, the average comfort rating was 8.96 for buyers and 6.64 for sellers.

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<sup>7</sup> Complete instructions are provided in an appendix that is available from the authors.

<sup>8</sup> The quiz asked institution-specific questions designed to insure that the incentives were transparent and that participants understood the market mechanism.

<sup>9</sup> Plott and Zeiler (2007) showed that exchange asymmetries can exist in experimental settings and that the asymmetries can cause disparities between WTA and WTP that are mistakenly thought to be the endowment effect. We do not control for exchange asymmetries because we attempt to increase the potential for strategic bias in individual bidding behavior through our experimental design.

<sup>10</sup> Comfort was elicited through a self-reported rating on a scale of 1–10 without indicating to subjects which value represented the greatest comfort level. Our assumption was that individuals would exhibit a positive correlation between comfort and the scale. In addition, subjects should become more comfortable in the role as they gain experience with the mechanism. In the experiment, 79 percent of the 34 people who changed the rating of their comfort level between the first and the third form reported that their comfort level increased.

**Table 1. Sample Characteristics**

Variable	Sellers	Std Dev.	Buyers	Std Dev.
Number of observations	27		26	
Class freshmen	5		1	
Class sophomore	7		8	
Class junior	10		10	
Class senior	5		7	
Own business	3		6	
Average years ownership for owners	2.67		2.67	
Experience buyer (years) <sup>a</sup>	12.89	(9.53)	10.11	(8.58)
Experience seller (years) <sup>a</sup>	5.82	(8.71)	2.62	(3.14)
Initial comfort buyer			7.69	(1.64)
Initial comfort seller	6.52	(2.23)		
Intermediate comfort buyer			8.65	(1.29)
Intermediate comfort seller	6.82	(2.28)		
Final comfort buyer			8.96	(1.34)
Final comfort seller	6.64	(2.48)		

<sup>a</sup> Participants were allowed to interpret experience subjectively.

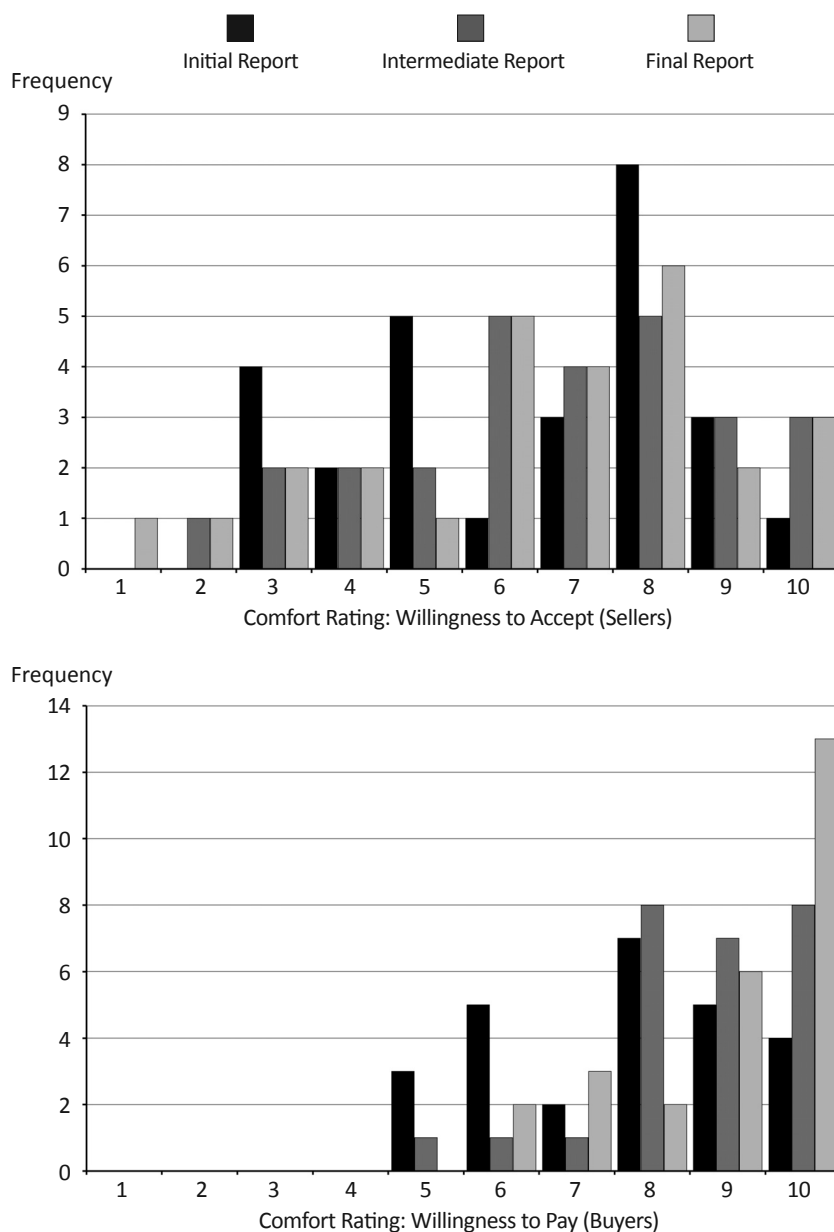
Figure 1 displays the reported comfort levels by role and stage of the auction. Prior to bidding, sellers' comfort ratings ranged from 3 to 10. At the midpoint in the experiment, the lowest value had declined to 2 and the high remained at 10. After the auction had been completed, sellers' comfort ratings ranged between 1 and 10. Buyers' comfort ratings prior to bidding ranged from 5 to 10, and the range shifted only slightly by the end of the auction to 6 to 10. The largest proportion of both buyers and sellers initially reported a comfort rating of 8. The final post-experiment confidence levels show a reduction in dispersion of the responses of buyers with a mode of 10. Dispersion of the final confidence ratings of the sellers increased; ratings of 6 and 8 were the most common.<sup>11</sup>

Table 2 reports how often subjects chose the dominant strategy of truthful demand revelation relative to an increase or decrease in comfort level between the beginning and the end of the experiment. Sellers whose comfort level had decreased chose the dominant strategy 13 percent of the time while sellers with no change or a positive change in comfort chose the dominant strategy 78 percent of the time. Buyers whose comfort level had decreased chose the dominant strategy more often, 33 percent of the time, while buyers with no change or a positive change chose the dominant strategy 80 percent of the time. Thus, the dominant strategy (truthful demand revelation) was used significantly more by participants whose comfort with their role remained constant or increased.

Participants completed the first personal information sheet and then began the eight rounds of bidding in the experimental auction. At the conclusion of each round, a volunteer participant drew a random price using the BDM mechanism.

<sup>11</sup> When we applied a matched-pairs test to examine differences in the means between initial and final levels of comfort, we found no significant difference for sellers and a significant ( $p < 0.01$ ) positive difference for buyers. At the intermediate point, there was no significant change in the means between the intermediate and final level of comfort for either group.





**Figure 1. Frequency of Sellers' and Buyers' Stated Comfort Levels**

That price was posted as public information. Participants then calculated their profits or losses from that round's transactions and the experiment monitor checked their calculations for accuracy.

Prior to bidding in each round, the subjects received a market information sheet that provided the resale value assigned to the mug for that participant and market information regarding the resale values of the coffee mugs. The participants' resale values were assigned from one of two discrete sets: {2, 3, 3, 4, 4, 4, 6, 6, 6, 7, 7, 8} and {12, 13, 13, 14, 14, 14, 16, 16, 16, 17, 17, 18}. The market information representing the opposing market force was presented

**Table 2. Percent of Participants Who Used the Dominant Strategy**

	Percent of Sellers	Sample Size	Percent of Buyers	Sample Size
Stated Confidence at the End of the Experiment				
Confidence rated as less than 5	0.5625	(48)	0.00	(0)
Confidence rated as 5 or greater	0.714	(168)	0.745	(208)
Difference in dominant strategy play: p-value (two-tailed test)	< 0.05			
Difference in Stated Confidence: [end of experiment] – [beginning of experiment]				
Difference less than 0	0.125	(32)	0.333	(24)
Difference greater than or equal to 0	0.777	(184)	0.799	(184)
Difference in dominant strategy play: p-value (two-tailed test)	< 0.01		< 0.01	

as either a discrete set (precise market information) or a continuous set (less precise market information) of values: [0.25, 10], [10.25, 20], {2, 3, 3, 4, 4, 4, 6, 6, 6, 7, 7, 8}, and {12, 13, 13, 14, 14, 14, 16, 16, 16, 17, 17, 18}.<sup>12</sup>

Theoretically, market information should have no impact on bidding decisions in either a WTP or a WTA auction. However, if buyers or sellers have misconceptions regarding how price is determined, the presence of market information could impact individuals' strategic bias; individuals could act strategically rather than report their true WTP or WTA in an effort to capture a larger portion of the gains from trade.

The market information sheet also described the set of the 40 possible market prices in 25-cent increments. Subjects were asked to mark an "x" next to all of the market prices at which they would be willing to make a transaction.

At the midpoint of the experiment (between the fourth and fifth rounds), each participant was given a strategy sheet that provided information regarding profit calculations and included an exercise in which the subject could choose to calculate profit for three sets of market prices for a given resale value based on their role. The strategy sheet was designed to illustrate that opting for a price that is below the resale value would result in losses for sellers and gains for buyers, while opting for a price that exceeds the resale value would result in gains for sellers and losses for buyers. In other words, the strategy sheet was designed to identify the BDM's weakly dominant strategy of truthful valuation. Completing the strategy sheet was voluntary and the participants' answers were not reviewed.

<sup>12</sup> When the sellers' and buyers' resale value was drawn from the {2, 3, 3, 4, 4, 4, 6, 6, 6, 7, 7, 8} set of values, the market information was presented as either [0.25, 10] or {2, 3, 3, 4, 4, 4, 6, 6, 6, 7, 7, 8}. Similarly, when the sellers' and buyers' resale value was drawn from the {12, 13, 13, 14, 14, 14, 16, 16, 16, 17, 17, 18} set of values, the market information was presented as either [10.25, 20] or {12, 13, 13, 14, 14, 14, 16, 16, 16, 17, 17, 18}.

**Table 3. Means and Standard Deviations**

Variable	Mean	Standard Deviation
<i>ERROR</i>	0.24	0.43
<i>LOWVALUE</i>	0.50	0.50
<i>CONTINUOUS</i>	0.50	0.50
<i>CONF</i>	7.72	2.30
<i>WTA</i>	0.50	0.50
<i>WTACONF</i>	3.32	3.68
<i>VALUE</i>	9.99	5.78
<i>POSTTEST</i>	0.50	0.50

## Results and Discussion

Our experiment involved 53 subjects who each participated in eight rounds, generating 424 observations.<sup>13</sup> Means and standard deviations for all of the variables are provided in Table 3. We evaluate the results of our experiment in two steps. First, we look at the role of confidence in truthful revelation of WTA and WTP by examining the ability of resale values and degrees of confidence to predict the bids observed. We then look at the influence of experiment characteristics on whether subjects used the dominant bidding strategy.

### *Influence of Confidence on Truthful Revelation*

We focus first on proposition 1. Theory predicts that rational bidders who have no misconceptions about the elicitation mechanism or their role in the market will set their bid equal to their resale value. However, if some bidders have misconceptions, their bids will differ from their resale values. We examine bidding behavior by estimating a two-way random-effect generalized least squares regression equation:

$$(6) \quad \text{bid}_{it} = \alpha + \beta_1 \text{VALUE}_{it} + \beta_2 \text{CONF}_i + \beta_3 \text{WTA}_i + \beta_4 \text{WTAVALUE}_{it} + \beta_5 \text{WTACONF}_i + u_i + \varphi_t + \varepsilon_{it}.$$

In this equation,  $\text{bid}_{it}$  denotes subject  $i$ 's bid in trial  $t$ ;  $\text{VALUE}_{it}$  denotes subject  $i$ 's resale value in trial  $t$ ;  $\text{CONF}$  denotes the initial comfort of subject  $i$  with the market role;  $\text{WTA}_i$  takes a value of one when subject  $i$  is a seller and a value of zero when subject  $i$  is a buyer; and  $\text{WTACONF}_i$  is an interaction term created by multiplying  $\text{CONF}$  by  $\text{WTA}$ . Thus,  $\text{WTACONF}_i = \text{CONF}_i$  for a seller and equals zero for a buyer.  $\text{WTAVALUE}_{it}$  interacts  $\text{WTA}$  with  $\text{VALUE}$ , allowing the slope to differ for sellers relative to buyers;  $u_i$  denotes subject-specific characteristics for individual  $i$ ;  $\varphi_t$  represents round-specific effects, including learning, for

<sup>13</sup> As expected, there was no evidence of the endowment effect. The predicted number of transactions for buyers was 121 and 111 transactions were observed ( $p = 0.165$ ). For sellers, the predicted number of transactions was 114 and 120 transactions were observed ( $p = 0.412$ ). For both sellers' WTA and buyers' WTP, we fail to reject the null hypothesis that the observed proportion equals the predicted proportion.

round  $t$ ; and  $\varepsilon_{it}$  is an identically and independently distributed error term. An absence of misconceptions would be evidenced by revelation of truthful resale values:  $\beta_1 = 1, \alpha = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ . If those conditions are satisfied for the BDM elicitation mechanism, no disparity exists. If those conditions are not satisfied, a disparity does exist. And if the disparity is a result of misconceptions, we expect estimated WTP to approach WTA as confidence increases.

Table 4 reports the results of the regression. The estimated coefficient on *VALUE* is 0.98 and is not statistically different from one. The constant, however, has a value of -2.19 and is different from zero at a 1 percent level of significance. The coefficient on confidence (*CONF*) is 0.21 and is different from zero at a 5 percent level of significance, and the estimated coefficient on *WTA* is 2.32 and is significant at the 1 percent level. Also, the coefficient on *WTACONF* is -0.18 and significant at a 17 percent level. *WTAVALUE* is not significantly different from zero so the slope coefficients are statistically the same in the BDM elicitation mechanism for WTA and WTP.

To test for an absence of misconceptions, we re-estimate equation 3 with an implied restriction:  $\beta_1 = 1$  and  $\alpha = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ . Based on a Wald test, we can reject the null hypothesis ( $p < 0.001$ ) that the restricted model performs as well as the unrestricted model, which allows all of the estimated parameters to vary. We conclude, therefore, that misconceptions are present and that the misconceptions can be explained by level of confidence and other differences present in the WTA/WTP setting.

To directly test proposition 1, we examine the influence of confidence on the disparity between WTA and WTP by estimating the marginal effect of the WTA elicitation mechanism on WTP while holding the resale value constant:

(7)  $\partial bid / \partial WTA = 2.32 - 0.18 WTACONF$

It is clear from equation 7 that proposition 1 is satisfied; the disparity between WTA and WTP tends toward zero as confidence increases.

*Result 1:* Strategic bias is evident when eliciting individual values with the BDM mechanism but is attenuated as bidders become more confident in their roles in the BDM auction.

**Table 4. Results of Generalized Least Square Regression with Two-way Random Effects**

Variable	Estimated Coefficient	Standard Error
Constant	-2.19*	(1.05)
VALUE	0.98*	(0.014)
CONF	0.21**	(0.12)
WTA	2.32*	(1.15)
WTAVALUE	0.006	(0.02)
WTACONF	-0.18	(0.13)
R-square	0.95	
Number of observations	424	

Notes: \* significant at a 1 percent level; \*\* significant at a 5 percent level; \*\*\* significant at a 10 percent level.

### *Influence of Experiment Characteristics on Use of the Dominant Strategy*

Because our data is best described as a panel data set, we estimate the impact of several explanatory variables on whether a subject employs the dominant strategy using a random-effects probit model:

$$(8) Y_{it} = \beta_0 + \beta_1 ERROR_{it} + \beta_2 LOWVALUE_{it} + \beta_3 CONTINUOUS_{it} + \beta_4 CONF_{it} + \beta_5 WTA_{it} + \beta_6 WTACONF_{it} + \beta_7 VALUE_{it} + \beta_8 POSTTEST_{it} + U_{it}$$

In this case, *VALUE*, *CONF*, *WTA*, and *WTACONF* are as previously defined in equation 6.  $Y_{it}$  equals one if subject  $i$  bids the weakly dominant strategy in round  $t$  and zero otherwise. *ERROR* equals one if subject  $i$  made any errors in completing the strategy sheet designed to illuminate the weakly dominant strategy of the BDM auction mechanism and zero otherwise. *LOWVALUE* equals one if subject  $i$  was provided market information on resale values for the opposing market force that were bounded between \$0 and \$10 and could be continuous or discrete and equals zero otherwise. The omitted category is high market values bounded between \$10 and \$20. *CONTINUOUS* equals one if subject  $i$  was provided with resale values for the opposing market force presented as a continuous interval and zero if presented as discrete values. Finally, *POSTTEST* equals one for rounds five through eight, which occurred after the strategy sheet was administered.

The error term  $U_{it}$  is the sum of two components,  $\alpha_i$  and  $\Omega_{it}$ .  $\alpha_i$  represents individual-specific error, which remains constant over time and is assumed to be independently distributed;  $\Omega_{it}$  represents the serially correlated error term across rounds (Wooldridge 2006). We assume that the covariance between each explanatory variable and  $\alpha_i$  is zero.

The estimated coefficients, standard errors, and marginal effects from the random-effects probit model (calculated with Limdep version 9.0) are provided in Table 5. We use this model to address proposition 2—that use of the dominant strategy increases with confidence. The results in Table 5 show that the estimated coefficient on *CONF* is positive and statistically significant at a 1 percent level and that the marginal effect is 1.52. Thus, a 1 percent increase in confidence will result in a 1.52 percent increase in the probability of truthful revelation of the resale value. When the average buyer's confidence in her/his market role increases from 8 to 9, the probability of truthful revelation of his/her resale value rises 19 percent. For sellers, the effect of confidence on truthful revelation of resale value is the sum of the coefficients on *CONF* (1.80) and *WTACONF* (−1.22,  $p$ -value  $\leq 0.01$ ), 0.58. Thus, a 1 percent increase in a seller's confidence would result in a 1.07 percent (1.52 − 0.45) increase in truthful revelation, and when the average seller's confidence in her/his market role increases from 8 to 9, the probability of truthful revelation will rise by 13 percent.

**Result 2:** Individuals' confidence in their role in an experimental BDM auction increases the probability of their using the dominant strategy of truthfully revealing their valuation.

This result is further supported by how frequently subjects used the dominant bidding strategy relative to their post-experiment level of confidence and change in confidence (*ex post* confidence minus *ex ante* confidence) by market role (see Table 2). On average, participants who initially rated their confidence

at between 5 and 10 played the dominant bidding strategy more frequently than participants with less confidence (significant at a 5 percent level). In addition, on average, subjects who either maintained or increased their level of confidence as the experiment progressed played the dominant strategy more often than subjects whose confidence decreased as the experiment progressed (significant at a 1 percent level).

### *Additional Findings*

As shown in Table 5, the coefficient on *CONTINUOUS* (representing less precise market information) is positive and significant with an elasticity of 0.02, which implies that bids are more accurate when information on the opposing market force is a range of resale values rather than a set of specific values. Thus, the probability of playing the dominant strategy decreases as information regarding resale values for the opposing market force becomes more precise.

The coefficient on *POSTTEST* is positive and insignificant with an elasticity of 0.03. Recall that *POSTTEST* equals one for rounds following voluntary completion of the strategic information exercise designed to help subjects identify and internalize the dominant bidding strategy. In our sample, use of the dominant strategy increased following exposure to the training material; however, these results cannot be generalized to the overall population. Consequently, we find that allowing subjects to voluntarily engage in a strategy exercise designed to help them internalize the institution's incentives and mechanism design has no statistically significant impact on the probability of playing the dominant strategy.

**Table 5. Results of Probit Regression with Random Effects**

Variable	Estimated Coefficient	Standard Error	Elasticity
Constant	-14.75*	5.05	
<i>ERROR</i>	-0.86	0.72	-0.02
<i>LOWVALUE</i>	1.25	1.24	0.07
<i>CONTINUOUS</i>	0.40**	0.22	0.02
<i>CONF</i>	1.80*	0.60	1.52
<i>WTA</i>	11.97*	5.12	0.67
<i>WTACONF</i>	-1.22*	0.59	-0.45
<i>VALUE</i>	0.07	0.90	0.07
<i>POSTTEST</i>	0.47	0.38	0.03
Rho <sup>a</sup>	0.92*	0.03	
$X^2 = 189.5, p < 0.01$			

<sup>a</sup> Rho, which measures the correlation between  $U_{it}$  and  $U_{is}$ , is highly significant, verifying the importance of accounting for the panel data structure.

Notes: \* significant at a 1 percent level; \*\* significant at a 5 percent level; \*\*\* significant at a 10 percent level.

## Conclusion

Earlier research shed light on the presence of misconceptions regarding elicitation of private values among participants in economic experiments that use incentive-compatible elicitation mechanisms such as BDM. Some recent research that implemented procedural designs to correct for these misconceptions has been criticized as potentially too paternalistic. In training away misconceptions, researchers may inadvertently impose their own preferences on the subjects. In this study, we proposed using subjective confidence as a proxy for misconceptions.

Our results indicate that confidence is a factor in the disparity between measures of WTA and WTP and impacts the frequency of use of the dominant strategy. As participants gain confidence in their role in the institution and in their grasp of the institution's design, the disparity between WTA and WTP diminishes and the likelihood of their truthfully revealing their private valuations increases.

We show that confidence plays an important role in explaining misconceptions that result in subjects choosing nondominant strategies and in the divergence of WTP and WTA in experimental settings. By controlling for confidence, researchers likely can eliminate some misconceptions without risking the detrimental effect of increased paternalism associated with training, leading to greater accuracy in both laboratory and field studies. Confidence is likely to play a larger role in explaining misconceptions when the elicitation mechanism and/or the scenarios are unfamiliar to subjects. Controlling for misconceptions by including self-reported measures of study participants' level of comfort in their role is an unobtrusive, low-cost way to calibrate WTA and WTP preferences.

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