Effects of Information Framing and Information Seeking Behavior on Willingness-to-pay for a Wildfire Management Program

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Abstract:

Provision of adequate and unbiased information is a prerequisite for contingent valuation. However, there remains substantial disagreement and lack of understanding regarding how information provided in the survey influences responses to valuation questions. In this study, we examine the effects of wording of the willingness-to-pay (WTP) statement (question framing), the level of information provided by the survey instrument (information framing), and prior exposure of respondents to information about the issue on WTP for a wildfire management program to reduce wildfire risk. Question framing had a statistically insignificant effect on WTP. On its own, information framing was a statistically insignificant determinant of WTP; however, became significant when prior exposure of respondents to information was accounted for. For all information framing levels considered in the study, respondents with greater prior exposure to information were found to have higher WTP than those with less prior exposure. Respondents used information provided in the survey to update their risk perceptions and WTP for the program, although the direction of change was conditional on their prior exposure to information. As the level of information provided by the survey increased, the WTP of respondents with alternative levels of prior exposure to information converged. This convergence supports calls from practitioners to better inform survey recipients about the good they are being asked to value. Our study suggests testing the level of agreement between respondents with differing levels of prior information may be desirable for increasing the level of confidence with which non-market valuation estimates may be used to support decision-making.

Keywords: Willingness-to-pay, Contingent valuation, Information framing, Risk, Wildfire

JEL Classification: Q51, D81

1 Introduction

The contingent valuation (CV) method has become one of the most widely used valuation techniques for the valuation of non-market goods and services (Carson 2000, 2012; Bateman and Mawby 2004). It is believed to provide reasonable value estimates, and is one of the major tools available for policy decision making, especially when an important component of the benefits or costs of the proposed policy is beyond the reach of evidence from the existing market (Haab *et al.* 2013).

From a policy perspective, it is necessary not only to examine willingness-to-pay (WTP), but also to identify and examine the determinants that explain preferences and WTP. The information provided about goods or services under consideration, the payment mechanism, and the specific socio-economic and environmental context are relevant, and affect WTP values (Hoehn and Randall 2002; Alberini *et al.* 2005). For example, the framing of risk information presented to respondents could influence the level of concern and consequently WTP. It has been argued that the information that changes respondents' true WTP for a good should affect their stated WTP (Randall *et al.* 1983; Berrens *et al.* 2004). Thus, validity of stated WTP relies heavily on the information conveyed to respondents, since varying information affects the magnitude of the WTP values (Boyle 1989). In many cases, where respondents are not well informed, the information provided in the survey may be all the information a respondent has to support their valuation (Hoevenagel and Linden 1993). Because of this significance, provision of adequate and unbiased information was recommended by the NOAA panel (Arrow *et al.* 1993).

There exists a substantial body of literature on the effect of information on WTP, and earlier studies have resulted in mixed evidence. The reasons for these mixed effects are not clear. Some studies have shown that information provided in the survey has no effect on WTP (Cummings *et*

al. 1986; Boyle *et al.* 1990; Loomis *et al.* 1994), while others have found information does have a systematic effect on WTP (Samples *et al.* 1986; Bergstrom *et al.* 1989, 1990; Whitehead and Blomquist 1991, 1995; Tkac 1998; Bateman and Mawby 2004). Tkac (1998), Hoehn and Randall (2002), and Alberini *et al*. (2005) found that knowledge or prior information held by the respondent did statistically significantly affect WTP, as well as statistically significantly affecting how the level of information provided in the survey influenced WTP. Further, the effect of information on WTP also depends on the type of good, and the respondents (Tkac 1998; Hoehn and Randall 2002; Bateman and Mawby 2004).

Despite this effort, there remains substantial disagreement, and a considerable lack of understanding about how respondents formulate answers to questions posed in valuation surveys (Bateman and Mawby 2004). In particular, little has been done to understand the interaction of respondent information seeking behavior and information provided in the survey on WTP.

Our study contributes to the literature by examining the combined effect on WTP of different: (a) levels of information provided in the survey instrument (information framing); (b) wording of the WTP question (question framing); and (c) levels of respondent-stated prior exposure to information. The specific context of this study is WTP of residents in the wildland-urban interface (WUI) of Flathead County, Montana, USA, for a wildfire risk mitigation program. To test the effect of information framing, three alternative descriptions of existing wildfire risk were reported. To test the effect of question framing, four versions of the WTP question were tested that differed according to whether respondents were asked their WTP to reduce the likelihood of evacuation versus home destruction, and whether the spatial context was ‘Flathead County’ versus ‘you and your immediate neighbors’. Information framing was found to statistically significantly affect respondent preferences, but the influence varied according to the

respondents' prior exposure to information. Question framing did not statistically significantly affect WTP.

The paper is organized as follows. The next section reviews relevant literature about the application of non-market valuation to support wildfire management. We then describe the case study area in Section 3, and the survey in section 4. The theoretical framework and empirical estimation are described in section 5. Results and discussion follow in sections 6 and 7.

2 Wildfire Management and Non-market Valuation

Several previous studies have used non-market valuation techniques such as CV method and choice experiments to estimate residents' WTP for wildfire risks reduction (Winter and Fried 2001; Kaval *et al.* 2007; Walker *et al.* 2007; Talberth *et al.* 2008; Kaval 2009; Loomis *et al.* 2009; Loomis and Gonzalez-Caban 2010; Holmes *et al.* 2012; O'Donnell *et al.* 2014). The majority of these studies have found that homeowners are, in general, willing to pay for a program that would reduce wildfire risks. However, there is a great deal of variation in WTP values. Thus, wildland fire management provides an interesting setting for studying the effects of different levels of information on WTP in a CV study.

One of the first studies to examine the public preferences for wildfire management program was conducted by Winter and Fried (2001). The authors did not find any evidence that initial subjective risk perceived by respondents influenced WTP. However, homeowners' perception and objectively assessed risk both influenced the probability of market participation. WTP to mitigate wildfire risk through prescribed burning and mechanical thinning was found to be strongly influenced by perceived risks in Walker *et al*. (2007). Similarly, perceived risk was

found to be higher than objectively assessed risk, and respondents with higher perceived risk were willing-to-pay more in annual taxes to reduce wildfire risk in Colorado (Kaval *et al.* 2007; Kaval 2009). Subjective wildfire risk perceived by respondents was also found to influence both WTP and averting behavior in New Mexico by Talberth *et al*. (2008). More recently, Holmes *et al*. (2012) used choice modeling to examine homeowners' preferences and to estimate WTP for wildfire protection programs that reduce the probability of damage and economic losses from wildfire in Florida. Respondents who had personal experience with the effects of wildfire were found to have higher WTP. Respondents who perceived that they lived in a wildfire risk area also had significantly higher WTP.

These studies suggest that there is a great deal of variation in WTP values for wildfire risk reduction, which has been attributed to demographic characteristics, as well as experience, and perceived and objective risk. Further, as discussed by Winter and Fried (2001), residents possessing different level of information regarding wildfire risk are likely to provide different WTP responses. However, it is not clear how new information provided in the survey interacts with the respondents' exposure to prior information, and how it influences risk perception and WTP values for risk reduction. It is also unclear how wording of the WTP statement may affect WTP. This study addresses both of these questions.

3 Flathead County as a Case Study

Severe and frequent large wildfires that cause loss of life and property, and forced evacuation in the WUI have been a growing problem in the western United States. Flathead County serves as an ideal region to study public preferences towards wildfire management because of the

significant area of forest, growing WUI population, and frequent and severe wildfires in recent years (Gude *et al.* 2008; Stetler *et al.* 2010; O'Donnell *et al.* 2014). Wildfire is most costly natural hazard in western Montana (Wall and Halvorson 2011; O'Donnell *et al.* 2014; Paveglio *et al.* 2014). The influx of new residents and increasing number of homes that are being built in the WUI have expanded developed areas into forested landscapes, making a greater number of people vulnerable to wildfire risk.

The majority of the County landscape is forested public land, including more than half of the County's land area being national forest managed by the United States Department of Agriculture, Forest Service. Although the County has not experienced any private structure loss to wildfire since 1988, about 10 percent of the County was burned by wildfire between 2003 and 2007 (O'Donnell *et al.* 2014). Since residents have become accustomed to wildfire, smoky days, and road closure due to wildfire, respondents are expected to have subjective perceptions about wildfire risk. Further, varied respondent experience and exposure to information allows us to examine the relationship between prior information, different levels of information framing in the survey instrument and WTP.

4 The Survey and Data

The data for this study comes from a self-administered mail back survey conducted in Flathead County, Montana, that was designed to assess WUI homeowners' WTP for wildfire risk mitigation programs in the County. Twelve versions of the survey were developed, each with one combination of three levels of information about wildfire risk and four WTP questions that varied according to whether the wildfire risk mitigation program being valued halved the

likelihood of evacuation or home destruction over the next 10 years, for either Flathead County generally or the respondents' home and immediate neighbors. The wording of the levels of information and WTP questions are reported in Table 1 and Table 2 respectively.

[Table 1 about here]

[Table 2 about here]

The first level of information (*INFO1*) informs respondents that hundreds of homes have been evacuated over the last few years, providing respondents with one metric with which to assess wildfire risk in Flathead County. The second level of information (*INFO2*) lets respondents know that, despite these mandatory evacuations, no homes have been destroyed in Flathead County since 1988. We expect respondents will interpret the level of wildfire risk conveyed by *INFO2* as being less than *INFO1*. Third level of information (*INFO3*) provides information about the annual number of homes evacuated and destroyed due to wildfire in the US generally, and the most recent large loss of homes in western Montana due to wildfire. We expect respondents will interpret the level of wildfire risk conveyed by *INFO3* as being less than *INFO1*, but it is not clear whether the additional factual information in *INFO3* will be processed by respondents as meaning wildfire risk is relatively higher or lower than the risk level conveyed by *INFO2*. If respondents are aware of the tens of millions of homes at risk from wildfire, they may come to the same conclusion as Venn and Quiggin (in press), that the risk to any individual home in United States is small (Venn and Quiggin).

The survey instruments were pre-tested on a small number of Flathead County residents and necessary improvements were made. The survey instrument informed respondents about the approximate level of state and federal taxes the respondent is already paying annually for the

current wildfire management program. Respondents were told that additional taxes would need to be levied to fund the program described in the survey instrument. The survey first asked respondents whether they were willing to pay an additional annual tax to fund the wildfire risk mitigation program. Those who responded "yes" were presented with a CV question with several payment card values ($1, $7, $15, $30, $50, $75, $100, $150, $200, $350, $500, $1000) and asked to circle their maximum WTP for the program. Respondents were reminded to consider their budget constraint before making their choice.

The survey was administered in Fall 2011 using a shortened Dillman *et al*. (2009) method. Pre-survey letters were sent to 2058 randomly selected WUI households in Flathead County that were identified as having homes at risk from wildfire. Addresses for the 169 undeliverable letters were removed and one randomly selected version of the questionnaire was mailed to each of the remaining 1889 households in early October 2011. A thank you and reminder post card was mailed to all households on October 20, 2011. The overall response rate was 61 percent with 1,155 returned questionnaires.

5 Theoretical Framework and Hypotheses

5.1 Theoretical Framework

Microeconomic utility theory suggests that WTP for improvements in goods and services is related to the amount of improvement being purchased. The purchased good in this study is a wildfire management program that would reduce the likelihood of home destruction or evacuation due to wildfire. We model household utility as a function of wildfire risk to assess

WTP for wildfire risk reduction. Consider an indirect utility function of an individual that depends on wildfire risk and other socioeconomic characteristics,

$$v = v(r_0, m) \tag{1}$$

where r_0 is initial wildfire risk, *m* is household income, and $\frac{\partial v}{\partial r_0} < 0$. All other terms of the indirect utility function are constant and are suppressed for expositional convenience. WTP for a wildfire management program with a goal to reduce risk from r_0 to r_1 can be expressed as,

$$v(r_0, m) = v(r_1, m - WTP) \tag{2}$$

For a program aimed at reducing risk, WTP is the maximum amount of money that can be taken away from an individual at a higher level of utility associated with reduced risk to keep utility same. WTP can be expressed in terms of an expenditure function (Blomquist and Whitehead 1998; Hoehn and Randall 2002),

$$WTP = e(r_0, u) - e(r_1, u) \tag{3}$$

where *e*(.) is the expenditure function and *u* is the reference level of utility.

Substituting for the indirect utility function and replacing reference level expenditure by income,

$$WTP = m - e\big(r_1, v(r_0, m)\big) \tag{4}$$

Perceived risk does not generally match with objective risk, and respondents state WTP based on their perceived risk. Further, perceived risk is assessed subjectively and can be obtained through a Bayesian updating mechanism (Bergstrom *et al.* 1989; Blomquist and Whitehead 1998; Hoehn and Randall 2002; Bhattacharya *et al.* 2007; Alberini and Longo 2009)[1],

[1]The Bayesian updating mechanism has been used by several authors to study the effect of information on WTP for environmental quality (Bergstrom *et al*., 1989; Blomquist and Whitehead, 1998; Hoehn and Randall, 2002), the effect of new information on WTP for

$$r^*(r_0, I) = \alpha r_0 + \delta I \quad (5)$$

where r^* is perceived risk, α and δ are learning parameters for prior and new information respectively, and I is new information provided in the survey. α is positive, ensuring perceived and objective risk are positively correlated. Under the assumption that respondents revise their risk perception based on new information provided in the survey, the WTP function in equation (4) can be written as,

$$WTP = m - e\left(r_1^*, v(r_0^*(r_0, I), m)\right) \quad (6)$$

The effect of new information provided in the survey can be examined by differentiating the WTP function in equation (6) with respect to new information provided in the survey,

$$\frac{\partial WTP}{\partial I} = -\frac{\partial e\left(r_1^*, v(r_0^*(r_0, I), m)\right)}{\partial v(r_0^*(r_0, I), m)} \frac{\partial v(r_0^*(r_0, I), m)}{\partial r_0^*(r_0, I)} \frac{\partial r_0^*(r_0, I)}{\partial I} \quad (7)$$

Substituting for the partial derivative of perceived risk with respect to new information from equation (5),

$$\frac{\partial WTP}{\partial I} = -\frac{\partial e\left(r_1^*, v(r_0^*(r_0, I), m)\right)}{\partial v(r_0^*(r_0, I), m)} \frac{\partial v(r_0^*(r_0, I), m)}{\partial r_0^*(r_0, I)} \delta \quad (8)$$

The sign of $\frac{\partial WTP}{\partial I}$ depends on the sign of all the terms on the right hand side of equation (8). The first term, $\frac{\partial e\left(r_1^*, v(r_0^*(r_0, I), m)\right)}{\partial v(r_0^*(r_0, I), m)}$, is marginal cost of utility (inverse of marginal utility of income) and is positive. The second term, $\frac{\partial v(r_0^*(r_0, I), m)}{\partial r_0^*(r_0, I)}$, is marginal utility of initial perceived risk and is

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monument conservation (Alberini and Longo, 2009), and the effect of information about risk reduction on WTP to reduce risk of dying in road traffic accidents (Bhattacharya *et al*., 2007).

negative[2]. Since, combined effect of all the terms, other than δ, is positive, the sign of $\frac{\partial WTP}{\partial I}$ will depend on the sign of δ, as described in the following two cases.

Case 1- If initial perceived risk, before the provision of additional information, is greater than objective risk, i.e. $r^* > r$, then from equation (5), $\alpha > 1$. Additional information about risk will decrease perceived risk such that $\delta = \frac{\partial r_0^*(r_0,I)}{\partial I} < 0$ and $\frac{\partial WTP}{\partial I} < 0$. That is, WTP will decrease with the additional information.

Case 2- If initial perceived risk, before the provision of additional information, is smaller than objective risk, i.e. $r^* < r$, then from equation (5), $\alpha < 1$. Additional information about risk will increase perceived risk such that $\delta = \frac{\partial r_0^*(r_0,I)}{\partial I} > 0$ and $\frac{\partial WTP}{\partial I} > 0$. That is, WTP increases with more information.

Comparative statistics from the above cases suggests that WTP is influenced by respondents' perceived risk. Any variables (e.g. additional information provided in the survey) that influence the risk perception will eventually affect WTP. It is possible that the same information affects alternative groups of respondents differently, affecting their WTP accordingly.

[2]The combination of first two terms of equation (8) is the marginal effect of WTP with respect to initial perceived risk (i.e. $\frac{\partial WTP}{\partial r_0^*(r_0,I)}$). The combined effect is positive, indicating that marginal WTP increases with an increase in initial perceived risk, and suggesting that an increase in WTP is associated with higher utility gain.

5.2 Empirical Models and Hypotheses Tested

Payment card (PC) is one of several elicitation formats used in CV method. Although the referendum approach is the most popular for eliciting WTP using CV method, PC approach has several advantages (Rowe *et al.* 1996; Hu *et al.* 2011). For example, Rowe *et al*. (1996) demonstrated that the PC format is free of range and centering bias when the range of the WTP distribution included in the PC is sufficiently large that it does not constrain the respondent. The PC elicitation method was used in this case study.

We use the random utility approach to model responses to CV questions. In a PC WTP question, respondents are shown a payment card and asked to circle the maximum amount they would be willing to pay. If the respondent chose not to participate, her WTP is less than the lowest value on the payment card. The probability of WTP being less than the lowest value in the payment card (C_L) can be written as (Kriström 1997; Hu *et al.* 2011):

$$P(WTP_i \leq C_L) = 1 - F(C_L\beta_P - X\beta) \quad (9)$$

where β_p is an unknown parameter associated with the cost of the program being valued; *F*(.) is the cumulative logistic distribution function under the assumption that the random error has a standard logistic distribution; X is a vector of socioeconomic characteristics; and β is a vector of unknown parameters.

If an individual chooses a card value C_k as the highest acceptable price, the true WTP lies between the card value C_k and the next value C_{k+1} (Hanemann and Kanninen 1996; Hu 2006). The probability that WTP is greater than the value chosen by the respondent and less than the next value in the card is;

$$P(C_K < WTP_i < C_{K+1}) = F\left(C_k\beta_p - X\beta\right) - F(C_{K+1}\beta_P - X\beta) \quad (10)$$

Similarly, if the respondent chooses the highest card value (C_M) as her WTP, the probability that the true WTP is at least as high as this card value is;

$$P(C_M \leq WTP_i) = F\left(C_M\beta_p - X\beta\right) \tag{11}$$

The relevant likelihood function can be written as (Cameron and Huppert 1989; Cameron *et al.* 2002; Hu 2006),

$$\begin{aligned} L = \sum_{i=1}^{n} \Bigg(& d_L \ln\left(1 - F(\beta_P C_L - X\beta)\right) \\ & + \sum_{k=1}^{h-2} d_k \ln\left(F(\beta_P C_K - X\beta) - F(\beta_P C_{K+1} - X\beta)\right) \\ & + d_M \ln\left(F(\beta_P C_M - X\beta)\right) \Bigg) \end{aligned} \tag{12}$$

where d_L, d_k and d_M equals one if the respondent is willing to pay 0, C_K and C_M , and equals zero otherwise.

WTP can be calculated by maximizing the above likelihood function (Cameron and Huppert 1989; Hanemann 1989; Kriström 1997; Yoo and Kwak 2009; Hu *et al.* 2011).

$$WTP_{mean} = \frac{ln\left(1 + e^{X\beta}\right)}{\beta_P} \tag{13}$$

$$WTP_{median} = \frac{X_i\beta}{\beta_P} \tag{14}$$

We estimated three different models with the variables defined in Table 3. First, we started with a basic model (Model 1) that included dummy variables for different versions of the survey (*DESCTRUCTION, NEIGHBORHOOD, INFO2,* and *INFO3*) to examine the effect of different level information and wording of the WTP question on WTP. Arguably, individual and household characteristics also have bearing on how decisions are made and on WTP values. We included several socio-economic and demographic variables (*INCOME, EDU, AGE, MALE,*

RESIDENCY, and *FULLYEAR*) to control for the effect of these socioeconomic characteristics in Model 2. Model 3 also accounts for information seeking behavior prior to receiving the survey (*SEEKLESS*). Interaction terms (*INFO2_SEEKLESS* and *INFO3_SEEKLESS*) enable examination of the importance of different levels of information provided in the survey, conditional on prior exposure to information.

We expect that the gain to a respondent from a program is different depending on the wording of the WTP question (question framing), the level of information provided (information framing), and the level of prior exposure to information. Therefore, in addition to estimating WTP for the proposed program, we test the following five hypotheses.

1. $H_0: WTP_{DESTRUCTION} = WTP_{EVACUATION}$

2. $H_0: WTP_{COUNTY} = WTP_{NEIGHBORHOOD}$

3. $H_0: WTP_{INFO1} = WTP_{INFO2} = WTP_{INFO3}$

4. $H_0: WTP_{SEEKLESS} = WTP_{SEEKMORE}$

5. $H_0: WTP_{INFO1\_SEEKLESS} = WTP_{INFO2\_SEEKLESS} = WTP_{INFO3\_SEEKLESS}$

where $WTP_{DESTRUCTION}$ and $WTP_{EVACUATION}$ indicate WTP for a wildfire management program that would reduce home destruction or evacuation risk by 50%, respectively;

WTP_{COUNTY} and $WTP_{NEIGHBORHOOD}$ indicate the WTP for a wildfire management program that reduces the risk of home destruction or evacuation throughout Flathead County generally or for the respondent and their immediate neighbors;

WTP_{INFO1}, WTP_{INFO2} and WTP_{INFO3} represent the mean WTP under three different levels of information provision in the survey.

$WTP_{SEEKLESS}$ and $WTP_{SEEKMORE}$ represent the mean WTP for respondents who sought information about wildfire risk less than twice or at least twice prior to receiving the survey; and $WTP_{INFO1\_SEEKLESS}$, $WTP_{INFO2\_SEEKLESS}$ and $WTP_{INFO3\_SEEKLESS}$ represent the WTP for the three different levels of information provision in the survey, conditional upon prior exposure to information.

We test these hypotheses using the coefficient of the corresponding treatment dummies from a regression model, and by estimating WTP for different groups of respondents.

6 Results

Two hundred and forty seven responses were discarded because of missing information, leaving 908 usable observations for this study. Descriptive statistics for these valid responses and definition of the variables used in estimation are presented in Table 3. About 57 percent of respondents indicated they were not willing to pay for the program. This might be because respondents are satisfied with the current wildfire management program, as indicated by a similar study in Flathead County, Montana (O'Donnell *et al.* 2014). High levels of unwillingness to pay for wildfire risk mitigation programs has also been observed in other parts of the United States (Winter and Fried 2001; Holmes *et al.* 2012). In our study, 322 responses were protests, with respondents indicating they were not willing to pay any positive amount because they oppose paying any additional taxes. The protest responses were excluded from the analysis, leaving 586 observations with which to fit the model [3].

[3] We also estimated these models without excluding protest bids (results available from authors). While WTP values are statistically significantly different from those reported in Table 5, the

[Table 3 about here]

6.1 Regression Results

Results for the three model specifications are reported in Table 4. There are some similarities in all three models. First, the negative coefficients for values on the PC chosen by respondents (*PAY*) are as expected *a priori*, indicating that respondents are less likely to choose higher payment amounts from the PC. Second, positive coefficients on *DESTRUCTION* suggest that respondents are willing to pay relatively more if the management program reduces the risk of home destruction rather than the risk of home evacuation. However, the effect is not statistically significant. Third, WTP for a program that would reduce the likelihood that wildfire will destroy or require evacuation of the respondents' household and those of their immediate neighbors was higher than for Flathead County generally, but is also not statistically significant. Fourth, provision of more information had a negative effect on WTP, although these effects are only statistically significant in Model 3. Thus, we do not find enough evidence to reject our first and second hypotheses, but there is evidence to reject our third hypothesis and this is discussed below.

[Table 4 about here]

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impacts of level of information provided in the survey on WTP were consistent between the models with and without protest bids. Several models were also estimated with dummies for each of the 12 survey versions; results are available from the authors upon request.

Socio-demographic variables entered models 2 and 3. In both models, income, age and education were positively and statistically significantly associated with WTP. As number of years of residence in Flathead County increases, WTP for the wildfire risk mitigation program statistically significantly decreases. This was expected because, although wildfires burn annually in Flathead County, the numbers of people evacuated are small and a house has not been lost since 1988. Increased length of exposure to wildfire risk without incurring loss is likely to decrease risk perception and WTP for wildfire management programs.

We now turn our focus to Model 3 and the effects of information framing and seeking behavior. The results show that prior information is a statistically significant determinant of WTP, and that accounting for this behavior is necessary for information framing to become statistically significant. The negative and statistically significant coefficient of (*SEEKLESS*) indicates that respondents who sought information less frequently are less likely to pay as compared to those who sought information more frequently. The statistically significant negative coefficients for *INFO2* and *INFO3* indicate reduced WTP of respondents who sought more information prior to receiving the survey for levels of information above *INFO1*. However, the coefficients of the interactions of *INFO2* and *INFO3* with *SEEKLESS* are positive and significant. This result indicates that, all else equal, higher levels of information provided in the survey had a positive effect on WTP for respondents who had sought information about wildfire risk less frequently prior to the survey, and a negative effect on WTP for respondents who sought information about wildfire risk more frequently prior to the survey. Thus, we can reject hypotheses 4 and 5.

6.2 Willingness to Pay Estimates

The coefficients of explanatory variables in Table 4 provide directional impact on indirect utility and WTP. However, these coefficients cannot be interpreted directly in terms of WTP. Mean household WTP is calculated for the mean value of the variables with significant coefficients in Model 3, and suggest respondents are willing to pay \$79 (60, 100)[4] per year for a wildfire management program that would reduce the risk of home destruction or evacuation by half during the next 10 years. Table 5 highlights the effects of information framing and information seeking behavior on WTP.

[Table 5 about here]

The results suggest that WTP depends on the interaction of information provided in the survey and information seeking behavior of the respondents. Additional information provided in the survey had a small statistically significant positive effect for the group of respondents who sought information less frequently. For respondents who sought information more frequently, provision of more information in the survey statistically significantly decreased WTP.

As discussed by Hoehn and Randal (2002), if the new information provided in the survey suggests that the risk is greater than the one indicated by respondents' exposure to prior information, the change in risk is positive and WTP will increase. On the other hand, if the level of information provided in the survey suggests that the risk is lower than the one indicated by prior information, then the change in perceived risk is negative and WTP will decline. In our

[4] Numbers in parentheses indicate 95% confidence intervals calculated using the Krinsky and Robb (1986) approach with 1000 draws.

study, higher levels of information indicate that the likelihood of home destruction or evacuation due to wildfire is small. It seems that initial perceived risk was higher than objective risk for respondents who sought information more frequently prior to receiving the survey. It is reasonable to assume that information provided in the survey reduced their risk perception and their expected gain from the wildfire management program. Thus, reduction in risk perception reduced WTP. On other hand, respondents who sought less information prior to receiving the survey had a relatively low risk perception. That is, their perceived risk was equal to or less than objective risk. Additional information appears to have increased their level of perceived risk and WTP.

We find evidence that respondents combine their prior exposure to information (based on their information seeking behavior) with the different levels of information provided in the survey. Respondents' preference and WTP is thus influenced by the level of information conditional of respondents' own information seeking behavior. These results suggest that WTP is sensitive to information framing if respondents' exposure to prior information is taken into account.

7 Discussions and Conclusions

Provision of standardized information about the good and the contingent market, so that respondents can make more reasoned responses, is a primary aim of a CV survey. Further, as suggested by Berrens *et al*. (2004), although provision of information is under the control of the researcher, how that information may affect choices made by respondents is not. The effect of information provision within a survey on choices made by respondents could vary for different types of goods and for different groups of respondents. The purpose of this analysis was to

examine the impact of information framing and WTP question framing in a CV survey instrument on respondents' WTP for a wildfire risk mitigation program. Our study does support the hypothesis that information framing does statistically significantly affect WTP, but accounting for prior information seeking behavior is necessary to highlight the effect of information framing on WTP. We did not find statistically significant evidence for WTP question framing affecting WTP for the wildfire management program.

Regardless of the level of information provided in the survey, respondents who had sought information more frequently about wildfire risk prior to receiving the survey were willing to pay more than respondents who had sought information less frequently. This must be because of at least one of the following three factors: (a) they are intrinsically more risk averse than respondents who had sought information less frequently; (b) they perceive the probability of a wildfire threatening their assets to be greater than respondents who had sought information less frequently; and (c) they have a higher value of assets at risk than respondents who sought information less frequently. Since Model 3 controlled for income, this result is more likely to be due to factors (a) and (b).

Model 3 in Table 4 revealed that respondents do update their risk perception and preferences according to the Bayesian updating mechanism using information provided in the survey, but the ways in which risk perceptions were updated were conditional on their prior exposure to information. Specifically, provision of higher levels of information was found to positively influence WTP for respondents who had sought information less frequently. In contrast, higher levels of information decreased WTP for those who had sought information more frequently prior to the survey.

Table 5 indicates that the statistically significant net positive effect of higher levels of information on WTP for respondents who had sought information less frequently prior to the survey is small (see also *INFO2_SEEKLESS* and *INFO3_SEEKLESS* in Table 4). This finding is consistent with an argument that these respondents were relatively less concerned about the risk of wildfire prior to receiving the survey, and that the higher levels of information in the survey led some of these respondents to marginally increase their perception of wildfire risk and consequently their WTP for a wildfire risk mitigation program. On the other hand, the statistically significant net negative effect of higher levels of information on WTP for respondents who had sought more information prior to the survey is large. This suggests that these respondents were relatively more concerned about wildfire risk prior to receiving the survey, and that higher levels of information in the survey led them to reduce their wildfire risk perceptions and WTP.

As the survey instrument provided more information, the WTP of respondents with differing levels of prior information about the issue converged. Indeed, the difference in mean WTP between those who were more and less informed about the issue prior to the survey decreased by approximately 75% from $60 per year for *INFO1,* to $10 to $15 per year for *INFO2* and *INFO3* (Table 5). This finding supports calls from non-market valuation practitioners to better inform survey recipients about the good they are being asked to value. Convergence will improve the precision of WTP estimates and increase the confidence that economists and non-economists have in applying non-market values to support decision-making. Of course, the benefits of providing more information have to be traded off against the additional burden this may place on respondents.

Our findings are consistent with previous studies that have found information framing within a CV survey has an effect on WTP (Tkac 1998; Hoehn and Randall 2002; Bateman and Mawby 2004). However, in this study, prior exposure to information about the good being valued is revealed as the driving force behind the effect of information framing on WTP. We assert that one useful measure of the level of confidence that can be placed in WTP estimates from a non-market valuation survey is the level of agreement between respondents with differing levels of prior information, after controlling for socio-economic and other important case-specific variables. Therefore, we recommend obtaining information about the exposure of respondents to prior information become standard practice in non-market valuation surveys.

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Table 1. Different Levels of Information Provided in the Survey Instrument

Information level	Description
INFO1	In recent year, about 130 homes have been evacuated annually due to wildfire in Flathead County. Evacuated homes are considered to be in danger of being damaged or destroyed by wildfire.
INFO2	In recent years, about 130 homes have been evacuated annually due to wildfire in Flathead County. Evacuated homes are considered to be in danger of being damaged or destroyed by wildfire, although wildfire has not destroyed a home in Flathead County since 1988.
INFO3	In recent years, about 130 homes have been evacuated annually due to wildfire in Flathead County. Evacuated homes are considered to be in danger of being damaged or destroyed by wildfire, although wildfire has not destroyed a home in Flathead County since 1988. Many thousands of homes are evacuated each year in the United States and, on average, 1,156 U.S. homes have been destroyed by wildfire each year since 1999. Other parts of western Montana have experienced home losses due to wildfire in recent years. For example, the Bitterroot fires of 2000 threatened 1070 homes and destroyed 70.

Table 2. Different Versions of the WTP Questions Presented in the Survey Instrument

	EVACUATION	DESTRUCTION
NEIGHBORHOOD	Please circle the maximum amount that you would be willing to pay to fund an expanded wildfire management program that would reduce by half the likelihood that you and your immediate neighbors in Flathead County will be evacuated during the next 10 years.	Please circle the maximum amount that you would be willing to pay to fund an expanded wildfire management program that would reduce by half the likelihood that wildfire will destroy your home and the homes of your immediate neighbors during the next 10 years.
COUNTY	Please circle the maximum amount that you would be willing to pay to fund an expanded wildfire management program that would reduce by half the likelihood that homes in Flathead County will be evacuated during the next 10 years.	Please circle the maximum amount that you would be willing to pay to fund an expanded wildfire management program that would reduce by half the likelihood that wildfire will destroy homes in Flathead County during the next 10 years.

Table 3. Definition and Descriptive Statistics of the Variables

		Full sample				Protester only			
Variables	Definition	Mean	Std dev	Max	Min	Mean	Std dev	Max	Min
DESTRUCTION	Dummy variable for the survey version in which the WTP question referred to reducing likelihood of home destruction (1=Yes, 0=No)	0.52	0.5	1	0	0.54	0.5	1	0
NEIGHBORHOOD	Dummy variable for the survey version in which the WTP question referred to reducing the risk to respondents and their neighbors (1=Yes, 0=No)	0.49	0.5	1	0	0.47	0.5	1	0
INFO2	Dummy variable for the survey version with the second level of information (1=Yes, 0=No)	0.32	0.47	1	0	0.31	0.46	1	0
INFO3	Dummy variable for the survey version with the third level of information (1=Yes, 0=No)	0.35	0.48	1	0	0.36	0.48	1	0
INCOME	Household income ($000 per yr)	82.38	56.04	200	5	71.78	51.73	200	5
EDU	Education level of the respondents (yrs)	11	4.44	20	3	10.4	4.56	20	3
AGE	Age of the respondents	59.45	12.16	93	23	60.25	11.49	91	29
FEMALE	Respondent is female (1=Yes, 0=No)	0.37	0.48	1	0	0.34	0.48	1	0

RESIDENCY	Number of years resident has lived in Flathead County	18.39	14.19	87	1	20.51	15.54	87	1
FULLYEAR	Respondent lives in Flathead County throughout the year (1=Yes, 0=No)	0.76	0.43	1	0	0.81	0.39	1	0
SEEKLESS	Respondent sought wildfire risk information less than twice (1=Yes, 0=No)	0.81	0.39	1	0	0.83	0.38	1	0

Table 4. Result of Maximum Likelihood Estimation

Variables	Model1	Model2	Model3
PAY	-0.0102*** (0.0005)	-0.0109*** (0.0005)	-0.0111*** (0.0005)
DESTRUCTION	0.1292 (0.1442)	0.1626 (0.1466)	0.1676 (0.1471)
NEIGHBORHOOD	0.1406 (0.1446)	0.1285 (0.1474)	0.1256 (0.1481)
INFO2	-0.1219 (0.1782)	-0.1676 (0.1809)	-0.7834* (0.426)
INFO3	-0.1312 (0.1759)	-0.1197 (0.1798)	-0.6596* (0.3666)
INCOME		0.0064*** (0.0015)	0.0062*** (0.0015)
EDU		0.0529*** (0.018)	0.0479*** (0.0181)
AGE		0.0161** (0.0066)	0.0152** (0.0067)
FEMALE		0.0077 (0.153)	0.0298 (0.1535)
RESIDENCY		-0.0121** (0.0061)	-0.0124** (0.0061)
FULLYEAR		-0.2036 (0.1792)	-0.2661 (0.181)
SEEKLESS			-0.9783*** (0.3023)
INFO2_SEEKLESS			0.8166* (0.4731)
INFO3_SEEKLESS			0.6925* (0.4198)

constant	0.1956 (0.1553)	-1.5304*** (0.5261)	-0.5955 (0.5994)
Loglik	-1271	-1240	-1234
AIC	2555	2504	2498
N	586	586	586

Significance codes: *** 0.01 ** 0.05 * 0.1
Numbers in parentheses indicate standard errors

Table 5. WTP for Different Levels of Information and Information Seeking Behavior

Information Seeking Behavior	WTP ($) by information level (95% confidence interval)[a]		
	INFO1	INFO2	INFO3
SEEKMORE[b]	132; (90, 176)	85; (48, 127)	90; (56, 132)
SEEKLESS	73; (53, 95)	75; (54, 99)	74; (52, 97)
POOLED[c]	83; (61, 109)	77; (56, 104)	78; (56, 103)

[a]95% confidence intervals calculated using the (Krinsky and Robb 1986) method with 1000 draws.
[b]SEEKMORE is a dummy variable that takes the value 1 for respondents who sought wildfire risk information at least twice. This is the inverse of SEEKLESS.
[c]POOLED indicates pooled sample.