

**Experimental Evidence on the Divergence Between Measures of  
Willingness to Pay and Willingness to Accept:  
The Role of Value Uncertainty**

Peter R. Mueser

Department of Economics

University of Missouri-Columbia

Jay K. Dow

Department of Political Science

University of Missouri-Columbia

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Direct correspondence to: Peter Mueser, Department of Economics, 118 Professional Building,  
University of Missouri, Columbia, MO 65211. Tel.: (573) 882-6427.  
E-mail: [mueser@econ.missouri.edu](mailto:mueser@econ.missouri.edu)

## ABSTRACT

One of the most robust findings in experimental analysis in economics is that subjects often display a large discrepancy between the dollar value they are willing to accept in order to sell an item (WTA) and the dollar value they are willing to pay to purchase it (WTP). We suggest that often when individuals face purchase or sale decisions, the actual private value of an object is uncertain. This is significant because, in a large number of market environments, such uncertainty will cause individuals to display a disparity between WTA and WTP. Our review of the literature confirms that the WTA-WTP disparity does tend to grow where we might expect that estimating an object's value is more difficult. We then turn to our own experiments that attempt to measure such uncertainty more directly and examine how it relates to the WTA-WTP disparity. Our results confirm the hypothesis of a positive relationship.

One of the most robust findings in experimental analysis in economics is that subjects often display a large discrepancy between the dollar value they are willing to accept in order to sell an item (WTA) and the dollar value they are willing to pay to purchase it (WTP). Kahneman et al. (1990) reviewed nearly a dozen studies showing that individuals who have property rights to an item often indicate a minimum selling price that is substantially above that which otherwise identical individuals state is the maximum price they would be willing to pay for the item.

Several explanations have been proposed to explain the observed gap. Hanemann (1991) has pointed out that for goods that have no good substitutes in consumption, the WTA and WTP values may diverge even if income effects are modest. Although this may explain individual responses for some goods, such as environmental amenities, it cannot explain many existing experimental results. For example, studies by Knetsch (1995) and Bateman et al. (1997) have demonstrated a WTA-WTP disparity employing experimental designs that fully eliminated the income and substitution effects that drive Hanemann's explanation.

Thaler (1980) attributed the gap to an "endowment effect," and Tversky and Kahneman (1991) have spelled out the microeconomic foundations underlying this model. Individuals are posited to display "loss aversion" for consumption departures from a reference point, so that losses are weighed more heavily than gains. According to this theory, receipt of ownership, an "endowment," changes the subject's reference point, not only shifting a subject's position on the indifference map but also altering the shape of the indifference curves. Needless to say, behaviors under this model deviate from the predictions of standard models of utility maximization.

Huck et al. (1997) provide an explanation for such an endowment effect in terms of

evolutionary processes. They argue that individuals are frequently in bargaining environments where preferences that overvalue their own endowments will shift the terms of trade in their favor. Since survival likelihood will be greater for those who systematically overvalue their own endowments, such a tendency will dominate in the population.

The analysis here returns to an explanation based on a more conventional decision-making process. We suggest that often when individuals face purchase or sale decisions, the actual private value of an object is uncertain. This is significant because, in a large number of market environments, such uncertainty will cause individuals to display a disparity between WTA and WTP. Our review of the literature confirms that the WTA-WTP disparity does tend to grow where we might expect that estimating an object's value is more difficult. We then turn to our own experiments that attempt to measure such uncertainty more directly and examine how it relates to the WTA-WTP disparity. Our results confirm the hypothesis of a positive relationship.

### **Value Uncertainty and the WTA-WTP Disparity**

Most treatments of the WTA-WTP gap assume that subjects have full information about the value to be obtained from the object to be purchased or sold. In the experiments conducted by Kahneman et al. (1990), subjects specified a wide range of selling and buying prices. For example, the 22 subjects who were allocated coffee mugs specified minimum selling prices from \$2.25 to more than \$8; while the 22 subjects without mugs specified maximum buying prices from below \$.50 to \$4.75. The researchers comment that the dispersion of values suggests "that in the absence of an endowment effect there would be enough rents to produce gains from trade" (p. 1332). But if observed variation reflects, in part, errors across individuals in estimating value,

as suggested below, differences in stated valuation will not necessarily imply gains from trade.

In contrast, observers recognize that respondents to surveys involving environmental amenities are often highly uncertain about the value of a particular amenity. For example, Kahn (1994) explicitly models such uncertainty in an attempt to interpret the policy meaning of contingent valuation surveys. It is our contention that such uncertainty is not limited to amenities or exotic goods, but characterizes, in varying degrees, effective preferences for a wide range of choice objects.

There are several sources of errors in valuation. One derives from inability to judge how valuable the object will be in actual use. Uncertainty may be particularly large for goods which incorporate stochastic elements, such as insurance, where consumption does not imply direct knowledge of all relevant outcomes. Most individuals with fire insurance have no personal experience of a major fire, let alone any reliable basis for determining the chance that they will face such an event. In the case of an environmental amenity, judgments are made difficult by the fact that benefits may accrue over an extended period in an uncertain future, and that often the benefits are themselves highly abstract.

For more mundane goods, an important source of uncertainty is lack of knowledge about the cost of an acceptable substitute--including the difficulty of locating it. For such goods, we need not assume that the underlying preferences are unknown, but merely that the rational valuation, at a particular point in time, is tied to unknown market prices. For example, the values placed on coffee mugs by the subjects in the experiments of Kahneman et al. (1990) should rationally be tied to the cost of similar mugs at a local store. Incomplete knowledge about prices effectively creates uncertainty for a subject who must decide in the experimental environment

whether to buy or sell a coffee mug.

Whatever its source, we will label such incomplete knowledge *value uncertainty*. To illustrate its effect, consider a simple model where utility for subject  $i$  has the form  $Y_i + v_i^* \delta_i$ , where  $\delta_i=1$  if the subject keeps or obtains the object or amenity,  $\delta_i=0$  otherwise;  $Y_i$  is dollar expenditures on other goods; and  $v_i^*$  is the true value of the object for subject  $i$ . If subject  $i$  is a price taker and knows  $v_i^*$ , he chooses to purchase or retain the object so long as  $v_i^* > p$ , where  $p$  is the object's price, and chooses to sell it or not to purchase it if  $v_i^* < p$ . To capture the idea of value uncertainty, assume the individual does not observe  $v_i^*$  but does observe an error prone signal of the object's value,  $v_i = v_i^* + e_i$ , where  $e_i$  is the realization of a random variable,  $e$ , with mean zero. Intuitively,  $\text{var}(e)$  can be taken as an indicator of value uncertainty. Where  $\text{var}(e)=0$ , there is no value uncertainty, and  $v_i = v_i^*$ . As  $\text{var}(e)$  grows, value uncertainty increases and the signal is a progressively poorer measure of the object's actual value.

The impact of value uncertainty depends on the particular institutional structure in which an individual is acting. However, a wide variety of market structures that subjects face--and which closely parallel the experimental environments in which the WTA-WTP disparity has been observed--induce similar behavioral patterns. In the absence of value uncertainty, rational decisions imply a small or nonexistent WTA-WTP gap, but as value uncertainty increases, rational decisions imply a larger gap.

In the absence of any information other than  $v_i$ , the subject's estimate of value  $v_i^*$  can be written  $E(v_i^* | v_i)$ . However, when an individual interacts in a market, additional information is then available. In particular, the availability of the object to buy provides additional information, since it means that another individual chooses to sell it, or chooses not to purchase

it. Similarly, the presence of an opportunity to sell the object means that some other individual places a higher value on the object. If we designate  $B$  as the opportunity to buy an object in a given environment at the price  $E(v_i^* | v_i)$ , and  $S$  as the opportunity to sell it at that price, it can be shown that

$$E(v_i^* | v_i, B) \leq E(v_i^* | v_i) \leq E(v_i^* | v_i, S)$$

with strict inequality holding when  $\text{var}(e) > 0$ , and with the difference increasing with  $\text{var}(e)$ .

These effects are most easily demonstrated in the case of a simple common value sealed-bid auction. In such an environment, each participant  $i$  observes a private signal  $v_i = v^* + e_i$ , where  $v^*$  is the common (unobserved) value of the object to all participants (see Kagel and Levin, 1986). In this case,  $B$  indicates that the bid submitted by an individual is the winning bid to purchase the object. Since each participant's bid depends only on his own signal,  $v_i$  for the winning bidder must be greater than the signal received by any other participant. The gap  $E(v_i^* | v_i) - E(v_i^* | v_i, B)$  increases with  $\text{var}(e)$ . The same effect operates where bidders are competing to sell an object, although here the winning bid is the lowest, and  $E(v_i^* | v_i) - E(v_i^* | v_i, S)$  increases with  $\text{var}(e)$ .

As is well known, in a first-price auction, participants have an incentive to submit bids that deviate from expected value. For a buyer, the optimal bid will be below  $E(v_i^* | v_i, B)$ , and for a seller, it will be above  $E(v_i^* | v_i, S)$  and the optimal deviation increases with  $\text{var}(e)$ . Hence, insofar as subjects optimize appropriately for such an auction, we may predict that the gap between prices bid in a buying auction and prices bid in a selling auction will grow with value

uncertainty. This result does not depend on the assumption that the object has exactly the same value for all participants. The same basic conclusion obtains where there is idiosyncratic variation in the object's value across participants, as long as there is some common element in their valuation.

The effects of value uncertainty are not limited to contexts in which the subject submits bids. Mueser (1997) shows that even in markets where an individual is a price taker, the same effect occurs. Hence, when WTA is measured as a minimum selling price, and WTP is measured as a maximum buying price, a gap will exist so long as the subject experiences value uncertainty. This gap can be the result of optimizing decisions by subjects even when WTA and WTP values are elicited using a Becker-DeGroot-Marschak (1964) mechanism. The effect also occurs when a subject faces a take-it-or-leave-it offer to buy or sell an object (e.g., Knetsch, 1995) because the existence of such an offer, in itself, provides information. If it is an opportunity to buy, the expected value of the object is reduced, whereas if it is an opportunity to sell, it is increased. This implies that when a subject has an offer to buy an object at a price close to  $E(v_i^* | v_i)$ , he strictly prefers not to buy, and if he has an offer to sell the object at that same price, he strictly prefers not to sell. The price range for which he refuses such transactions grows with value uncertainty.

## **Value Uncertainty and Existing Experimental Results**

The claim that subject value uncertainty is an important factor in the WTA-WTP disparity is consistent with the patterns observed in empirical research. Those experiments in which subjects trade tokens with "induced" values--reflecting dollar exchange rates provided by the

experimenter--show no substantial gap between WTA and WTP values (Kahneman et al., 1990).

Similarly, the gap is very small where individuals are engaged in a market where they trade frequently, for example, where the object is a lunch at a cafeteria where the subject eats frequently (Knez et al., 1985). In explaining such results, Kahneman et al. appear to simply posit that the endowment effect does not occur where values are transparent: "No endowment effect would be expected for such tokens, which are valued only because they can be redeemed for cash." (1990, p. 1328). The explanation given above shows why the supposed endowment effect disappears in such cases. The WTA-WTP gap is a response to value uncertainty.<sup>1</sup>

A variety of other empirical regularities in the experimental literature can be explained by value uncertainty. Individuals' valuations involving very unlikely events, for example risk of death, are expected to be highly uncertain for several reasons. Often individuals have little personal experience with the event itself (e.g., death) and to obtain an estimate of the utility loss from the risk requires multiplication of this value times a very small number. A subject asked to make such a calculation is well aware that the resulting estimate is highly uncertain. He may recognize that even repeated attempts at the same calculation may produce disparate estimates.

Experimental evidence suggests that choices involving unlikely events display a larger WTA-WTP gap. Shogren et al. (1994) performed experiments attempting to test whether the WTA-WTP gap could be explained by the substitutability of a good, following Hanemann

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<sup>1</sup>Kahneman et al. (1990) argue that "valuation ambiguity" is necessary for the endowment effect to occur (p. 1343). This concept focuses on the difficulty of translating an object's value into pecuniary terms; it is not closely related to our concept of value uncertainty.

(1991). They showed that the gap between WTA and WTP was small or nonexistent for a candy bar or coffee mug, but large where the good was a small chance of food-borne illness. Although they interpreted their results as supporting the substitutability hypothesis, the results are better explained by value uncertainty. Value uncertainty is expected to be relatively small for commonplace consumer goods but large in the case of small risks involving illness. Thaler (1980) reported values for WTP and WTA for a small chance of death which differed by a ratio of more than 100.

Value uncertainty also explains the observation that the WTA-WTP gap is initially high but tends to decline after repeated play. Coursey et al. (1987) showed that in a Vickrey second-price auction where subjects bid to avoid an unpleasant taste, a large WTA-WTP difference in average initial bids closed after extended rounds of practice bidding. The authors attributed this to subjects' increased understanding of the bidding mechanism. They provided no explanation for the finding of an initial WTA-WTP gap. Value uncertainty provides an explanation for both. Subjects were not provided with a prior sample of the unpleasant taste, so value uncertainty could be large and an initial gap would be predicted. Repeated play, however, would provide additional information on the underlying value of the experience, thus decreasing value uncertainty.

How much information is provided by repeated play depends on the particular structure of information (e.g., the random variable  $e$ ) and how that information changes with repeated play. Value uncertainty declines to zero insofar as each participant takes an independent draw of the relevant random variables in each play. For some objects, repeated play need not resolve all value uncertainty if participants receive no new information about the object in successive plays.

Hence, the findings of Shogren et al. (1994) that, after an initial decline, the WTA-WTP gap remained substantial for the chance of food-borne illness is also consistent with the role of value uncertainty.

The gap between WTA and WTP values appears to be particularly large when the commodity in question involves public goods or moral issues, cases where preferences relate to intrinsic rather than use value (Boyce et al., 1992). While there are several plausible explanations<sup>2</sup>, value uncertainty may partly explain the observed difference, since such goods would undoubtedly exhibit high levels of value uncertainty.

Of the experimental studies that examine the WTA-WTP disparity, only Bateman et al. (1997) recognized a possible role of value uncertainty, although in contrast to our discussion here, they attributed any impact to psychological factors. Although their results suggested the possibility of such an effect, their experimental design precluded any systematic examination of the role of value uncertainty.

## **Experimental Results: The Impact of Value Uncertainty**

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<sup>2</sup>Brookshire and Coursey (1987) showed that this gap declined appreciably when estimates were based not on answers to hypothetical questions but rather behaviors in a market where individuals faced appropriate incentives for accurate revelation. For public goods, Hanemann's (1991) explanation for the WTA-WTP gap in terms of the relative elasticity of substitution and budget effects may also play a role here.

Although results of existing studies that investigate the WTA-WTP disparity are consistent with the importance of value uncertainty, they do not provide the data that would allow a direct test of our hypothesis. We therefore undertook a series of experiments involving hypothetical decisions about purchase and sale of various objects. These were based on questionnaires administered to undergraduates in three political science classes at the University of Missouri-Columbia. We first administered the questionnaires to a class of 26 students, followed by an open class discussion in which we asked students to explain their answers to the class and to provide written comments on the questionnaire. Based on this experience, we clarified the wording and added some additional questions. While we refer to some of the open-ended responses from this class, we do not report the quantitative results. We then administered the questionnaire to 32 students in a second class ("class 1" below), and finally, after minor modification of the questionnaire, to a class with 236 respondents ("class 2" below).

In each class, half of the students were given questionnaires in which they were asked to indicate the maximum price they would be willing to pay for specified objects (WTP). The other half were asked to indicate the minimum price for which they would be willing to sell the objects if they owned them (WTA). In each case, instructions were designed to elicit the price for which an offer would make the subject just indifferent about whether to make the trade. The instructions specified, in part, "You should imagine that someone offers to purchase the object from you [sell you the object] at a specified price, and your *minimum price* [*maximum price*] is the lowest [highest] at which you would sell [purchase] the object . . . Assume this is the only chance you have to sell [buy] the object at this time. There is no bargaining and no way you can

influence the price you are offered [selling price]."<sup>3</sup>

Students were not provided with monetary incentives. Although it is well known that, under some circumstances, even modest monetary incentives may cause substantial changes in observed behaviors (for an extreme case, see Cummings et al, 1995), we anticipate that the basic pattern of our results would not be altered by requiring subjects to undertake actual trades. In choice experiments related to ours, Fox and Tversky (1995) rely largely on questionnaire responses involving hypothetical questions with no monetary incentives. Their comparisons with experiments offering monetary incentives do not suggest important differences.

Our questions considered a number of objects that might be expected to differ in their levels of value uncertainty. Of course, we have no direct measure of value uncertainty, but one rough proxy is available. If we consider two objects and we observe variation in values of WTA (or WTP) across subjects, this variation may be due either to differences in preferences, or to differences in subject estimates of object valuation due to value uncertainty. For two objects where the variation in preferences across subjects is similar, the total variance will be greater for the object with greater value uncertainty. We therefore hypothesize that the coefficient of variation for the WTA and WTP values across subjects may be taken as a rough measure of value uncertainty.

Our first question posed an unusual opportunity: The chance to purchase or sell a \$5 bill. We designed this question both to acquaint subjects with the decision process and to obtain some indication of whether subjects had fully understood the instructions. In one of the classes (class

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<sup>3</sup>The questionnaire is available on this journal's web site.

2), we accompanied this question with a detailed example designed to make students aware of profit opportunities they would forgo by setting values far from \$5.

Table 1 lists statistics based on the question regarding the \$5 bill, as well as three other objects. One was a certificate which could be redeemed for \$6 cash at another location on campus, and the other two were lottery tickets involving opportunities for gains and losses. In each case, the table indicates the mean willingness to accept (WTA) value specified by subjects who received the selling value questionnaire, and the mean willingness to pay (WTP) value for subjects who received the buying value questionnaire. The ratio of these means is denoted  $r$ , and the symbol (s/ns) indicates whether the difference between the means is statistically significant based on a t-test at a 5 percent confidence level. The fourth statistic, labeled CV, is a measure of the variation in the answers given by subjects. It is the simple average of the coefficient of variation of the WTA (standard deviation of WTA values divided by the WTA mean) and the coefficient of variation for the WTP (standard deviation of WTP values divided by the WTP mean). Insofar as this serves as a proxy for value uncertainty, our hypothesis is that it will be positively related to  $r$ .

Consider first statistics based on the 32 respondents in class 1, which are listed in column (1). The mean WTA-WTP gap for the \$5 bill is 6 percent, and the gap for the \$6 certificate is 14 percent. If the vagaries of redeeming a certificate induce value uncertainty, such a difference is consistent with our hypothesis. The relative size of the coefficients of variation for these two objects is also consistent with this interpretation, since that for the \$6 certificate is nearly twice as large.

The last two objects in Table 1 are tickets to play bets. Bet A offers a 35/36 chance of

winning \$4, and a  $1/36$  chance of losing \$1. Bet B offers an  $11/36$  chance of winning \$16, and a  $25/36$  chance of losing \$1.50. For an individual maximizing expected utility, any uncertainty in the assignment of probabilities or accuracy of calculations would cause greater value uncertainty in Bet B. Consistent with predictions, in class 1 the ratio of WTA to WTP is greater for Bet B. In addition, the coefficient of variation is greater for Bet B, suggesting that differences in the coefficient of variation are proxying differences in value uncertainty.

We were concerned that not all subjects may have fully understood the instructions. In our pilot study, students who specified particularly high or low values for objects frequently explained their values in terms of a bargaining motive. These individuals appeared to believe that their stated values might influence the trading price. One screen for proper understanding might be the subject's evaluation of the \$5 bill. Of the 32 respondents in class 1, five specified values above \$5.25 or below \$4.75. Eliminating them might reduce the number of subjects who misunderstood the instructions. It would also tend to reduce the number of subjects with large personal transactions costs. One (presumably wealthy) student explained her WTP value of \$4.00 for the \$5 bill by stating that it was not worth taking out her wallet unless the profit was at least a dollar. Of course, those with large transactions costs are expected to exhibit a larger WTA-WTP gap.

Column (2) applies this screen.<sup>4</sup> Contrary to expectation, those giving more extreme answers on the first question do not appear to give substantially more extreme valuations for the other objects. In the screened subsample, the differences between average WTA and WTP measures for objects other than the \$5 bill are very similar to those in the full sample. The

pattern of results is unaffected.

Column (3) reports statistics for all subjects responding in class 2. Although the results are generally consistent with the predictions, there are several anomalies. The pattern is not nearly so neat as that of the smaller class. First, the difference between average WTA and WTP measures for the \$5 bill is much greater in class 2. In addition, the difference in CV for Bet A and Bet B does not correspond with expectations. One explanation is that there is much greater noise in subject responses in the larger class. Not only are students in the larger class less likely to be responsive to instructions, but the class also contained a much larger number of freshman, who might well have more difficulty responding to the questions.

Column (4) reports statistics for the subsample that omits respondents who reported a valuation of the \$5 bill below \$4.75 or above \$5.25. We see this omits half of the initial respondents. Comparison of these statistics with those obtained for the full sample suggests that the selection may well be identifying more predictable subjects. In this selected sample, the two measures which our model suggests may be tied to value uncertainty,  $r$  and CV, are monotonically related: The WTA-WTP ratio and the coefficient of variation both increase for objects as we move down the table, consistent with priors of relative value uncertainty.

Results for a still more restricted sample from class 2 are presented in column (5). The maximum prize in Bet A is \$4, while the maximum prize in Bet B is \$16. In this column all subjects specifying values for either bet in excess of \$16 are omitted, in addition to those omitted in column (4). The statistics based on this selected sample are remarkably close to those based

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<sup>4</sup>Knetsch (1989) limited his analysis to groups of subjects screened in a similar way.

on subjects in class 1. Not surprisingly, the measure of the coefficient of variation is much better behaved in this sample, reflecting the sensitivity of variance measures to outliers.

It should be noted that all of the objects listed in Table 1 were evaluated by all subjects. Questions about the \$5 bill and the \$6 certificate were the first and second questions. Evaluation of Bets A and B occurred in a single question, which was in position 8 or 9. The variation in type of object is therefore within subject, while the selling and buying conditions are between subjects. Fox and Tversky (1995) show that within subject variation response to certain choice differences is much greater than between subject variation. In the statistics reported next, we examine whether variation across subjects in value uncertainty also produces results consistent with our hypothesis's predictions.

The third and fourth questions asked subjects to evaluate a T-shirt and a coffee mug, respectively, where both were displayed in the front of the classroom. The T-shirt was conventional, with the university name on it, and the coffee mug had a hand-painted design and was made in Italy. Although all subjects evaluated both items, the written information about the items differed across subjects. Half of all subjects were told that the T-shirt could be purchased at a specific local shop for \$13.99 (this was correct), while the other half were given no price information. Half of the subjects were told that the cup was purchased in Italy and that pottery made in Italy might be fired with a lead-based glaze which could pose health risks. The other subjects were merely told that the mug was made in Italy and purchased in St. Louis. The two written versions of the questions were randomized across individuals, so approximately one quarter of the subjects received each pair of versions.

Table 2 provides statistics based on evaluations of the T-shirt and the mug. Column (1) is

based on class 1, column (2) on all responses in class 2, and column (3) on the subsample limited to those in class 2 whose evaluations of the \$5 bill were at least \$4.75 but not more than \$5.25. The differences between WTA and WTP are substantially greater for the mug than for the T-shirt. The coefficient of variation is also generally larger for the responses regarding the mug, suggesting that this may be proxying for value uncertainty.

Class size undoubtedly affected the information students obtained concerning the displayed objects. While the T-shirt could easily be identified at a distance, most students in the large class would not have been able to see the pattern on the mug. Hence, we might expect that value uncertainty in the large class would exceed that in the small class for the mug but not for the T-shirt. In fact, the WTA-WTP ratio and the coefficient of variation both are greater in the large class, whereas they are similar for the T-shirt. Taken as a measure of the effect of between subject variation, this pattern supports our hypothesis.

The comparisons involving different information about the displayed objects provide somewhat weaker support for the proposed hypothesis. In each of the three columns,  $r$  is greater for the T-shirt when there was no price information, what we might expect if value uncertainty was greater in this case. For the large class, the CV is also greater for the T-shirt in this case, consistent with the view that the CV proxies value uncertainty, although this is not the case in the small class. Comparison of the two information conditions for the mug provides similar support for the hypothesis. We anticipated that the warning concerning the glaze would create value uncertainty, given that subjects had no way to judge its applicability. The coefficient of variation for valuations of the mug in both classes is greater for subjects who received the warning regarding the glaze, consistent with expectations. Also consistent, the ratio of WTA to WTP is

greater for statistics based on the large class, but this pattern is reversed for the small class.

Hence, for both the T-shirt and the mug, the observed violations of expected patterns occur in the small class, where sampling error is of greater importance.

Table 3 reports results of a gamble involving draws from a bag of poker chips under various conditions, including a change in the trading environment. In each case, subjects were asked to evaluate a ticket allowing them to play a game in which they would win \$100 if they specified, in advance, the color of a poker chip to be drawn from a bag. In the first condition, instructions specified that the bag contained 50 red and 50 black poker chips. In the second, the bag was specified to contain 100 poker chips, but the proportion of red and black chips was not specified. In both of these conditions, the subject was provided with no information about the identity of the other party to the transaction. In the third condition, the bag was specified as having an unknown proportion of red and black poker chips, but the subject was told that he was transacting with the owner of the bag. Each subject evaluated only one of these offers, so all variation in conditions was between subjects.<sup>5</sup> Given the very small numbers of respondents in class 1, only results for the larger class are reported. Column 1 reports results based on all subjects who responded (excepting two outliers), and column 2 omits individuals who valued the \$5 bill below \$4.75 or above \$5.25, or who evaluated the draw at more than \$100.

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<sup>5</sup>This question was patterned after that in Fox and Tversky (1995).

The difference between the first and second conditions identifies the effect that Ellsberg (1961) termed "ambiguity." Of course, the conventional analysis would imply that the risk associated with these conditions should be the same, since the subject chooses between two possible colors. We suspect, however, that the wording of the problem creates uncertainties that are difficult to capture in the formal treatment, stemming in part from difficulties the subject may have in interpreting the instructions.<sup>6</sup> If the lack of information about the composition of poker chips in the bag creates additional value uncertainty for the subject, the WTA-WTP disparity should be greater, as should the coefficient of variation. This prediction is confirmed, with the WTA-WTP ratio greater where the proportions are unknown.

The third condition is designed to underscore the possibility that the trader has better information than the subject, since the owner of the bag of poker chips is specified as the trader. In this third condition, the WTA-WTP ratio is larger again, as is the coefficient of variation. It appears, then, that the WTA-WTP disparity varies across conditions in a way predicted by the hypothesis.

### **The WTA-WTP Gap: Conclusion**

The experimental evidence presented in this study supports the hypothesis that subject

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<sup>6</sup>The possibility that such uncertainty may have a rational basis is suggested by the observation that the statement of the choice problem might be interpreted as allowing the bag to contain poker chips of colors other than red and black. The formal treatment normally ignores this and other sources of uncertainty that may rationally influence choices.

uncertainty regarding an object's ultimate value systematically influences the price at which one is willing to trade across a variety of market settings.

Evidence of the informational basis of the WTA-WTP gap is obtained from both within subject and across subject variation in the experimental conditions. The portion of the experimental protocol designed to induce within subject differences in object value produces the clearest pattern of variation across objects. Hypothetical transactions involving a \$5 bill and a negotiable certificate, and two lotteries of differing complexity indicate that value uncertainty induces differences in market behavior corresponding to ownership rights. In all cases the WTA-WTP disparity increases as the value of an object becomes less certain. When variation in value uncertainty is introduced across subjects, results also support our hypothesis that value uncertainty accounts for much of the difference observed in market settings. In transactions involving T-shirts and coffee mugs the difference in the means of the WTA and WTP values is typically significant, with corresponding changes in the coefficient of variation occurring in the expected direction. We also obtain results consistent with expectations in our adaptation of Fox and Tversky's (1995) game involving draws from bags of poker chips with known and unknown ratios of different colored chips.

In short, our results support the hypothesis that value uncertainty is an important empirical determinant of the WTA-WTP disparity. Our analysis does not, of course, disprove the existence of an endowment effect that causes shifts in indifference curves as endowments vary. However, given that our hypothesis was derived from conventional individual optimization, it suggests that the assumption of rational decision making, in conjunction with a recognition of the informational structures that individuals face, may be useful in predicting these kinds of

behaviors.

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Table 1: Willingness to Accept and Willingness to Pay Statistics for Selected Respondents

Item		(1)	(2)	(3)	(4)	(5)
		Class 1	Class 2	Class 3	Class 4	Class 5
			ss 1	ss 2	ass 2	ss 2
\$5 bill	WTA (N)	5.06 (16)	5.00 (15)	5.74 (117)	5.06 (57)	
	WTP (N)	4.78 (16)	4.96 (12)	4.50 (117)	4.92 (60)	
	r (sig)	1.06 (s)	1.01 (ns)	1.28 (s)	1.02 (ns)	
	CV	0.06	0.02	0.27	0.02	
\$6 certificate	WTA (N)	5.89 (16)	5.88 (15)	6.44 (118)	6.20 (57)	
	WTP (N)	5.19 (16)	5.12 (12)	4.50 (118)	4.73 (60)	
	r (sig)	1.14 (s)	1.15 (s)	1.43 (s)	1.31 (s)	
	CV	0.11	0.12	0.18	0.13	
Bet A (-\$1.00,1/36; \$4.00,35/36)	WTA (N)	3.03 (16)	2.97 (15)	4.04 (112)	3.80 (54)	3.67 (50)
	WTP (N)	1.67 (16)	1.67 (12)	2.38 (117)	2.17 (60)	1.87 (59)
	r (sig)	1.81 (s)	1.77 (s)	1.70 (s)	1.75 (s)	1.96 (s)
	CV	0.43	0.38	1.08	0.83	0.55
Bet B (-\$1.50,25/36; \$16.00,10/36)	WTA (N)	5.69 (16)	5.93 (15)	7.03 (113)	7.38 (55)	6.52 (51)
	WTP (N)	2.69 (16)	2.54 (12)	2.32 (117)	2.29 (60)	2.16 (59)
	r (sig)	2.11 (s)	2.33 (s)	3.03 (s)	3.22 (s)	3.01 (s)
	CV	0.79	0.73	0.83	0.90	0.87

Note: In class 2, two students indicated WTA values of 80 and 100 for bet A, while the next highest value was 36. These same individuals indicated WTA values of 40 and 50 for bet B, while the next highest value was 20. We therefore dropped these two individuals from the calculations for the bets .

Key:

$r = \text{WTA} / \text{WTP}$ , where WTA is the mean willingness to accept evaluation and WTP is the mean willingness to pay evaluation.

$CV = [\text{sd}(\text{WTA}) / \text{WTA} + \text{sd}(\text{WTP}) / \text{WTP}] / 2$ , where  $\text{sd}(\text{WTA})$  and  $\text{sd}(\text{WTP})$  are the standard deviations of responses across subjects for the category.

Table 2: Willingness to Accept and Willingness to Pay Statistics for Selected Respondents

Item		(1) Class 1	(2) Class 2	(3) Class 2
T-shirt (price \$13.99)	WTA (N)	8.12 (8)	10.81 (59)	11.13 (28)
	WTP (N)	5.94 (8)	8.08 (60)	7.56 (32)
	r (sig)	1.36 (ns)	1.23 (s)	1.47 (s)
	CV	0.66	0.36	0.40
T-shirt (no price)	WTA (N)	9.00 (8)	6.98 (57)	6.98 (27)
	WTP (N)	5.75 (8)	4.73 (58)	4.52 (28)
	r (sig)	1.56 (ns)	1.47 (ns)	1.54 (s)
	CV	0.56	0.56	0.58
Mug (no warning)	WTA (N)	9.62 (8)	16.14 (59)	19.69 (31)
	WTP (N)	2.38 (8)	3.98 (59)	3.77 (30)
	r (sig)	4.04 (s)	4.05 (s)	5.22 (s)
	CV	0.54	1.34	1.40
Mug with possibly dangerous glaze	WTA (N)	5.68 (8)	6.53 (58)	8.78 (25)
	WTP (N)	1.50 (8)	1.21 (56)	0.86 (28)
	r (sig)	3.70 (s)	5.40 (s)	10.21 (s)
	CV	1.05	1.65	1.80

One individual in class 2 specified a selling price for the t-shirt of \$1000, while the next highest price specified was \$15. The former response has been omitted.

Key: See table 1.

Table 3: Willingness to Accept and Willingness to Pay Statistics for Selected Respondents

Item		(1)	(2)
Draw from bag, 50-50 proportion	WTA (N)	41.13 (38)	39.12 (17)
	WTP (N)	14.41 (39)	13.32 (16)
	r (sig)	2.85 (s)	2.93 (s)
	CV	1.19	1.05
Draw from bag, unknown proportion	WTA (N)	38.64 (37)	35.13 (15)
	WTP (N)	7.42 (40)	9.00 (22)
	r (sig)	5.20 (s)	3.90 (s)
	CV	1.23	1.32
Draw from bag, unknown pro- portion, transact with owner	WTA (N)	52.77 (38)	54.05 (20)
	WTP (N)	9.91 (39)	10.16 (22)
	r (sig)	5.32 (s)	5.32 (s)
	CV	1.36	1.40

Two responses, specifying evaluation levels of \$1000 and \$5000, have been omitted in all analyses. (The next highest evaluation is \$200.)

Key: See table 1.