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W-133
BENEFITS AND COSTS OF RESOURCES POLICIES AFFECTING
PUBLIC AND PRIVATE LAND

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INTRODUCTION

This volume contains the proceedings of the 1999 W-133 Western Regional Project Technical Meeting on "Benefits and Costs of Resource Policies Affecting Public and Private Land." Some papers from W-133 members and friends who could not attend the meeting are also included. The meeting took place February 24th - 26th at the Starr Pass Lodge in Tucson, Arizona. Approximately 50 participants attended the 1999 meeting, are listed on the following page, and came from as far away as Oslo, Norway.

The W-133 regional research project was rechartered in October, 1997. The current project objectives encourage members to address problems associated with: 1.) Benefits and Costs of Agro-environmental Policies; 2.) Benefits Transfer for Groundwater Quality Programs; 3.) Valuing Ecosystem Managment of Forests and Watersheds; and 4.) Valuing Changes in Recreational Access.

Experiment station members at most national land-grant academic institutions constitute the official W-133 project participants. North Dakota State, North Carolina State, and the University of Kentucky proposed joining the group at this year's meeting. W-133's list of academic and other "Friends" has grown, and the Universities of New Mexico and Colorado were particularly well represented at the 1999 W-133 Technical Meeting. The meeting also benefitted from the expertise and participation of scientists from many state and federal agencies including California Fish and Game, the U.S. Department of Agriculture's Economic Research and Forest Services, the U.S. Department of Interior's Fish and Wildlife Service, and the Bureau of Reclamation. In addition, a number of representatives from the nation's top environmental and resource consulting firms attended, some presenting papers at this year's meeting.

This volume is organized around the goals and objectives of the project, but organizing the papers is difficult because of overlapping themes. The last section includes papers that are very important to the methodological work done by W-133 participants, but do not exactly fit one of the objectives. -- I apologize for the lack of consistent pagination in this volume.

On A Personal Note... Any meeting or conference is successful (and fun!) only because of its participants, so I would first like to thank all the people who came and participated in 1999 - listed below. I also want to thank Jerry Fletcher for all his help at this meeting and prior to it, and John Loomis who passed on his knowledge of how to get a meeting like this to work, and who continues to have the funniest little comments to lighten the meetings up. I especially thank Paul Jakus, who helped me to organize this conference and have a lot of fun during it and afterward. Finally, I want to thank Nicki Wieseke for all her help in preparing this volume, and Billye French for administrative support on conference matters.

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June, 1999

P.S. P.F. and J.C. - As far as I can tell, that darn scorpion is still dead!

WHAT DO WE KNOW ABOUT DON'T KNOWS?
ABSTENTION, AMBIVALENCE, DECEPTION

BY

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Paper presented at annual meetings of regional project W-133, Benefits and Costs of Resource Polices Affecting Public and Private Land, Tucson AZ, February 24-26, 1999. Department of Agricultural Economics, Washington State University. This research was funded by the Environmental Protection Agency and the Washington State Department of Ecology as part of Northwest Columbia Plateau Wind Erosion PM-10 Project.

What do We Know about Don't Know Responses:
Abstention, Ambivalence and Deception[1]

Often, respondents in contingent valuation surveys do not provide definitive answers to all questions. Such *missing* or *don't know* responses present a theoretic and practical challenge. Don't know responses to the valuation (bid) questions create a particularly thorny conundrum when an estimate of total value is required. In disciplinary analysis, one can focus on characteristics of the definitive answers (yes or no for dichotomous choice format; zero or a bid value in open ended bid formats). Certainly, economists are supplied with ample puzzles even where responses are definite. However, in a policy situation, the applied analyst does not have the option of ignoring the don't know response. Some value must be imputed willy-nilly.

Consider the two most obvious treatments of the missing values: omitting the observation with the missing value or assigning the response a value of zero. Omitting an observation with a missing value is a standard approach. The consequence of omitting the observation is that the respondent is implicitly assigned the value of the average response when the sample results are generalized back up to the population. A simple example using an open-ended valuation question will illustrate. Suppose the average response to the willingness-to-pay (bid) question in a survey is $50, counting zero and non-zero responses, but with don't know responses omitted. Suppose the relevant population contains one million people. Using the average response gives a total value of $50 million for the valuation object. But using the $50 average value in the total value estimate implicitly assumes that the valuation of the don't know group is the same as that of the "typical" or average respondent in the survey.

Another straightforward approach to treating the missing value is to argue that, since the value of the don't know respondent is unknown, no positive value can be inferred; and therefore a default value of zero should be assigned. Now suppose that 20% of respondents answer don't know to the bid question. If these respondents are assigned a zero value, then the weighted sample average value becomes $40 (.8*50 + .2*0). When the revised value is generalized to

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[1]Without attaching blame for any errors, the authors wish to acknowledge stimulating and insightful discussions with Ron Mittelhammer and many of the W-133 family in addition to those formally acknowledged by inclusion in the cited literature.

the population the total value becomes $40 million. Treatment of don't know responses has created a swing of $10 million in the estimate of total value. In the case of a dichotomous choice or closed ended bid question the mechanics are a little different, but the basic pattern holds[2].

Therefore, while much disciplinary research in contingent valuation is appropriately focused on methods for eliciting a valid bid value, the approach used to treat the don't know responses to the bid question can be at least as important for practical and policy research. The major purpose of this paper is to explore the possible meanings of the don't know response and suggest a systematic approach to modeling the responses which emphasizes the heterogeneity of the don't know responses. We will also briefly review some of the literature on treating missing/don't know responses to the bid question, analyze some empirical evidence regarding the nature of don't know responses in a case study of the contingent valuation of the off-site benefits of reduced agricultural dust emissions, and, finally, offer some suggestions for future contingent valuation studies.

Meaning of the don't know response

Respondents in a contingent valuation survey might fail to give definitive responses to the bid question for at least four reasons: insufficient consideration/information, rejection of response categories, uncertain (ambivalent) preferences, and deception. (See, e.g., Arrow, et al, 1993; Alberini and Champ, 1998; and Wang, 1997, for other discussions.) In the first case the respondent might have insufficient information about the valuation topic or be unwilling or unable to invest sufficient time in the decision process to determine a definitive value. The respondent's preference set is incomplete.

In the second case the respondent rejects the response space provided by the survey instrument. For instance, the respondent may have negative values for the valuation topic and

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[2]Recently the willingness-to-pay elicitation method in which the respondent is offered a bid amount and then asked whether or not he will pay that amount in a voting/referendum framework has become known as the dichotomous choice method. For reasons that will become obvious the term closed ended will be used in this paper.

so cannot legitimately respond with an amount he or she is willing to pay. While some respondents in this situation may choose a zero value in an open-ended survey or a NO in a dichotomous choice referendum, others may not find these options satisfactory. Another reason for rejecting the response options might be that the respondent objects to monetarization of his or her values. Essentially the don't know response may be another form of "protest" response. (Zero and NO responses are sometimes examined for "protest" responses which are then omitted from the data.)

In the third case the respondent is truly uncertain or ambivalent about his or her true valuation of the valuation topic. Indifference surfaces are thick or fuzzy. This is an area of current development in instrument design and analysis.

A final case of indefinite or missing response might occur when the respondent feels that his or her true response would not be socially acceptable or would not be strategic. For instance, a respondent might feel that a "don't know" response is more appropriate than zero for a valuation object that has positive social value. Thus, a respondent might feel embarrassed to respond with a low or zero value in a survey concerning a policy that affects public health although the respondent truly has little personal value for the proposed policy.

Do motives matter?

In standard economic demand analysis, economists do not worry about the motives behind consumer decisions; their analysis is based on behavior. All the analyst needs to be concerned about is whether the consumers' underlying preferences satisfy basic rationality requirements. However, in non-market valuation the analyst has the task of reconstructing the respondents' values from the stated information. Generally, the values inferred from the survey information will differ depending on how preferences are modeled. In this case inquiring into motivation may assist in constructing valid survey instruments, in modeling preferences, and in inferring appropriate values.

For instance, if don't know responses are primarily a result of insufficient information or insufficient decision effort, then increased emphasis should be placed on the construction of the survey instrument to provide information and context to assist, but not bias, the decision process. In modeling and analyzing the data, the analyst would look for information biases and any selection bias that may arise if the values of those whose preferences are not clearly formed tend to be lower than those who do respond. In contrast, if don't know responses arise primarily because of ambivalence of preferences, then the survey instrument should either try to minimize the source of this ambivalence or explicitly provide for indifference/ambivalence responses.

In summary, more information about the nature of the don't know responses would facilitate the construction of valid contingent valuation survey instruments and the development of valid methods to infer values.

Modeling the don't know response process

For purposes of modeling, the four cases cited above can be associated with three response patterns: abstention, ambivalence, and deception. Each of these three response patterns requires a different modeling approach, and perhaps a different instrument design.

Abstention might occur in either of two cases: 1)when respondents have insufficient information to answer or are unable or unwilling to formulate a definitive response; and 2)when respondents find the question inappropriately formulated or the response categories don't fit their preferences. Abstention implies a two stage or nested decision process. The respondent decides whether or not he or she will formulate a value and then calculates the value. Therefore, any stated value is conditional on the decision to respond. This means that abstention has two potential effects: a potential bias in the observed responses and a missing value problem. One must determine if one has the correct response for those who do provide a definite value, and one must assign a value to those who do not provide a definite value.

Abstention is essentially a problem of non-response, a problem well-known in the survey literature. Specifically, these abstention-don't know responses are an instance of item non-

response (see, e.g., Mitchell and Carson, 1989)[3]. As indicated in the introduction, non-response is often treated by simply omitting the observation and calculating the value for the population based on the remaining sample. However, omitting these observations creates the risk of bias: either (item) non-response bias or selection bias (e.g., Mitchell and Carson, 1989). A non-response bias occurs if some identifiable groups are more likely to respond to the question than other groups. The non-response circumstance can become a sample selection problem if those who do not respond differ systematically from those in comparable groups who do respond. A sample selection bias presents a more serious problem than the non-response bias. One does not generally know how the answers of non-respondents would differ from those who actually did respond.

Simply omitting the missing values does not capture the nested nature of the decision process. A better approach is to re-weight the values of the sample respondents according to their incidence in the population. However, there may be unobserved characteristics that distinguish the respondents from the non-respondents. An explicit two stage estimation process in which the decision to respond and the value response conditional on the response would therefore be better still. Cameron, Shaw, and Ragland (1999) have recently applied this approach for the case of unit non-response (failure to return the whole questionnaire) for a mail travel cost valuation study.

After one corrects the value of the respondents with definite values, one must still deal with the values of those who respond don't know in a contingent valuation study. In the Cameron, Shaw and Ragland study, if respondents do not take trips, they do not have behaviorally revealed economic value. In contrast, in a contingent valuation study, respondents who abstain may have economic value that they are not revealing for one reason or another. The situation is somewhat analogous to missing income data; most respondents who refuse to provide income data have an income.

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[3] The analyst faces a similar problem of potential bias when the survey is not answered at all, or when the whole observation must be dropped because irregularities in responses. See, for instance, Mitchell and Carson, or Cameron et al, for discussion of "unit non-response."

A standard, "missing data," remedy for don't know responses is to impute some value to the don't know (DK) respondent based on information about the respondent. Thus, suppose respondents with lower incomes are more likely to answer "don't know" (or some other responses coded as "missing") than are other groups. Rather then omitting the observation and implicitly assuming the simple average value, one can estimate the mean responses by income -- and other socio-demographic characteristics -- for those who do respond and use these estimates to reweight. Equivalently, one can estimate a model of bid values statistically, and use the model to predict the values for the missing (don't know) data, using the revised sample totals to estimate total value.

The abstention model of don't know responses suggests that we examine motives for abstaining in order to predict the don't know values. In the two stage decision process we are predicting the don't know response as much as we are predicting the definite answer response. The value of the don't know respondents is conditional on their don't know response as much as the value of the definite value respondents is conditional on their decision not to abstain. For instance, the non-response literature suggests that respondents for whom the survey topic has low saliency will be less likely to respond to the survey. An obvious analogy is that don't know responses to value questions are likely to come from those with lower interest in the survey topic--and therefore with lower value for the value object. In this case simply omitting the don't know respondents' observations would lead to an overestimation of the program's value. It may be that less informed respondents are also likely to have lower education and income. In this case one can adjust the results provided that one has the socio-economic data. Of course the difficulty here is that low saliency may or may not be correlated with observable characteristics.

In summary then, the abstention model suggests that one first model the decision of whether to abstain (respond don't know or missing) or give a definite value. One then estimates a conditional value for those who give a definitive value and a conditional value of those who abstain. The problem is that one has little or no information with which to estimate the conditional value of the non-respondents. In essence, the conditional estimate of the willingness to pay for the abstention/don't know non-respondents is conditional on the assumption made by the analyst - whether that is an assigned zero value or some estimated value.

Supposing that the respondent is willing and able to respond, he or she still may be ***ambivalent*** about his or her value. Under standard micro theory assumptions, individuals know their own preference and should be able to make a definitive offer. Recently however, value uncertainty has been investigated in some contingent valuation studies. Value uncertainty may be a result uncertainty in the preference structure itself or it may enter somewhere else in the response decision process. For instance, it may be that the respondent is not really certain of the consequences of the program. Often the two cases will be indistinguishable for purposes of modeling[4].

The idea that respondents may have uncertain responses due to ambivalent preferences has been developed by a number of authors including Opulach and Segerson (1989), Ready et al (1995), Wang (1997), and Li and Mattson (1995). Loomis and Ekstrand (1998) have a short survey of the recent empirical literature. Much of this literature has been focused on the uncertainty of stated responses. In one line of research, analysts attempt to use post-bid question expressions of the degree of confidence in the bid to refine the estimates of value (e.g., Li and Mattson, 1995; Loomis and Ekstrand, 1998). Another line of research explicitly incorporates uncertainty in the response categories of the survey instrument. Providing an explicit option for an uncertain/unsure response was one of the NOAA panel recommendations (Arrow, et al). For instance, Ready et al, provide six options ranging from definitely yes to definitely no. Recently a new valuation method has been developed which explicitly incorporates uncertainty in the response set (e.g., Welsh and Poe, Cameron et al). The multiple bound method comprises a matrix of bid levels by degree of certainty (for instance, values of $10, 20, etc and certainty levels: definitely yes, probably yes, not sure, probably no, definitely no).

A third line of research concerns the idea that the item non-response or don't know response to the bid valuation question is itself an expression of ambivalence (Wang, 1997; Alberini and Champ, 1998). Dichotomous choice becomes tri-chotomous choice with YES, DON'T KNOW/NOT SURE, and NO, being the possible response categories - even where the don't

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[4]However, in a theory of adaptive utility, preference uncertainty might be reduced with increased experience (Cyert and DeGroot, 1987).

know response is not explicitly provided[5]. Wang uses ordered probit and related methods to estimate a willingness-to-pay values based on this model.

In summary, the ambivalent/don't know response is generated by a different kind of decision process than the abstention/don't know process. For the ambivalent/don't know preference, the don't know response represents one of an ordered set of possible responses. The respondent is choosing one from among several alternative responses rather than abstaining from answering. In the case of the closed ended elicitation format, the choices are yes, no, or don't know. In the case of the open ended bid format, the choices are zero, a positive value, or don't know. In the closed-end bid question the respondent answers don't know if his or her value is close to the proffered amount. In the open-ended case the respondent answers don't know if the variance is so great it cannot be resolved into a discrete amount (including zero). One implication is that the don't know/ambivalence respondent is different for the open-ended and the closed-ended surveys.

The third type of don't know response is motivated by ***deception*** or strategy. For instance, it may be that the respondents true value is at odds with what is perceived to be the "proper value." Or perhaps, as Opaluch and Segerson (1989) suggest, the respondents personal values are at odds with his or her moral values; the respondent is not lying, but the response does not truly reveal personal willingness to pay. For these cases, the true value may be zero for the open ended question and NO for the dichotomous choice format, but the socially accepted or morally correct value is non-zero or YES respectively. If such deception can be verified, then assigning the zero or NO response is the correct remedy. One obvious procedure is to assess whether or not the don't knows resemble the zero or NO respondents. For instance, Alberini and Champ (1998) found that don't know respondents in a closed-ended contingent valuation study resembled the no respondents. Essentially, Alberini and Champ tested the ambivalence hypothesis of Wang against the deception hypothesis for explaining don't know responses.

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[5]Ready et al label their multiple response categories with explicit degree of confidence, the "politomous choice" (PC) format.

One problem is that no test to distinguish the deceptive from the non-deceptive can be definitive. It may be that one finds a difference between the don't knows and the actual zero or no respondents but the difference is due to the fact that the prevaricators are, in fact different - but they are indeed prevaricators. It may be that one finds no difference between the don't knows and the actual zeros or NO respondents, but that the similarity on the particular measures used is coincidental and would be discovered if other, currently unobserved characteristics were measured.

More recently Blamey, Bennett and Morrison (1999) have suggested that the "yea-saying" tendency many analysts believe are characteristic of closed-ended responses can be countered by offering an appropriate set of response categories. Yea-saying is a kind of deception in which respondents to closed-ended bid questions are assumed to say yes when offered bids higher than their true willingness to pay. BBM offer respondents the opportunity to say they support a socially valued policy with or without financially supporting it. BBMs results are particularly interesting because they compare three models: one which explicitly accounts for uncertainty/ambivalence (Ready et al, 1995), the standard dichotomous choice (closed ended), and their proposed multiple choice bid elicitation format. BBM find that accounting for ambivalence does not change value estimates in the same way that accounting for deceptive responses (yea-saying) does. It appears that the BBM approach of incorporating multiple response categories may address several three don't know response types: inappropriate response categories, ambivalence, and deception/strategy. On the other hand, it strays from the a primary raison d'etre of the dichotomus choice format: an attempt to replicate a voter referendum.

The above discussion suggests that the reasons that respondents fail to answer the willingness to pay question, or give a don't know response are heterogeneous. The implication is that one is really dealing with more than one phenomenon and that modeling approaches based on addressing just one of the possible generators of don't know values may be incomplete. A single strategy for dealing with don't knows may still leave some aspects of the problem mis-specified.

In the remainder of this paper we will present some preliminary analysis of don't know heterogeneity based on an empirical contingent valuation study. The topic of this study was the off-site benefits of agricultural dust reduction.

The agricultural dust study

The Columbia Plateau covering much of Eastern Washington and parts of neighboring states is characterized by high levels of windblown agricultural dust. This is both a soil conservation problem and an air quality problem. The Northwest Columbia Plateau Wind Erosion PM-10 Project is a comprehensive, multi-disciplinary research and education program whose purpose is to study wind erosion from area cropland, analyze its impacts on air quality, and discover and implement strategies for reducing the wind erosion. A contingent valuation study was initiated to measure the off-site benefits of possible improvements in air quality from reductions in wind erosion. (For study details see Scott and Wandschneider, 1997.) It is important to note that local particulate air quality is a public good with direct impact on the area population. Issues of existence/passive use should play a minor role in responses. However, there is opportunity for the influence of altruism and of social approval on the bid revelation process.

The contingent valuation questionnaire was developed in a multistage process: interviews with experts, formal focus groups, medium sized panel response groups[6] (25 participants responding electronically to 90 minutes of questions) and pre-testing of the survey instrument. The survey instrument was administered by a professional survey organization (Social Survey Research Unit at the University of Idaho). The survey used a random telephone survey frame. An advance letter was sent and a lottery based reward was offered to respondents to help increase participation. A total of 1802 interviews were completed with 868 from Spokane and 934 from the tri-cities area of Washington (Richland-Kennewick-Paco). The overall cooperation rate (ratio of completes to completes + partials + refusals) was 74%. The overall cooperation rate (the ratio of completes to all eligible sample numbers) was 59%.

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[6]The panels were conducted by Tell-Back, Inc, of Spokane Washington.

Some general attitudinal and environmental perceptions questions revealed that the survey population was fairly well informed. For instance Spokane residents reasonably viewed motor vehicles as the biggest contributor to air pollution whereas respondent from the tri-cities viewed agricultural dust as the largest contributor. About 9% of the respondents reported that at least one member of their household had asthma and about 20% reported at least one member with some chronic respiratory or heart condition that would place them at risk for health effects from poor air quality.

A two stage split sample valuation format was used. In the first stage all respondents were asked if they would support a program designed to improve air quality by reducing the incidence of agricultural dust during strong wind events. In the second, split sample stage, about one-third of the sample were asked an open-ended format bid question and the remainder were asked a closed ended (dichotomous choice) question. Bids for the dichotomous choice question were based on the distribution of early responses to the open-ended questions. Follow-up questions including follow-up bid questions were asked based on initial responses. For instance, those who could not provide a definite WTP response (zero or a value) were branched into the closed-ended question sequences.

Results, Abstention

The literature suggests that the open ended bid format should generate more decision-process related abstentions than the closed ended format (see, e.g., Mitchell and Carson, 1989). An examination of the don't know respondents to the open ended question in the dust study supports this general finding. Table 1 shows that 60 of the don't know/unsure respondents had responded to the first stage (no valuation) question with an indication of support for the dust reduction program. (Those who answered NO in the first stage question were assumed to possess zero value and were not asked to express a willingness to pay value - except for a small number based on responses to follow up questions .) The table also shows that, of the 108 respondents who initially reported a don't know/unsure response, 54 (exactly half) reported a value when asked a follow-up dichotomous choice question. Therefore, at least some of the don't know respondents have a positive willingness to pay value -- although they are reluctant to

express it in the initial open-ended situation. For those who eventually express a value, it is not clear whether their bid value is lower than the initial open-ended respondents as the low saliency model would predict. For comparison, the initial open-ended respondents had an overall average of $54 dollars but an average of $85 excluding the zero values.

Table 1: Open-ended don't know responses v program support

Program Support	N	Follow-up Valuation	
		N	Mean Bid
For program	60	40	$66
Depends on cost	25	7	$56
Not Sure/no opinion	20	7	$35
No answer	3		
Total	108	54	

The table is also interesting for the negative finding that some people remain in the don't know/missing value category after the follow-up dichotomous choice bid question and other follow-up questions designed, for instance, to identify "true zeros" from don't knows. The residual don't know respondents may remain in the don't know for any of the reasons discussed above although the ambivalence rationale seems least likely. Respondents have had at least two chances to reveal some level of willingness to pay.[7]

We asked follow-up questions which identified, and reclassified some respondents who said they weren't sure but, for instance, gave inability to pay as the reason for not responding. Thus, at least some of the low saliency, don't know responses are revealed by properly phrased follow-up questions to be true zero responses.

Our survey provides some evidence regarding the "answer categories inappropriate" rationale for the abstention-don't know. The first stage of the dust questionnaire was explicitly designed

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[7]Since the open-ended don't know respondents were branched into the dichotomous choice (DC) routine. they also were asked the open-ended follow-up questions asked of the DC branch.

to allow people who opposed the program to express their opposition in a voting framework. We also included a branch allowing a negative valuation for those who opposed a dust reduction program. We received a small number of these negative bids -- too small to reliable use for estimating the costs of the proposed program[8]. In another recent study, Blamey, et al (1998), allowed respondents to choose among degrees of support for a project, with and without financial commitment. The use of multiple response categories with qualitatively different dimensions appears to have potential for responding to some of the abstention-don't know response processes.

Ambivalence and deception

The closed-ended bid elicitation format, including dichotomus choice and a growing number of variations, has been the major venue for investigating ambivalence and deception as a cause of don't know/unsure responses. Alberini and Champ (1998) suggest analyzing data from dichotomus choice studies in two stages. In the first stage the characteristics of the respondents who gave don't know responses are compared to the characteristics of those who gave no responses in order to test whether the don't know is really a separate response. In the second stage the actual willingness to pay estimation is made based on the appropriate treatment of the don't know group. Alberini and Champ use a multinomial logistic model for the first stage test. If the first stage results indicate that don't know responses are not distinct from NO responses, then the don't know responses are reclassified as NO responses. If the don't know and NO response groups are different, then Wang's procedures for trichotomous choice should be used. Alberini and Champ found that, for their sample group, the don't knows were very similar to the NO group, but they suggested that these might not be general results; each circumstance may need to be evaluated separately. Alberini and Champ estimated willingness to pay for their sample under both the don't knows reclassified as NOs and the trichomous Wang method.

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[8] Costs of the program could be directly estimated using forgone agricultural net revenues. Values for opposition to the program by non-farmers might be used to calculate any off farm costs of the dust reduction program. Such values would be primarily existence and altruistic values introducing more problematic valuation questions.

We have not completed our analysis following the Alberini and Champ method, but a "quick and dirty" stage one test using discriminant analysis suggested difficulty in classifying the don't knows as a separate group. Discriminant analysis treats the response categories as simply three groups to be classified by their characteristics. It does not explicitly model the choice process. In future research we will determine if these rough results hold up using a multinominal logistic model and more formal testing. Still the classification approach may be a useful quick screening method to investigate the different response groups.

The results from the dust study show that the discriminant functions for the don't know and the NO response groups were similar in a three way classification, though not for all classification variables. (See table A1.) Interestingly, in a test to see how well the classification scheme worked on the same data that generated it, the discriminant functions assigned no respondents to the don't know group when using the observed prior proportions. A discriminant analysis classifying only don't know and NO responses assigned all responses to the No group when using observed prior proportions. In sum, the evidence from the discriminant analysis is mixed, but provides some support for classifying at least some of the don't knows as NOs.

We have also made some preliminary estimates using a standard 2-way logistic model and the trichotomous ordered probit model following Wang (1995). Appendix table A2 compares logistic estimates of dichotomous choice models with the don't know respondents reclassified to NO responses and the ordered probit trichotomous of YES-DK-NO responses in two specifications: one with only the bid explanatory variable, one with other co-variates - all of which were significant, though statistics are not reported in the table (available from the authors). While tests to formally compare the models have not yet been done, visually, the coefficients are little different between the reclassification-dichotomous models (1 and 3) and the trichotomous, ordered probit models (2 and 4).

A direct examination of the individual responses has something to say also. A notable feature of the don't know responses is that the don't know responses in the dichotomous choice sub-sample are remarkably stable compared to the don't knows in the open-ended sub-sample. Only one of 232 don't know respondent switched to a definite willingness to pay value under an

open-ended follow-up payment question - and that for just $2! If the don't knows reflect ambivalence, the ambivalence is very stable.

This combined group of don't knows also includes 53 don't know respondents who branched in from the open-ended sub-sample. (The don't knows from the open-ended sub-sample were branched into the dichotomous choice questions as follow-up questions, and about half responded with a definite response while half remained don't know.) These "triple don't knows" still included 20 who had answered the program screening support question positively and 18 who said it depended on cost. More generally, of the 232 don't know responses to the dichotomous choice question, 112 had supported the dust reduction program in the screening vote and 47 reported it depends on cost. These program supporters are might be expressing either indifference or deception over the payment choice. Still 70 of the total group of 232 and 15 of the 53 "triple don't knows" had given no answer or an unsure response to the program support question. These truly uncertain respondents seem to be unlikely candidates for deception or payment indifference. They seem more likely to be abstentions.

Conclusions

Our analysis of the dust survey data is preliminary, but this preliminary evidence indicates heterogeneity in the don't know/unsure respondents. This analysis supports the generally accepted idea that the open-ended bid format is more likely to induce don't know responses due to incomplete decision processes than the dichotomous choice format. A telling point here is that some of the open-ended format sub-sample don't knows gave bid values in follow-up questioning where virtually none of the dichotomous choice format respondents did. Those who don't respond seem to include people with low saliency and lower than average values.

The analysis also supports the point that don't know responses to the dichotomous choice question should not simply be omitted. While some of these respondents may be truly ambivalent about the support level, some appear to be better described as NO respondents. If these results hold up, they suggest that the Alberini and Champ (1998) results for a small convenience sample are supported, at least in part, in one larger, random sample survey.

These results also render some support for the Opaluch and Segerson (1989) framework but raise a question about how to interpret some don't knows. Suppose a respondent has an internal conflict between his or her moral values and personal values and cannot decide whether or not to pay. Does this imply a real NO value that the individual is reluctant to reveal, or does it imply a real ambivalence which is best interpreted as indifference as Ready et al (1995) and Wang (1995) do. The difference between these interpretations may very easily be related to an unobserved variable so that tests such as those described by Alberini and Champ will not be able to distinguish the two cases.

Overall this analysis suggests that there is work to be done in determining what to do with don't knows. The analysis suggests that some rough idea of the magnitudes of the don't know respondents values can be gained by follow-up questions and additional analysis. The results also suggest that simple solutions won't work: omitting the don't know observations is likely to produce an overestimate of total value and assigning a zero value will produce an underestimate.

What is to be done? Certainly the tests suggested by Alberini and Champ need to be conducted. But these tests alone will not suffice. Further development of bid formats and follow-up questions are likely to be required for additional progress to be made in dealing with the don't know respondents. It is unlikely we will ever totally eliminate the don't know/uncertain respondent group. For those remain don't knows, the best practical solution in policy applications, after making the best possible estimate, is to provide a range of values from assigning a zero value at the lower bound to assigning the best weighted average value at the upper end.

Appendix

Table A1: Linear discriminant functions for three classes of responses to CVM bid question

Variable	YES bid group	Don't know/unsure	NO bid group
Bid	0.01973	0.02293	0.033660
ReClean	1.36915	1.72316	1.68815
Income	1.81787	1.67792	1.63707
ReDeath	1.44393	1.40759	1.69174
Other issues	2.07324	2.05177	1.85987
Male	0.92913	0.35510	0.50782
AgDust	2.16043	2.25880	2.37374

Table A2: Logit models of bid responses: dichotomous & trichotomous ordered probit (Y=0 in all models)

Variable	Model 1	Model 2	Model 3	Model 4
Intercept	0.7253	0.7454	0.4456	0.3652
Intercept 2		1.0486		0.7019
Bid	-0.0115	-0.0118	-0.0127	-0.1300
Jobscale			0.0814	0.0743
AgDust			-0.1790	-0.1792
ReClean			-0.3237	-0.2967
ReCosts			-0.2006	-0.1788
OtherIssues			0.1432	0.1815
Male			0.4618	0.3937
Income			0.1735	0.1706

Variables:
Bid: bid amount offered
Jobscale: jobs v environment attitudinal scale
AgDust: Agricultural dust is major air pollution contributor
ReClean: Cleaner air is important for reducing cleaning costs
ReCosts: Cleaner air is important for reducing medical costs
Male: Respondents' sex
Income: Household income
ReDeath: Reduce risk of death
Other Issues: Other issues more important

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