

DISSERTATION

MEASURING VALUES FOR ENVIRONMENTAL PUBLIC GOODS:
INCORPORATING GENDER AND ETHNIC SOCIAL EFFECTS INTO STATED-
PREFERENCE VALUE-ELICITATION METHODS

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ABSTRACT

MEASURING VALUES FOR ENVIRONMENTAL PUBLIC GOODS: INCORPORATING GENDER AND ETHNIC SOCIAL EFFECTS INTO STATED- PREFERENCE VALUE-ELICITATION METHODS

This dissertation explores the theory and seemingly paradoxical results between the economic literatures of contingent valuation method and risk aversion and the interdisciplinary literature of perceptions of risk, specifically with regard to race and gender effects. While a review of the contingent valuation literature shows no systematic gender or race differences in willingness to pay to reduce risks associated with nonmarket goods and services, the risk aversion literature finds systematic gender and race differences in levels of aversion to risks. Women are found to be more risk averse than men and Blacks and Hispanics less risk averse than whites. It is hypothesized that an individual measure of willingness to pay to reduce risks associated with nonmarket goods should be directly related to individual levels of risk aversion and consistent with individual perception of risk. The results from the risk perception literature also find systematic gender and race differences. These results are consistent with the risk aversion literature for gender effects, but inconsistent for Blacks and Hispanics who are found to perceive more risks than whites.

To explore this inconsistency, a theoretical model is constructed that connects the contingent valuation theory to that of risk aversion and perceptions of risk. Insights from the risk perception literature are used to create a model of absolute risk aversion in order to make a tractable connection to risk aversion and stated valuation in CVM. Data from a previously collected dataset by Loomis et al (2009) is fit to the model. The results reinforce the inconsistency found between the risk perception and contingent valuation literatures and indicate a possible shortcoming of traditional methodology used by contingent valuation studies and the need for use of proper payment vehicles.

The existence of social preferences has been well established in the experimental literature and is formally modeled in this dissertation by incorporating influences of self-interest, altruism, reciprocity, fairness, and commitment in the context of stated willingness to pay in contingent valuation methodology. The models suggest that the existence of social preferences may explain some of the inconsistency between the relevant literatures.

A dichotomous choice stated valuation study of various vaccination programs was conducted among college students at Colorado State University. The findings indicate gender differences in willingness to pay for vaccination programs and that the payment vehicle may have substantial effects on valuation. The inclusion of social preferences is a substantial improvement to modeling of valuation and when not included, may lead to underspecified models that ignore existing gender effects.

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Chapter 1: Introduction

Environmental policy initiatives and projects are frequently subject to benefit-cost tests in the worthwhile attempt to ensure that society's resources are efficiently used to maximize social outcomes. Since many aspects of the environment are public goods without market prices for assigning value, the measurement of benefits must depend on nonmarket valuation methods developed by environmental economists. In many cases the only comprehensive and workable approach is a "stated preference" method, most notably the contingent valuation method (CVM). CVM has been extensively developed as a methodology, and is accepted for federal cost-benefit purposes under Executive Order 12866 and EPA regulations.

Because of the wide use and importance of CVM valuation estimates in policy-making, the need for accuracy is of utmost importance. Use of proper technique, methodology, and modeling are essential in attaining accurate estimates of valuation from CVM. Accounting for the diverse motivation of CVM behavior will allow for proper econometric specifications. This dissertation will explain the theory behind CVM and the limitations of its methodology while introducing an alternative model that will try to fix the limitations and allow for more accurate measures of valuation.

Chapter two describes the assorted uses of valuation techniques and which is most appropriate under which circumstances. Since this dissertation is dedicated to valuation for hypothetical nonmarket goods and services, the contingent valuation method (CVM) and its methodology is thoroughly described. A survey of the CVM literature is conducted with specific emphases on gender and race differences in valuation. The chapter also includes a review of critiques and potential limitations of CVM methods. The chapter concludes with a review of the risk aversion literature to assess the consistency between the gender and race effects found in these literatures.

Chapter three introduces the risk perception literature as a way of exploring the critiques from chapter two. An extensive literature review of risk perception studies is conducted with an emphasis on gender and race differences in perceptions of environmental and health risks. A case study using reanalyzed CVM data is conducted to explore the validation of the risk perception literature and potential limitations of CVM methodology. The data supports the general risk perception findings and indicates a mis-estimation resulting from traditional CVM methodology. To further explore these initial discoveries, a model of decision-making that incorporates the essence of risk perceptions into a risk-aversion model is created. Using the data from the previous study, results further substantiate the risk perception findings and question the appropriateness of traditional CVM methodology.

Chapter four establishes a theoretical model of individual decision-making that includes motivations of self-interest, altruism, reciprocity, fairness, and commitment. A review of the experimental literature is investigated and supports the inclusion of social

preferences in models of behavior. Sen's theory of commitment is explored and modeled within the framework of self-interest and social preferences.

Chapter five conducts an analysis to test the appropriateness of including social preferences in a stated valuation study. The data was collected through paper surveys distributed during various economic courses and filled out by volunteer Colorado State University students. The study was designed to estimate valuation of various vaccination programs amongst college students at Colorado State University. The findings suggest that social preferences and the choice of payment vehicle may substantially affect estimates of valuation.

The findings of this dissertation are discussed in chapter 6. A list of references and appendices follow, which concludes this document.

Chapter 2: Nonmarket Valuation Techniques

In neoclassical theory, goods and services are valued at the price in which they are traded in markets. This concept of value is based on three fundamental assumptions of neoclassical theory: the purpose of all economic activity is to increase the welfare of all individuals, individuals are self-interested, and individuals are the best judge of their own welfare in given situations. Therefore, the preferences of individuals over alternate states give measures for valuation. Individual preferences are assumed to be exogenously given with the property that ‘more is better’ and with substitutability, meaning that trade-off ratios between pairs of goods reveal the value of these goods. (Champ, 2003, p.11).

In cases where markets are nonexistent, prevailing market prices cannot be used as a measure of valuation. Two approaches are commonly used to estimate the economic value of environmental resources: physical linkage techniques and behavioral linkage techniques. The most commonly used physical linkage technique is the dose-response model. Unlike behavioral linkage techniques, the dose-response technique does not rely directly on individual preferences. The technique involves a two-step process. The first step includes determining the relationship between levels of environmental damage and the associated physical damages. The second step involves assessing costs to the damage function, usually estimated through market prices (Milne, 1991).

Use of dose-response models are most appropriate in cases where individuals are unaware of the true effects of environmental changes. In cases where the community commonly understands environmental damages and their damage effects, use of a dose-response model may be inappropriate. Another limitation of dose-response models is the need for extensive data. If the relationship between environmental damage and costs has not previously been analyzed, collection of the appropriate data could be very extensive and extremely costly. For the purposes of assessing valuation for nonmarket goods, the dose-response reliance on market prices to estimate costs may prohibit its use. Because of these shortcomings, the dose-response model is not an appropriate tool for estimating valuation of many nonmarket goods, especially hypothetical goods and services (Milne, 1991).

Within mainstream economic theory, three behavioral linkage techniques are commonly used to capture valuation in the absence of markets. Depending on the type of good or service in question or the situation given, the travel cost method, hedonics, or contingent valuation method is used to estimate value. When questions arise about the value of many environmental services or public goods, these techniques are commonly used. These nonmarket techniques are necessary and distinct from the neoclassical price theory since, unlike in price theory, individuals cannot always unilaterally choose the optimal level of these goods. The levels of environmental goods are usually determined by social choices, not individual choice (Champ, p. 27-28).

Nonmarket valuation makes the same assumptions as the neoclassical price theory of market goods; individuals maximize utility given a limited budget and exogenously set preferences. For nonmarket goods, individuals are not able to choose the specific amount

of the good to be consumed. The nonmarket good is assumed to be rationed in such a way that the level is fixed. Therefore the basic neoclassical model is augmented to include the given level of the nonmarket good in question:

$$\max u_i = u(x, q) \quad (2.1)$$

$$\text{st } px = I \quad (2.2)$$

$$q = \bar{q} \quad (2.3)$$

Where x is a vector of all market goods, q the quantity of the nonmarket goods, p is the price vector of all market goods, I is total income, and \bar{q} is the fixed level of nonmarket goods. For individual i , the demand function for market goods is therefore $x^* = x(p, q, I)$.

Nonmarket goods have various attributes that can limit the techniques available for measuring their values. Two main groups of valuation through behavioral linkage techniques are used by economists depending on the nature of the good in question. Revealed preference valuation methods use values from actual market transactions made by individuals. These models are used to estimate the use values of environmental amenities and public goods. Estimations of value are based on data analyses from purchase decisions related to the specific good. Travel cost models and hedonic models are the most commonly used revealed preference techniques. Travel costs models are typically used for recreational values and hedonic modeling used to access the premium that households pay to purchase a property associated with a specific amenity in question.

Unlike revealed preference models, stated preference models use data from survey questionnaires asking respondents what choices they would make under alternative quantities or qualities of a specific nonmarket good. From a theoretical

perspective, stated preference techniques provide estimates of Hicksian surplus, whereas revealed preference techniques can be used for estimates of Marshallian surplus. Stated preference models can go beyond revealed preference methods to capture nonuse values of nonmarket goods as well as estimate values of levels of goods that have not been yet experienced. The hypothetical nature of stated preference techniques allows for the flexibility to capture these values.

2.1 Contingent Valuation

The most commonly used stated preference technique is contingent valuation method (CVM). CVM has been in use since the 1960's to measure values of environmental amenities and was given further credibility from the NOAA (1993) panel report. Since stated preference methods provide estimates of Hicksian surplus, CVM uses the following methodology to measure the value of a policy that changes the quantity or quality of the good, service, or amenity in question:

$$v(p^0, q^0, I-c) = v(p^1, q^1, I) \quad (2.4)$$

Where $v(.)$ is the indirect utility function, p^0 is the initial price of the nonmarket good, q^0 is the initial quantity or quality of the good, I is current income, c is the Hicksian compensating variation, q^1 is the decreased level of the good in question if the policy is not implemented, and p^1 denotes the price of the good if the policy is not implemented. Therefore, the value of c is the willingness to pay for the increased quantity or quality through the policy.

Once the good in question is determined and the population of interest is attained, a questionnaire is created that captures the necessary elements to measure Hicksian surplus. First the good is thoroughly described, giving the current level of the good and

the potential increased level and any effects or concerns at these levels (e.g. health problems, limited fishing access). An extensive, detailed description of the good, along with information is outlined so that respondents are informed and can make rational responses. Respondents are also asked for income levels along with other demographic information. Next, respondents are told the current price of the good and the associated proposed price on the increased level, and asked their individual willingness to pay for the proposed increase.

To elicit an accurate measure of willingness to pay, the questionnaire must state the nature of payment; either hypothetical or real. In a hypothetical payment, respondents are asked how much they would pay, in a hypothetical market situation, but are informed that there will be no actual transfer of money for the stated change. On the other hand, with a real payment, respondents actually face a market-like decision, where payment is exchanged for the stated change. If the payment is real, the payment vehicle must be explicitly noted in order to capture respondent's real trade-offs and valuation. Also to meet the guidelines of the NOAA panel, a decision rule must be given along with an explanation of the method of provisioning, and a timetable for the change in the good to occur.

Along with the informational component of the survey instrument, the actual contingent valuation question needs to be completed with certain specifications. A response format is used that allows for responses of \$0 and varies depending on the sample size and the specific purposes of the study. Because of the potential bias from the hypothetical nature of the valuation question, other questions must be asked to screen for protest and other misleading responses. Also included in the survey are other questions

that provide for covariates for statistical analysis and to address specifics of the study. Additional questions are included that assess the validity of the responses. These necessities combine into a very detailed questionnaire of which the specifics depend on the ultimate goal of the study (Champ, 2003).

Once the questionnaire is drafted, pretests and focus groups are usually completed to test the soundness of the questions and to determine if respondents have full understanding of the good in order to give relevant responses. The questionnaire is then implemented to a sample of the select population. The mode of elicitation varies, but is most commonly through mail or personal interviews. Once the questionnaires are completed and the data is entered, data analysis is completed and the appropriate willingness to pay values are determined. The type of econometric modeling and data analysis depends on the intent of the study, responses format, and the payment vehicle. For example, logit and probit models are commonly used with dichotomous choice formats and the Hanemann technique is frequently used to estimate the mean willingness to pay. The final steps include reporting study results and checking the validity and reliability of those results (Champ, 2003).

2.2 Race, Gender, and Contingent Valuation

Many demographic and socioeconomic variables are attained in CVM questionnaires, such as income, age, gender, race, and schooling levels. Many of these are used primarily as control variables in estimating willingness to pay and are not the subject of specific comparisons. Recently, these demographic variables have been analyzed beyond controls and have been used to measure different valuation amongst different groups (e.g. Ladenburg and Olsen, 2008).

Historically, very few CVM studies were been done that focused on, or had any substantial conclusions about different willingness to pay amongst different classes, races, and gender groups. Of the more recent studies that include these variables, few focus on environmental services or public goods. The limited number of studies cannot give a complete analysis of any specific group's systematic willingness to pay for environmental of health improvements. Since CVM is used to measure benefits in many cost benefit analyses designed to determine the future of environmental policy, this gap in the literature needs to be of concern to economists interested in the overall conclusions of CVM and its use in policy-making.

When focusing only on public good studies, CVM has found no specific trends in gender differences. Brown and Taylor (2000), Berrens et al. (2002), and Kealy et al. (1990) find that men have a statistically larger stated value of willingness to pay than women for the provisioning of public goods. On the other hand, Swallow et al. (1994) find that women have higher valuations, while many such as Teal and Loomis (2000) find no differences.

Limiting the scope to environmental public goods, studies find either no gender differences, or that men are willing to pay a larger amount for environmental amenities. Dupont (2004) suggests that “women [should be] more willing to pay for environmental public goods improvements to reduce risks, [but] economic theory on the role played by time in valuation suggests that the presence of differential time constraints will lower the WTP values of individuals with the least amount of leisure, typically women with children” (p. 274). His observation may give an explanation for the inconsistent results from CVM studies.

Dupont (2004) uses data from a survey conducted in 1995 intended to obtain the value of benefits from a clean-up of the Hamilton Harbour in Ontario, Canada in order to encourage water-based recreational activities. The payment vehicle used was an increase in households' water bills, or rent for tenants. The data suggests that gender is irrelevant to one's determination of WTP for the clean-up. When the focus is limited to WTP for swimming, men have a higher WTP than women, and with issues of fishing, men are willing to pay over twice that of women. Furthermore, Dupont suggests that the time constraint that women face outweighs their desire to reduce risks when asked for their WTP for recreational environmental public goods.

Dupont (2004) makes a very clear explanation for inconsistent gender findings amongst CVM studies. Future studies could distinguish motives and constraints by including questions in the survey that capture time constraints suggested by Dupont to be the main cause of women's lower stated valuation. Controlling for this additional constraint may lead to better estimates of valuation and more consistent gender effects found among CVM studies.

Since most policy makers are males, if females rank environmental quality higher than males, the interests of the general population may not be represented by governmental environmental policy. This potential inconsistency gives motivation for Teal and Loomis's (2000) CVM study to determine gender differences for environmental resources in the San Joaquin Valley. The dataset included 803 individual household members, not specifically the 'head of household'. The findings suggest that women are significantly less likely than men to hold beliefs about consequences resulting from environmental conditions affecting salmon fishing and waterfowl hunting. Gender was

not found to be a significant predictor in a respondent's WTP for habitat improvement, wildlife contamination control improvement, or river and salmon improvement. Finding no gender differences led Teal and Loomis to conclude that female and male policymakers will likely vote the same way in regard to environmental issues.

Brown and Taylor (2000) used surveys that ask respondents their willingness to contribute to the Nature Conservancy, a national nonprofit organization that developed and sponsors the Adopt an Acre program which allows individuals to contribute directly to the protection of rainforest land. The authors found that when faced with a hypothetical contribution, women were willing to pay a significantly lower amount towards rainforest land than men, only willing to contribute on average \$28, as compared to over \$72 for men. When asked to actually donate money, women were still willing to donate less, but the magnitude of the difference decreased, with women, on average willing to donate \$3.23 and men \$6.14, and the contribution behavior between the sexes was not significantly different. The authors conclude that the hypothetical biased is stronger for males and that women are less likely to free-ride. These results suggest that women reveal WTP that corresponds more closely to the 'real market'. This result may indicate a problem for CVM in trying to measure true valuation. In many cases the environmental good in question is a public good and when sold in any market, consumers would be willing to pay significantly less than the socially optimal price or their true valuation due to free rider issues. Therefore if women express a willingness to pay of environmental public goods in CVM that is very close to what they would pay in the market, then the methodology may be eliciting the 'price' they would pay in the market and not their true valuation, which theoretically should be much higher.

One of the few nonmarket valuation studies that find women having a higher willingness to pay is Swallow et al.'s (1994) siting of landfills. Results from the basic models with no interactions, found that women were more willing to pay for siting that does not take away as many environmental services. In the more specific models the authors run, women have a significantly higher marginal WTP to avoid impacts of farmland stock, habitat quality, groundwater quality, homes, farms, and parks from a landfill site. The authors note that:

A gender wage gap may challenge valuation methods that use a household utility model, since genders may represent household values differently. [Since] inequalities may exist across genders, political economists might be keenly interested in the gender gap, (or that) nonmarket values may question methods, that assume constant preferences across residential groups or household members. (p.441)

An interesting note is that the conclusions about gender differences in WTP may be due to the good or amenity in question. Those studies either finding no gender differences, or that males are willing to pay more, usually ask about environmental amenities that are more recreational in nature. Studies finding that women are willing to pay more have an environmental amenity that is more necessary and often has health implications. The distinction between these two types of environmental goods may have many implications for the format of survey used to determine value.

Contingent valuation methodology suggests that demographic information needs to be asked, but the specific demographics to ask are usually not specified (Carson, 2000). Gender therefore may be seen by some as an unnecessary demographic variable to use in economic theory, since usually only income is assumed critical. Race and ethnicity are included even less than gender in CVM, and when included, usually coded only as a dummy variable with race divided into white and non-white categories. Not surprising,

when race is measured through a dummy variable, it hardly ever has explanatory power in WTP differences. When race or ethnicity is a focal point for a WTP study the focus is typically on issues such as language bias (Loomis et al. 2002), violence (Ludwig and Cook 2001, Cohen et al. 2004), job safety (Gerking et al. 1988), food safety (Misra et al. 199) or health risk reduction (Byrne et al. 2004, Wagner et al. 2001) and not specifically on environmental amenities. Results from these limited studies suggest that minorities are willing to pay less than whites in most cases.

Wagner et al. (2001) captured WTP by race for mammography among low-income women. This study is unique in that incorporates race with gender and income. Also, contrary to most mainstream WTP studies, the authors did not simply use a dummy variable for white and non-white. Ethnicity or race was divided into African American, Chinese, Filipino, Latina, and Non-Hispanic white. Consistent with standard theory, women with more money had a higher WTP for a mammogram than others. Results showed that WTP for mammography differed significantly by race. Chinese and Filipino women had a WTP that was significantly less than the other racial groups. Also when compared to the control group—white women—African American women had a WTP that was slightly more and Latinas slightly less. These results show that when the minority group is predominantly Latina and African American, a WTP study may not show any significant racial difference when using a simple dummy variable, even in the presence of differences when race is further disaggregated.

When focusing on environmental CVM studies, little has been done that includes race as a determinant of WTP. Loomis et al. (2004a) and Loomis et al. (2004b) try to determine WTP for fire prevention and fuel reduction by race by focusing on differences

amongst whites, African Americans, and Hispanics. Although, consistent with other studies, differences amongst race was not found to be significant, these papers found that African Americans had a mean WTP for prevention that was \$100 (\$505) more than whites (\$400). As stressed by the authors, Hispanics were found to be willing to pay almost twice that of whites (\$863 v \$437) for fuel reduction, but again, the difference was not found to be statistically significant. With no significant differences found between Whites and minorities, these studies show that the common conclusion that minorities are WTP less for goods and services may not be the same for environmental amenities. This gap in the literature is surprising given the rise in the environmental justice literature and, like gender, should be of importance to political economics.

Table 2.1 presents a quick summary of important CVM studies and their associated conclusions.

Table 2.1 Summary of CVM studies

Study	Good and/or Service	Focus	Finding
Dupont 2004	Benefits from a cleanup of the Hamilton Harbor in Ontario	Gender differences	
	General clean up Swimming Fishing		No difference Men higher WTP Men higher WTP
Teal and Loomis 2000	Environmental services in the San Joaquin Valley	Gender differences	
	Salmon fishing Waterfowl hunting Habitat control Wildlife contamination control		Men higher WTP Men higher WTP No difference No difference
Brown and Taylor 2000	Contributions to the Nature Conservancy for Rainforest Protection	Gender differences	
	Hypothetical Payment Real Payments		Men higher WTP Men higher WTP
Swallow et al 1994	Siting of Landfills	Gender differences	
	Siting that will not impact farm land, habitat quality, groundwater, homes, and farms		Women higher WTP
Loomis et al 2004	Fire Prevention	Racial differences	No differences

2.3 Limitations of CVM

Contingent valuation uses neoclassical models and assumptions making it subject to the limitations within neoclassical theory. CVM uses the neoclassical assumptions that preferences of individuals over alternative states are the basis for valuation. Individuals are assumed to act purely out of self-interest and have exogenous preferences that follow the neoclassical assumptions of utility functions which are maximized, subject to total expenditure on market goods that cannot exceed income. The stated willingness to pay for the nonmarket good from that income is therefore assumed to represent the value that the self-interested individual places on the nonmarket good in question (Champ, 2003).

Many shortcomings have been identified in the traditional methodology adopted by CVM. First, full information is needed for individuals to state true valuation in CVM surveys. Since there are no markets for public goods, it has been suggested that in many cases the survey does not include enough information to elicit valuation and that individuals do not have enough prior market experience with the good to obtain valuation (McFadden, 1994; Arrow, 1982; Boxall et al., 1996). This may be of particular concern with environmental public goods since individuals have no experience with the market providing these goods. Making valuation decisions in a public context would be much more familiar and realistic to respondents.

Also CVM may not elicit true valuation for public goods. CVM studies elicit value by mimicking a market. From public good theory, markets will not give the socially optimal level, or value of any public good. In theory, any public good left to the market will give a value that underestimates the value society places on the good because of the 'free rider' incentive. The problem with CVM studies for public goods is the assumption

that respondents will give their true valuation, not just what they would pay in a market (Sen, 2000; Sen, 1977). It therefore becomes reasonable to assume that the value given from a CVM study will understate the true value that society places on the benefits from public goods. Evidence from CVM studies may exist to support the undervaluation of environmental public goods. Many studies find a hypothetical bias when respondents are not actually paying for the good (Popp, 2001). The stated willingness to pay for public goods when the payment is hypothetical is up to ten-fold the stated willingness to pay when the respondents are to pay directly. This large gap may in fact be measuring the undervaluation of public goods when placed in a market setting and not capturing any bias at all.

The use of an individual income constraint becomes problematic when it is not implemented in reality. Its use may lead to irrelevant alternatives to enter into the social choice (Sen, 2000). Since most of the nonmarket goods assessed in CVM studies are usually provided by public institutions, not individuals, asking individuals their willingness to pay may give inaccurate results because of a lack of references. Due to the influence of commitment on social choice, CVM “has ambiguities especially when it comes to interpreting what people say they are ready to pay for public goods... [since] the philosophy behind contingent valuation seems to lie in the idea that an environmental good can be seen in essentially the same way as a normal private commodity that we purchase and consume” (Sen, 2000, p. 948).

CVM’s reliance on willingness to pay places the same weight on everyone’s dollars irrespective of the poverty or prosperity of the individual respondents (Sen, 2000). This valuation technique gives less voice to those with fewer dollars. Therefore the poor

will have less say in the valuation of public goods and other nonmarket goods. CVM, being individually based has the additional problem of possibility. Sen (2000) notes that:

For example, a case in which it is inquired how much I would pay to save all the living creatures that perished as a result of the Exxon Valdez disaster, and I say \$20. As interpreted by CV, it is now presumed that if \$20 paid by me would wipe out altogether all these losses, then I am ready to make the payment. It is hard to imagine that this question and answer can be taken seriously... The very idea that I treat the prevention of an environmental damage just like buying a private good is itself quite absurd. The amount I am ready to pay for my toothpaste is typically not affected by the amount you pay for yours. But it would be amazing if the payment I am ready to make to save nature is totally independent of what others are ready to pay for it, since it is specifically a social concern. The 'lone ranger' model of environmental evaluation – central to the interpretation of CV valuations – confounds the nature of the problem at hand (948-949).

These critiques revolve around the traditional methodology utilized by CVM, but the science has made changes to address many of these criticisms. The use of a tax referendum payment vehicle instead of a market-like transaction vehicle can minimize many of the shortcomings addressed. Respondents are asked if they would support a tax referendum, in which the respondent would have to pay a given increase in taxes, in order to have the stated change in the nonmarket good. This alleviates the issue of possibility since, although each individual is paying a relatively small amount, it is clear that a 'communal' larger amount is needed to pay for the change. The critique of irrelevant alternatives, where individual choices in CVM are not representative of real life situations can also be minimized by a tax referendum format. Since many of these goods are funded by tax dollars, a referendum is a realistic format in which most respondents will have experience and understand trade-offs in order to state accurate values.

Although CVM has changed to address many critiques, there are still others that have not been adequately tackled. The limitations of the neoclassical methodology give rise to critiques from the race and gender literatures. CVM's reliance on neoclassical

assumptions of self-interest and utility maximization lead the methodology to rely on assumptions of neoclassical rationality. This form of rationality assumes that all individuals act in the same way and therefore only one model of behavior is needed. The unit of analysis is economic or ‘mushroom’ man who springs up fully formed, has exogenously set individual preferences, is purely self-interested, is autonomous, has no age or dependencies, and his only form of communication is through prices and the market (Nelson, 1995). From this perspective, stated willingness to pay for a good should dictate value for all individuals regardless of their race, gender, or class since all agents are assumed to behave like economic man. But the feminist literature explains the need for a richer theory of human economic behavior that allows for pluralistic modeling in order to best understand and describe human behavior. By exploring the limitations of neoclassical assumptions of economic man, the feminist critique allows for the discovery of more realistic descriptions of the different constraints that are placed on different social groups within society and how these influence choice beyond the simplicity of economic man. CVM’s current use of neoclassical rationality seems to be a poor choice in understanding the decisions and values of women and many minorities, and gives credence for an alternative methodology to accurately capture value.

The neoclassical modeling of human behavior leads to assumptions of rationality and utility maximization that are gender biased. These assumptions rely on masculine-associated traits such as individualism and self-interest and ignore feminine-associated traits about cooperation or altruism. Therefore the feminine is considered non-economic and assumed not to enter into decision-making. But this reliance on solely masculine traits cannot explain feminine behavior and choices made by many women (Nelson,

1995). This neoclassical model does not incorporate what women do since it is an outdated theory, culturally based at a time of patriarchy in which these foundations hurt women's positions. Feminist economics challenges this modeling to not only help women's economic and social status, but also in the attempt to truly understand economic decision-making and suggest a discipline that is based on sociology, history, and is normative in its place (Strober, 1994; MacDonald, 1995; May, 2002).

Concepts of self-interest and rationality when extended to women and the family come in to question. Self-interest is assumed to the extent that individuals always act selfishly and only interact with other adults in an impersonal environment rather than more realistic personal relations. Feminist theory criticizes this formation of rationality and individualism since "these models assume an individual without connection to others and whose behavior has no room for empathy, altruism and relation decisions" (Beneria, 1995 p. 1846). Any relations involving affection and love are ignored which leaves many family relations out of the realm of economic analysis. Decisions that have a caring component are ill suited for neoclassical theory, since such behavior by agents is not accepted. The feminist analysis questions the assumptions of independence and autonomy and presses issues of altruism, connection and reliance on others, giving rise to altering behavior amongst individuals with varying levels of these qualities. (Folbre, 1994; Nelson, 1995; Strober, 1994).

Although women have more labor market freedom than ever before, social norms still affect preferences and act as constraints leading to socially imposed altruism. Many women are still housewives, the largest single occupation, because social norms make other options seem worse (Bergman, 1981). Those women who do break out of the mold

and move into the labor market are highly segregated into occupations with a care component. As seen by women's career choices, a feeling of love and commitment is socially imposed on women, therefore creating a situation where women have love and commitment enter into decision-making. This sense of love and commitment may not initially play a role in women's decision making, but after taking on such caring roles, may begin to influence behavior (Folbre and Nelson, 2000). Humans do not simply exist without dependencies, have no age and have exogenous preferences that are fully formed. Individuals have altruistic motivations that are shaped and constrained by the surrounding social structure. These characteristics are very important in preference formation, specifically in women. Simply, humans do not behave the way described by economic man, especially women.

Ideas of socially imposed altruism give rise to another important difference between feminist and neoclassical economic theories; the way in which preferences are determined. In neoclassical theory, individuals are assumed to have exogenously determined preferences where social relations, influences, and cultural constraints play no role in preference formation. Individuals' only form of communication is through pricing in markets leaving the ways in which society and cultural norms influence behavior disregarded. Feminist theory suggests how gender and racially biased value, social inequality and norms influence individual preferences and acknowledge the reflection of group and society in patterns of preferences. Since one cannot freely choose the group that society places one in, social norms can act as an additional constraint to human behavior that goes beyond the simple expenditure constraint in neoclassical modeling. Therefore, feminist theory addresses the importance of group identity, social norms, and

their impact on group differences in describing and predicting systematic differences in group behavior (Folbre and Weisskopf, 1998; Folbre, 1993).

From the feminist critique of neoclassical theory, the gendered nature of the economy and social norms suggest that differences in behavior and outcomes of decisions between men and women are expected. These differences go beyond altering neoclassical theory by introducing a gender dummy variable into the analysis. Gender interacts with many socioeconomic and demographic categories, such that true gender differences can only be understood with full interaction models as shown by the labor market and wage discrimination studies (Figart, 1997). The same arguments have been made for race or ethnic differences.

Gender and racial identity formation is associated with economic outcomes and choices. But mainstream neoclassical theory continues to treat gender and race as a fixed parameter associated with an individual. A group is treated simply as the aggregate of all individuals assigned to that group and this framework can therefore not explain the formation and persistence of social norms related to group identity. “There is ... a choice involved within ... identification. However, macro-level social processes define the choice set and constrain the social and economic implications of individual identity choices” (Darity et al., 2006, p. 289). Because of gender and racial norms and economic outcomes, gender and racial identities are ingrained in individuals. One outcome of racial identity is a lower economic status for many minorities which may lead to an oppositional identity associated with certain economic behavior that is opposite to those groups with more economic opportunities (Akerlof and Kranton, 2000). Those minorities with a higher economic status who identify with the same racial group may feel a

commitment to the group and will make decisions that are best for others in the group (Sen, 1985). Therefore it would be expected that those who identify with a racial group that is economically disadvantaged would have similar behavior and decision-making as others in the group regardless of economic status. Gender and racial identity influences on decision-making can be extended to include environmental or health valuation.

Racial differences in environmental attitudes have been categorized into three explanations: hierarchy of needs, cultural differences, and environmental deprivation. At first glance, the first two explanations would predict that many racial minorities, particularly Blacks and Hispanics would be less concerned about environmental quality because of wealth disparities and cultural norms. On the other hand, the third explanation of environmental concern would hypothesize that racial minorities would be more concerned with environmental quality because of a higher burden of poor environmental conditions (Mohai and Bryant, 1998).

The environmental justice literature suggests that minorities, specifically Blacks and Hispanics are disproportionately exposed to environmental harm (Mohai and Bryant, 1998; Bullard, 1983; U.S. General Accounting Office, 1983; Downy, 2007; Mohai and Saha, 2007). This unequal impact from environmental risk is due particularly to the siting of hazardous waste sites in predominantly Black and Hispanic neighborhoods and has been suggested as the cause of increased concern for neighborhood and community environmental concern. This concern can be expanded beyond those living in these neighborhoods. If reducing environmental harm becomes associated with racial identity, then those Blacks and Hispanics living outside of these polluted neighborhoods may still have high levels of concern if they associate with the racial identity.

The ecofeminist literature suggests that social norms, power relations and identity may predict that women will also have more concern over environmental harm than men. Historically, women have been responsible for water collection, fire wood collection, and food preparation. Therefore any destruction to the environment will have a disproportional impact on women's roles. Women also make up the majority of the world's poor, the group that is disproportionately impacted by environmental damage. The characteristic of superiority over nature is considered masculine, while connection with nature is considered feminine. These issues all suggest that there is a connection between environmental destruction and the treatment of women and the environment. Therefore, it would be expected that women would have more incentive to support environmental protection (Nelson, 1997; McMahon, 1997; Mellor, 2002; Zein-Eladbin, 1996).

The neoclassical assumptions of self-interest and exogenously determined preferences lead CVM to disregard any preferences that are endogenously determined through social constraints and formation of identities. The limited use of neoclassical theory prohibits any systematic gender or racial differences to be included in the modeling of CVM measures of valuation. The following chapters will explore alternative explanations of preference formation that are socially determined to allow a richer measure of valuation of nonmarket goods.

Table 2.2 gives a summary of the main criticisms of CVM provided in this paper.

Table 2.2. Summary of CVM critiques from non-traditional perspectives

Critique	Author	Reason
Individual Constraint	Sen 2000	Leads to potential of irrelevant alternatives and problems of possibility
Assumptions of Rationality, Self-Interest, and Utility Maximization	Nelson 1995	Use of masculine traits, ignorance of feminine traits leads to use of Economic Man which is gender biased
	Folbre 1995 and Folbre and Weisskopf 1998	Socially imposed altruism, social norms, and groups identity create situation where humans, especially women do not act in accordance to these assumptions
Identity formation	Darity et al 2006	Society decides the choice sets of individual identity choices
	Akerlof and Kranton 2000	Lower economic status of many minorities leads to an oppositional identity to whites
Findings from other literatures	Ecofeminism	Women are disproportionality hurt by environmental destruction and have different motivations to decrease degradation
	Environmental Racism/Justice	Minorities (specifically Blacks and Hispanics) are disproportionately hurt by and show concern for environmental harm
Econometric Modeling	Figart 1997	Gender and race more than a dummy variable

2.4 Risk Aversion

Measures of risk aversion describe how individuals act in the presence of uncertain outcomes. The same assumptions that apply to the individual utility function used by CVM also apply to risk aversion, namely that preferences are assumed to be exogenously given and stable over time. Using a twice continuously differentiable von Neumann-Morgenstern (VNM) utility function, as introduced by von Neumann and Morgenstern (1944), individual i 's level of absolute risk aversion, introduced by Pratt (1964) is given by:

$$r_i = -\frac{U_i''}{U_i'} \quad (2.5)$$

The level of absolute risk aversion, measured by r , quantifies the extent to which an individual will avoid risk through the purchase of insurance. The level of absolute risk aversion depends on the concavity of the VNM utility function. The amount that an individual is willing to pay for insurance to avoid the risk should, theoretically, be proportional to their level of risk aversion to the specific risk (Nicholson, 2005, p. 542). Subsequently, the individual level of r should be consistent with the probability of willingness to pay to reduce risks, implying a predicted consistency between CVM and risk aversion findings among similar sources of risk; those found to have higher probabilities of WTP from CVM studies are predicated to also be found to have higher degrees of risk aversion.

Contrary to the results from the CVM literature, systematic gender and race differences across risk aversion studies are found. Halek and Eisenhauer (2001) find that for those with insurance, men are significantly less likely to be risk averse and that Blacks and Hispanics are consistently less risk averse than whites. Rosen et al. (2009) supports the conclusions reached by Halek and Eisenhauer (2001) and find that the factors that best explain higher levels of risk aversion are being white, having no college education, and being female.

With regard to gender and financial risk, Jianakopulos and Bernasek (1998) find “systematic differences in risk aversion by gender [which] may provide an explanation for women’s systematically lower levels of income and wealth compared with men’s” (p. 621). Taking into account race, single Black women were found to hold significantly more risky assets than single white women, but the reverse was not true when compared with single men and married couples. This study shows the need for interaction between

gender and race to give consistent results. Bernasek and Shwiff (2001) also find that gender is a significant predictor of risk aversion, with women being more risk averse than men. Interesting, the authors find that amongst married women, when a spouse becomes more risk loving, women become more risk averse. This finding suggests that studies should move away from the household being the main unit of analysis since it does not take into account relationships affecting data within the household. A summary of the risk aversion findings are given in Table 2.3.

Table 2.3 Summary of risk aversion finding

Study	Focus	Finding
Halek and Risenhauer 2001	Gender and Racial Difference	Those with insurance, men are less likely to be risk averse than women and Blacks and Hispanics less risk averse than whites
Rosen et al	Gender and Racial Difference	Men and minorities are found to be less risk averse. Factors found to indicate higher levels of risk aversion: being whites, no college education, and being female
Jianakopulos and Bernasek 1998	Gender and Racial Difference	Females more risk averse than males. Single Black females hold riskier assets than single white women.
Bernasek and Shwiff 2001	Gender and Racial Difference	Women are more risk averse than men. Amongst married women, if a spouse becomes more risk loving, then the female becomes more risk averse

Chapter 3: Perceptions of Risk

Within the CVM literature, studies rarely address the reason why valuations of nonmarket goods are at the reported level. Many authors make inferences, but this is a secondary view without the original intention of the respondents. The risk perception literature—a branch of sociology and psychology—offers a reason and understanding for the valuation of these goods. In essence, the two bodies of literature measure the valuation of the same good, just from different perspectives. This similarity is strongest when dealing with public goods that are health related. “A prevailing assumption in this literature is that people who perceive a relatively high likelihood of an adverse event are more likely to take personal meliorative steps and support government initiatives to do otherwise, even in the face of required sacrifice” (O’Conner et al, 1999, p. 461). It should then be assumed that those who have higher perceptions of environmental risk should also have a higher WTP for protecting the amenities the environment produces (O’Connor et al. 1999).

The risk perception methodology is similar to that of CVM in that primary data is collected through surveys. Unlike CVM, the risk perception literature is more direct in connecting the reasoning of individual choice with the choice itself. Risk perception studies ask questions about sources of risk and directly ask how these respondents view the reasoning behind these perceptions. Respondents are also asked demographic

information to be used as controls in regression analyses and to measure group differences in perceptions.

3.1 Risk Perception and Gender and Race

The risk perception literature gives a more interdisciplinary approach to risk. This literature has consistent and significant results with regard to race and gender effects to environmental risk. Risk perception goes beyond the grasp of mainstream economic theory and can give insights in explaining reasons why risk perception is different amongst different groups within society.

Although not considered in mainstream economic theory, “neither social reality nor scientific knowledge about reality is gender neutral” (Gustafson, 1998, p. 805). Therefore to make an assumption about the gender neutrality in any social science, including economics is likely false and will lead to invalid conclusions. The risk perception literature gives reasons for the nature of gender differences, along with race and class differences. From this literature, reviewed below, systematic differences in perceptions of risk are found between different groups. “A conventional wisdom had been that African Americans are not as concerned as are whites about environmental quality issues” (Mohai and Bryant, 1998, p. 475). But along with women, the prevailing conclusions from the literature suggest that minorities perceive more risk than Whites from the same sources, specifically Blacks and Hispanics. This is in sharp contrast to the racial conclusions, or lack thereof, found in the CVM literature.

Numerous studies have been conducted to determine perceptions of risks associated with environmental degradation and related health risks. Finucane et al. (2000) best explain differences in perception to environmental hazards as the ‘white male

effect'; a subgroup of white males that have significantly lower perceptions of risk than non-whites and women that influence aggregate risk measures. Flynn et al. (1994) find that women perceive significantly more risk, along with nonwhite males when compared to white males on numerous environmental hazards. The race and gender differences found were mainly due to 30% of the white male population that judged risks to be extremely low. The effect that this subgroup has on the general perceptions of risk on society was coined as the 'white male effect' by Finucant et al (2000). The 'white male effect' has been supported by over 95% of the risk perception literature.

Along with discovering the 'white male effect', Flynn et al. (1994) also revealed attitudes that these low risk perception males hold; agree that future generation can take care of themselves, that government and industry can be trusted with making proper decisions for managing risks from technologies, that society has gone to far to push for equal rights, and disagree that technology is destroying the environment, that they have little control over their health risks, and the need to have a redistribution of wealth.

The 'white male effect' was supported by Johnson (2002) but with a smaller percentage of white males having significantly lower risk perceptions than minorities and women. White males with lower risks had hierarchical and individualist views, high trust of technology, and distrust of government. Particular to air quality, white men differed from all other groups with women and minorities being around 25% more likely to rate outdoor air quality as a high health risk and were less likely to see themselves as sensitive to air pollution and suffering from respiratory problems. Johnson also notes that non-whites work outside more regularly than whites, increasing their exposure to many environmental issues, and may explain some of their increased risk perceptions.

Satterfield et al. (2004) study risk perceptions to determine if any racial or gender differences can be determined. They find that white males have significantly lower risk ratings than white females, nonwhite females, and nonwhite males, with nonwhite females having significantly higher risk ratings than other groups. The results supports the ‘white male effect’, with a subgroup of 48% of white males having significantly lower risks. These white males are also likely to perceive more benefits from science, technology, and industry, and feel that those benefits outweighed their risks. Whites and males are also found to see less discrimination and vulnerability with environmental issues than nonwhites and women. Those who feel that they were often discriminated against rate risk higher than those that do not feel discriminated against. “That is, many risk problems are framed by minorities as questions of justice and fairness and not as technical, scientific, or economic problems per se.” (Satterfield, et al., 2004, p)

The ‘white male effect’ is supported by Finucane et al. (2000) but found to be more complicated than originally discussed by Flynn et al. (1994). Women are found to have higher risk perceptions than men, and minorities, other than Asians, have significantly higher risk perceptions. These white males are found to be better educated, have higher levels of household income, more politically conservative and “may perceive less risk than others because they are involved in creating, managing, controlling, and benefiting from technology” (p. 161). But, perceptions are found to go beyond just ethnicity and gender and are dependent on social characteristics and individual ideology. Although lower in white males, a large amount of heterogeneity was found between males and females of different races indicating that how individuals define their identity has effects on perceptions beyond just race.

Specific to race, Mohai and Bryant (1998) find that most African Americans and whites rank similar environmental issues as important—particularly pollution—but African Americans are statistically significantly more likely to mention a neighborhood environmental problem as a concern and rate the quality as poor. Larger proportions of African Americans rate pollution problems, drinking water quality, and air pollution at higher levels of importance than whites. Contrary to theory, income is found to be negatively associated with nearly every dimension of environmental concern and it is clear that differences in income do not account for racial differences in concern. The conclusion reached by Mohai and Bryant indicate that there may be no ‘race effect’, but rather the differences in environmental concern can be attributed to cultural conditioning and related to the greater likelihood of African Americans to be living in poorer environmental conditions than whites.

Numerous studies have been completed to see if gender differences exist in risk perception. Riechard and Peterson (1998) find that females between the ages of 10-17 have significantly higher risk perceptions than their male peers and that environmental hazards were perceived to have the highest level of potential risks. Davidson and Freudenburg (1996) also find that women show higher concern for risks associated with health and safety of the family and site-specific environmental issues. Women were found to be less trusting of institutions and technology that surround the origins of potential risk. Mohai’s (1992) results support Davidson and Freudenburg’s conclusions. Women were found to report that water pollution and other immediate environmental issues were of higher concern, whereas men feel that recreational environmental issues were of higher concern. Barke et al. (1997) find that gender differences in perceived risks

are evident in males and females having similar occupations, specifically scientists, those with the most knowledge about environmental dangers.

Similar to findings that women self-report higher perceptions of risk than males, women have also been found to be more willing to take voluntary action to protect themselves and their families from environmental risks. O'Connor et al. (1999) find that woman—especially environmentalists—are more likely to take voluntary action than their male counterpart, regardless of the other variables included in their model. Schahn and Holzer (1990) also find that women are more likely to self-report voluntary protectionist behavior than males. Bord and O'Connor (1997) also find that women are more likely to take voluntary action with environmental risks. It therefore becomes conceivable that women perceive more environmental risks, and in order to reduce their family's risk to exposure, they are more willing to take voluntary steps than men to reduce exposure to these environmental hazards.

There are many explanations for why women and minorities perceive more risk from environmental hazards when compared to white men. Of the many possible explanations, the most prevalent within the literature are differences in identity formation, cultural norms, and socialization, constraints, different levels of experience and exposure, differences in knowledge, biology, benefits from technology, trust, feelings of control, and power.

Biological differences were originally used as a possible explanation for gender differences in risk perceptions, but when only based on sex related differences, adding in the factor of racial differences, the biological explanation became negated. For the biological explanation to hold, white males and minority males should have the same risk

perceptions, but—as the literature shows—there are consistent differences (Finucane et al., 2000).

Another popular explanation for documented differences is disparity in scientific and environmental knowledge. The thought is that the more knowledge an individual has about technology leading to environmental hazards, the closer their risk perceptions will be to the ‘true’ level of risk, that which is observed. Observers may attribute women’s and minorities’ greater perception of risk to reflect a poorer understanding of technology relative to white males. Although some studies find that women do report being less knowledgeable about environmental concerns (Bord and O’Connor, 1997), others find that this is not the case, with either women or minorities having more knowledge (Savage 1993). Davidson and Freudenburg (1996) report that more studies find statistical significance in the unexpected direction: that higher levels of knowledge are associated with increased levels of concern. Women and minorities therefore, may be more knowledgeable about environmental concerns. Other studies find no conclusive evidence to support knowledge as having any bearing, (O’Connor et al., 1999) or find that the effect is very indirect (Schahn and Holzer, 1990).

Barke et al. (1997) construct a very conclusive study to test the hypothesis that higher levels of knowledge will result in lower levels of risk perceptions since knowledge is adequately controlled for by studying male and female scientists in the same fields. Male scientists were found to consistently have lower risk perceptions than their female colleagues, although knowledge levels were the same. “Differences in risk perception between men and women is not simply a manifestation of different levels of scientific training” (p. 174). Although “(w)omen are discouraged from studying science and there

are relatively few women scientists and engineers,” those female scientists judge risks to be greater than their male colleagues (Slovic, 1999, p.692).

From the studies focused on risk perception and knowledge, no clear gender association can be detected. Unfortunately, no study has focused on race and knowledge. But as the gender studies suggest, it seems unlikely that knowledge could adequately explain racial differences in risk perception. “Women do indeed express higher levels of concern than do males, not because they know less but because they care more” (Davidson and Freudenburg, 1996, p. 328).

Another potential explanation that has been given attention within the literature is the role of technology and individuals’ relation to it. Slovic (1999) suggests that:

perhaps white males see less risk in the world because they create, manage, control, and benefit from so much of it. Perhaps women and nonwhite males see the world as more dangerous because in many ways they are more vulnerable, because they benefit less from many of its technologies and institutions, and because they have less power and control (p.693).

Finucane et al. (2000) explain that differences in worldwide views, trust, and control are key factors that reflect values about technology and its impact on society. “White males may perceive less risk than others because they are involved in creating, managing, controlling, and benefiting from technology” (Finucane et al., 2000, p. 161). White males were found to be more trusting of technology and less trusting of government than women and nonwhites. To white males “the world seems safer and hazardous activities seem more beneficial” (Finucane et al., 2000, p. 167). Davidson and Freudenburg (1996) find that women are less likely to trust institutions of technology than men, and “no other known study reports significant findings in the opposite direction” (p. 319). The

conclusion that white males express higher trust and benefits from technology was support by Satterfield et al. (2004), Johnson (2002), and Flynn et al. (1994).

Trust of government has been another potential determinant of risk perception. But, unlike the role of technology, trust of government has had mixed conclusions. Flynn et al. (1994) find that white males with the lowest risk perceptions tend to agree that government can be trusted. On the other hand, Finucane et al. (2000) find the opposite relationship, that white males are less trusting of the government. Satterfield et al. (2004) seem to agree, finding that the white males with the lowest risk perception are more conservative than women and nonwhites. Due to the inconclusive influence that trust of government has on risk perception, this measure alone cannot be used to determine perceptions of risk.

Power and the opposing sense of impotence, are also thought to be related to perceptions of risk. A feeling of control over hazards decreases perceived risks associated with the specific hazard (Sjoberg, 2000). Satterfield et al. (2004) find that race and gender differences in perceived risk is “attributed to the reduced social and formal decision-making power held by women and minorities as compared with white males” (p. 116). Flynn et al. (1994) also find that low risk perceiving white males feel that they have more control over risks than others. A sense of power seems to influence a lower level of perceived risk, usually held by white males, and a sense of having a lack of control, usually held by women and minorities, is likely to increase the level of perceived risk. Table 3.1 provides a summary of the overall race and gender findings from the risk perception literature.

Table 3.1 Summary of risk perception findings

Study	Finding	Specifics
Finucane et al 2006	White male effect	These white males are more conservative and have higher income
Flynn et al. 1994	White male effect	These white males agree that future generations can take care of themselves, industry can be trusted, society has gone too far to push for equal rights, and disagree that technology is destroying the environment
Johnson 2002	White male effect	These white males hold more individualistic views and have high trust in technology
Satterfield et al 2004	White male effect	These white males benefit more from technology, science, and industry, see less discrimination, and feel more control impacts
Mohai and Bryant 1998	Blacks perceive more risk	Blacks more likely to state higher perceived risks from pollution, drinking water, and air pollution
Davidson and Freudenburg 1996	Women perceive more risks	Women trust technology less than men and socialization of female identity
Barke et al 1997	Women perceive more risks	Female scientists perceive more risk than male scientists with similar knowledge of environmental damage
O'Conner et al 1999	Women perceive more risks	Female environmentalists willing to take more voluntary actions to protect themselves
Bord and O'Conner 1997	Women perceive more risks	Women more willing to take voluntary actions to protect themselves against sources of perceived risks
Slovic 1999	Women and Minorities perceive more risks	Those that create and benefit from technology perceive less risk associated environmental damage
Sjoberg 2000	General	Those who feel a lack of control over decisions perceive more risks

The environmental justice theory focuses on questions of minority populations being disproportionately burdened by environmental hazards. Many environmental justice studies have found that women and minorities are disproportionately exposed to environmental hazards (Bullard, 1983: U. S. General Accounting Office, 1983: the United Church of Christ Commission for Racial Justice, 1987: Downey, 2007: Mohai and Saha, 2007: O'Neil, 2007). The risk perception literature uses this claim as an explanation for higher risk perceptions among non-whites and women. Savage (1993) found that Blacks and women felt more exposed to environmental risks than men.

Gustafson (1998) agrees with regard to gender, and states that “the interplay between ideology and practice gives rise to gender differences in risk exposure” (p. 810).

Ecofeminism literature focuses on the increased exposure women have to environmental harm as opposed to men. The focus is on socialization and cultural gender roles that place women in charge of environmental tasks. Thus when the environment is destroyed, women disproportionately are burdened due to the socialized roles that create their dependence on the environment (McMahon 1997; M. Mellor, 2002; Julie Nelson, 1997). Similar findings across disciplines give credence to the risk perception literature’s association of risk perception and exposure to environmental exposure.

Socialization, cultural roles, and identity formation are key in understanding differences in risk perception. Within this literature, women have more concern for environmental issues because:

from childhood on women are socialized to be family nurturers and caregivers, that is, to develop a ‘motherhood mentality’ ...In contrast, men are socialized to be family breadwinners and economic providers. The socialization of men results in a ‘market mentality’ that gives priority to economic growth and development and that may portray environmental pollution as a necessary tradeoff for growth. (Mohai, 1992, p.2).

Davidson and Freudenburg (1996) agree that the literature points to socialization as an important determinant in perceived risks, stating that:

because female children do not identify with an alternative role model in the process of defining themselves, they continue to identify with their mother, and consequently they are not as likely to develop a distinction between themselves as individuals and the world around them ...The male is able to objectify and control his environment, and to define himself as separate from the world around him. (p. 304)

These cultural norms that are learned by men and women through socialization help explain why women are more likely to see environmental risk since “women are still seen

as outsiders to the public sphere dominated by men” and are not benefited by the economic process leading to the degradation of the environment and therefore do not see benefits that could outweigh the risks (p. 306). In describing the gender duality in economic theory, Julie Nelson (1995; 1997) supports this idea of the gendered nature of risk as it is tied to the gender norms and women’s connection with the environment. There is therefore a connection between the risk perception literature and feminist economic theory.

3.2 Differences between CVM, risk aversion, and risk perception literatures

The theories behind CVM and risk aversion methodology are both based on neoclassical economics, leaving very little differences in underlying assumptions. Because the risk aversion literature has not expanded to include environmental and health aversion, the only relevant assessment option is to compare CVM methodology and results to the methodology and results of risk perception. Although both CVM and risk perception studies use survey data, the methodology adopted varies significantly. Findings on race and gender in the risk perception literature are reported in the form of simple descriptive statistics, particularly means and difference in means (Mohai, 1992; Flynn et al., 1994; Bord and O’Connor, 1997; Slovic, 1999; Mohai and Bryant, 1998; Finucane et al., 2000). For describing racial or gender-based differences, difference of means tests can be very informative but are ignored within the CVM studies. In many studies when regressions are reported, the risk perception methodology goes beyond that of CVM, in that regressions are completed for males and females independently and minorities and whites independently (Johnson, 2002). The methodology behind running separate regressions is an improvement over adding gender and race as a dummy variable

since these factors interact with other independent variables (Figart, 1997). Since gender and race interact with many other socioeconomic and demographic variables, CVM studies use possibly underspecified modeling giving possibly incorrect conclusions. Some risk perception literature uses multivariate regression with gender and race simply as a dummy variable (Bord and O'Connor, 1997; Barke et al., 1997; O'Connor et al., 1999). Although the results given are less descriptive than running separate regressions, these risk perception studies include other statistical models to support the conclusions reached by the regressions. The methodology used in the risk perception literature has been supported by other social sciences, in particular the feminist economics and environmental justice literatures (Miller and Rodgers, 2008; Mohai and Saha, 2007).

The use of dummy variables becomes very problematic with respect to race effects. Although race is asked as a categorical variable in many CVM studies, a dummy variable is used to indicate a respondent as either white or non-white. This dummy variable can be very problematic in that different ethnic minorities may respond systematically different from one another, but when included as one group, the differences may be washed out. It has been noted in the risk perception literature that Asians have a very low level of perceived environmental health risk, whereas Blacks and Hispanics have much higher perceived risks. When Asians are aggregated with Blacks and Hispanics, a trend that truly exists may be ignored (Finucane et al., 2000).

Unlike CVM, the methodology used in the risk perception literature offers theoretical explanations of why certain groups within society would perceive different levels of risk. The survey technique used in risk perception studies ascertains beliefs, values, socioeconomic, and cultural factors that explain the found differences and support

the findings with other interdisciplinary social science work (Slovic, 1993; Mohai and Bryant, 1998; Gustafson, 1998; O'Connor et al. 1999; Sjoberg, 2000). CVM surveys also establish values, beliefs, and socioeconomic characteristics but use this information as a control, rarely giving the variables any explanatory power. Studies specific to race and gender have very limited background theory to support the conclusions, relying on previous CVM studies with only limited mention to interdisciplinary work (Teal and Loomis 2000; Brown and Taylor, 2000; Dupont, 2004). This gap of interdisciplinary theory leaves CVM only able to report results, instead of incorporating the results into a larger body of scientific knowledge. In general, CVM studies have a very shallow means of interpreting and modeling the data and do not include the richness offered by the risk perception literature.

A group of studies apply nonmarket valuation techniques to measure the value of reducing risks. This literature uses insights from risk perception studies as a basis for interpreting the results from nonmarket valuation techniques. In particular, Viscusi and coauthors use contingent valuation (Magot, Viscusi and Huber, 1988) and the hedonic method (Viscusi, 1993) to estimate the monetary value of reduced health risks, such as the value of cleanup at Superfund sites (Gayer, Hamilton and Viscusi, 2000). Although this work is a step forward in connecting these relevant literatures, it does not address gender or race effects present in perceptions of risks.

3.3 Case study

To test if the results from CVM and risk perception literatures are consistent, a case of valuation of water quality is conducted in this section. The data used were collected for a study conducted by Loomis et al. (2009). In the study, individuals were

asked if they would pay a stated amount for bottled water given the associated probabilities of good and bad health outcomes. This section will use this data, however a different economic model is constructed to determine the gender and racial difference in willingness to pay for the private good of bottled water as a proxy for an increase in the public good of water quality. The current study will also try to determine the suitability of CVM methodology as a tool for valuation of environmental health goods.

The theoretical foundation of CVM for health decision lies in the assumed form of the individual utility function. The typical utility function assumes that individual i receives utility through his or her own consumption of market goods X_1, \dots, X_n , on the level of individual health, H_i , and possibly the health of others H_j :

$$U_i = U_i(X_1, \dots, X_n, H_i, H_j) \quad (3.1)$$

Where $H \in \{B, G\}$, B represents a bad health outcome, and G a good health outcome.

The impact of market goods and health outcomes for individual j on utility are assumed to act independently of one another. That is, changes in individual i 's consumption of market goods will not affect the level of health outcomes for individual j , and vice versa.

If someone is purely self-interested then there is no incentive to pay to increase H_j , and therefore $\frac{\partial U_i}{\partial H_j} = 0$.

Assuming that the change of the good in question will reduce health risks, decisions of willingness to pay will be based on expected utility:

$$EU_i = P_B \cdot U_i(B) + (1 - P_B) \cdot U_i(G) \quad (3.2)$$

$U_i(B)$ is the associated utility of bad health, $U_i(G)$ is utility of good health, and P_B is the probability of bad health.

The utility function presented in equation 3.2 determines individual i 's action of 'Pay' (the act of that individual stating the desire to pay the stated amount to have the decrease in risk). But the form of the function itself is not apparent to the outside observer. To estimate the impact of the utility function on the 'Pay' choice, in a dichotomous choice framework, a logit regression analysis is performed. The responses from the questionnaire are combined with the associated cost of 'Pay' and risk factors into a regression that estimates the impact of factors (such as gender, age, perceived risks, and race) on the 'Pay' decision.

The probability that individual i will select the action 'Pay' suggests that individual i 's WTP for the increased probability of good health is greater than the cost of the program. Therefore, the probability that individual i is willing to pay the stated amount to reduce the risk of the bad health is:

$$\text{Prob (WTP} > \text{cost)} = 1 - \left(\frac{1}{1 + e^{B_0 + B_1(\text{cost}) + B_2(\text{risk})}} \right) \quad (3.3)$$

Where 'cost' is the stated cost in the survey associated with reduce risks and 'risk' is the reduction in health risks of the improved level of the good, i.e. a reduction in the probability of B and an increase in the probability of G. Socioeconomic variables are typically included as explanatory variables in the empirical model. The β s shown in 3.3 represent the coefficients of the associate variables found from the logit regression.

3.3.1 A Model of Risk Perception and Risk Aversion

To test the comparability of the theories, a tractable uniformity between the theories needs to be established. CVM and risk aversion methodology rely on expected utility theory. Risk perception theory, although thoroughly developed, has not been

empirically modeled in this context. In order to make the three theories connectable, a simple model of risk perception by extending the standard expected utility model is developed below. The main idea is that subjective perception of risk can alter both the perception of the probability associated with an outcome and the valuation of such outcome, as expressed by the individual utility function.

Let P_{bi} be the true underlying probability that individual i will experience bad health. The probability is indexed by individual to allow for different individuals to have different probabilities of bad health outcomes, since it is documented that certain individuals are burdened more by sources of health risks than others (e.g. Bullard, 1983).

Let π_i be a representation of individual perception of risk, where $0 < \pi_i \leq \frac{1}{P_{bi}}$. Studies suggest that individuals with very low perceptions of risk actually view risky outcomes as less likely to happen than the true probability, while those with high perceptions of risk believe that these outcomes are more likely to happen (Viscusi, 1993). Therefore, when $\pi_i = 1$, the individual perception of risk is equal to the objective risk associated with an outcome. Allowing π_i to be different than one, and possibly to be different across individuals, highlights the role of individual perception of risk in shaping subjective evaluations of risky outcomes. First, insights from the risk perception literature suggest that perceptions of risk affect the perceived probability of outcomes. This consideration points toward using *perceived* probabilities instead of true probabilities as weights in the expected utility function. We have:

$$EU_i = P_{bi}\pi_i \cdot U_i(B) + (1 - P_{bi}\pi_i) \cdot U_i(G) \quad (3.4)$$

$U_i(B)$ and $U_i(G)$ have the same meaning as defined in equation 3.2.

Further, the risk perception literature suggests that perceptions of risk influence not only perceived probabilities of outcomes, but also how individuals value outcomes. In other words, the perception of risk by individual i should not only influence the subjective probabilities that i associates to risky outcomes, but also enter as an argument of individual i 's utility function. The Pratt-Arrow measure of relative risk aversion is another measure of aversion to risk, but is specific to risks associated with particular options, not an overall measure of risk. In order to simply capture this idea, assume that individuals have constant relative risk aversion utility functions, which assumes a decreasing measure of absolute risk aversion of the following form:

$$U_i = \left(\frac{H_i}{\pi_i} \right)^\alpha \quad (3.5)$$

Where $H_i \in \{B, G\}$. Also, α represents the relative risk aversion coefficient with $0 \leq \alpha \leq 1$.

We assume that the level of relative risk aversion, α , is the same across all individuals.

This formulation of the utility function allows for the degree of risk perception to influence individual utility. In fact, using equation 3.4, the expected utility of individual i is:

$$EU_i = P_{Bi} \pi_i \left(\frac{B}{\pi_i} \right)^\alpha + (1 - P_{Bi} \pi_i) \left(\frac{G}{\pi_i} \right)^\alpha \quad (3.6)$$

From equation 3.5, r_i , the level of absolute risk aversion for individual i is calculated as:

$$r_i = - \frac{U_i''}{U_i'} = (1 - \alpha) \left(\frac{\pi_i}{H_i} \right) \quad (3.7)$$

We are interested in comparing risk aversion across individuals relative to the same type of outcome (B, G respectively). Therefore, we can normalize the outcome of $B=1$ and $G=\gamma$, where $\gamma > 1$, in order to simplify equation (3.7) to:

$$r_{Bi} = (1 - \alpha)\pi_i \quad \text{and} \quad (3.8)$$

$$r_{Gi} = (1 - \alpha)\frac{\pi_i}{\gamma} \quad (3.9)$$

for each outcome (B, G). Individual perception of risk, π_i , directly determines the level of absolute risk aversion for individual i , because it influences the concavity of the individual utility function. As it is clear from equation (3.8 and 3.9), an increase in perception of risk increases the level of absolute risk aversion. Since r_i influences the probability that individual i will be WTP to insure against risk, then this simple model provides an immediate empirical link from perceptions of risk to absolute risk aversion and the probability of WTP.

The model shown here assumes a dichotomous health outcome: good or bad health. In this study, respondents were given the probabilities of bad health outcomes, and thus also given the probabilities of good health outcomes. Because of the treatment of health outcomes as being dichotomous, the modeling of health outcomes as dichotomous is appropriate. But for other risks, the health outcome may not be as simple. In these cases health may be more accurately represented by a continuous health outcome. In these cases, the expected utility would be based on the underlying distribution of the probabilities of health outcomes. Perceptions of risk would still have an influence on the expected utility since the measure would still be based on the utility of health outcomes outlined in equation 3.5 and the perceived probabilities of outcomes. Overall, the influence of π on expected utility, and thus behavior with continuous health outcomes will be uniform.

The data from the previous section will be used to test not only the consistency of this link between the three literatures, but also to determine if different groups exhibit systematic differences within the results.

3.3.2 Loomis et al Findings

The study conducted by Loomis et al (2009) used the traditional model of willingness to pay without incorporating perceptions of risk. The original methodology adopted by Loomis et al. used a conjoint approach based on the theoretical foundation of the random utility stated preference model. Using an expected utility framework, adults were given a dichotomous choice stated preference survey following Hanemann's (1984) exposition of the utility difference foundation. In their model, the first choice was a 'no action' choice associated with no cost. The alternative choice given would reduced infant's risk of brain damage, shock, and death and was associated with a one-time cost of \$Z, which varied across the sample. The overall water quality and associated risks were determined though numerous discussions with water quality specialists.

The experiment included one cost factor and three risk factors; brain damage, shock, and death. For the 'no action' option, the cost was zero and the risk of shock, brain damage, and death were set at the baseline levels of 100/1000, 40/1000, and 9/1000 respectively. For the alternative of 'buy bottled water' there were five varying levels of each risk, of which, one was chosen randomly for each survey for each risk category. Two treatments were included in the study. For the consequential treatment, respondents were asked to pay real money for the bottled water from a sufficient amount of money given to the respondents to create a real opportunity cost of purchasing bottled water. The second treatment was non-consequential and included a hypothetical payment. For both

treatments, the survey packets included an explanation of the risks associated with the current level of water quality, and how purchasing bottled water would decrease these risks. Respondents were also informed of the layout of the questionnaire to increase understanding and decrease non-meaningful responses.

The data consisted of 188 completed surveys from Colorado households. Each packet included four willingness to pay questions. Once protest votes were eliminated, an effective sample size of 689 remained with 570 female responses, 103 male responses, 314 white responses and 168 Hispanic responses. Both gender and ethnicity were coded as a dummy variable, yet only gender was included in the econometric model. The gender dummy variable was coded as one for male respondents and zero for female.

The authors believed that the amount a respondents would be willing to pay depended on the cost or price of bottled water, the associated risk of infant health problem, how much they believed bottled water reduced these risks, whether the payment was real or hypothetical, the smell of their existing water, their gender, and perceived levels of control and norms around health issues. The econometric model therefore used is as follows:

$$Prob (WTP > cost) = f(cost, risks, mode, smell, bottled, gender, perceived control, water norms)^1$$

The results reached by Loomis et al. are shown in Table 3.2

¹ The probability can be calculated using the logit regression results in equation 2.3 but is not appropriate for this discussion since it does not include race differences.

Table 3.2 Loomis et al. Results

Variable	Coefficient	Probability
Cost	-0.001269	0.0629
Real Cost Dummy	-0.009515	0.0000
Shock	0.022628	0.0029
Brain Damage	0.041088	0.0211
Death	0.104565	0.0866
Survey Mode	-1.059893	0.0000
Water Smell	-0.338202	0.0060
Bottled	0.91329	0.0000
Gender	-1.151328	0.0000
Perceived Water Control	0.528444	0.0084
Water Norms	0.418877	0.0005
Constant	-1.887061	0.0331
Log Likelihood	-425.2796	

The variable Cost is the one time cost to the respondent. The Real Cost Dummy represents whether the survey was hypothetical or consequential (hypothetical = 1, consequential=0). Survey mode represents if the survey was conducted in-person (1) or through mail (0). Water smell is a four-point scale with 1 indicating a strong unpleasant smell up to a 4, indicating no smell. Bottled indicates whether the respondent thought that bottled water reduces the risk of nitrates (yes = 1, no = 0). Perceived Water Control is the control the respondent perceived over their drinking water and Water Norms are subjective norms for being concerned about drinking water quality.

The results reached by Loomis et al. support standard economic theory. The statistically significant negative coefficient on cost indicates a downward sloping demand

curve for bottled water. Also, the effect on willingness to pay for bottled water from reductions in the risk of infant death, brain damage, and shock are positive, suggesting that when bottled water reduces these risks, respondents are willing to pay more for bottled water. The statically significant negative coefficient on the Real Cost Dummy also supports theory since those who received a hypothetical payment are willing to pay more than those who received a consequential payment. Also—and not surprisingly—the results show that those who believe that bottled water reduces the risk of nitrates are more likely to pay for bottled water.

Of further interest is the coefficient on gender which shows that women are more likely to pay for bottled water, a conclusion that seems to support the risk perception and risk aversion literatures. The model also suggests those who perceive more control over water quality will be more likely to pay for bottled water along with those who seem to be more concerned with water quality.

The results reached by Loomis et al. seem to support the theoretical link between the literatures. However, the use of a dummy variable for gender without including interaction effects, not including ethnicity, and ignoring other important right hand side variables, raises many questions about the robustness of the results. The econometric model that is developed in this chapter addresses such questions.

3.3.3 Study Incorporating Perceptions of risk in Stated Valuation

The current study uses the data collected by Loomis et al (2009), but uses an alternative methodology and estimates the model introduced in section 3.3.1

3.3.3.1 Methodology

The method adopted in the present study uses a random effects logit model for estimations in order to control for the fact that each individual was asked four WTP questions. Instead of including dummy variables for race and gender, separate random effects logit regression models are completed for gender and race groups². Running separate regressions is an improvement over adding gender and race as dummy variables since these factors have been shown to interact with other independent variables in significant ways (Figart, 1997). Since gender and race interact with many other socioeconomic and demographic variables, not adequately controlling for these interactions runs the risk of using underspecified modeling.

Due to the economic structure of Colorado and its dependence on agricultural labor, the only ethnic groups with a large enough sample to get robust results are White and Hispanic. To be comparable to the risk perception literature, variables are included to measure perceptions of risk and social norms. Also socioeconomic variables are incorporated in the econometric model, such as income and years of schooling.

3.3.3.2 Results

Several differences between men and women and between whites and Hispanics are found within the sample. Women answering the survey were over twice as likely to have a live-in family member that had been pregnant within the last three years and have children under the age of 18 than men. Those women sampled were younger, had more years of schooling, and had lower stated household incomes than men. When comparing

² This econometric technique is equivalent to one model that includes full interaction terms. For ease of exposition, the separate regressions are reported.

those who identified themselves as white to Hispanic, whites were less likely to have had a pregnancy within the household in the last three years and have children under the age of 18 than Hispanics. Whites were also found to be younger, have fewer years of schooling, and have a significantly lower income than sampled Hispanics. These differences in the sample show that there is heterogeneity amongst the different sub-groups of the population and, unlike Loomis et al. (2009), need to be included in the econometric models in order to accurately control for the heterogeneity.

The risk perception literature finds that women are more likely to take voluntary actions to protect themselves against risk. This finding is substantiated by this study with women being more likely to use a water filter (Table 3.3). On the other hand, Hispanics are found to be less likely to use a filter and spend less money on bottled water. But, Hispanics are found to be more likely to use bottled water while nursing, indicating that Hispanics are also more likely to take voluntary action when the risks are perceived to be higher, further substantiating the risk perception findings.

The results from Table 3.3 suggest that women perceive more risk associated with nitrates in drinking water. Women are more likely than men to think their drinking water is unsafe, believe that it is more important to test the quality of drinking water, and believe that it is not normal for infants to be ill more often than adults. These findings support not only the risk perception literature, but also the risk aversion literature. On the other hand, Hispanics are also found to perceive more risk by believing that their drinking water is less safe than whites and also believing that it is more important to test the quality of the water. This finding corroborates the risk perception literature, but is seemingly in contradiction to the risk aversion literature.

Table 3.3: Sample Differences ³

Variable	Men	Women	White	Hispanic
Pregnancy (% yes) ⁴	0.35 chi2=57.0339*** ⁵	0.75483871	0.636363636 chi2=22.4116***	0.803921569
Kids under 18 (% yes)	0.307692308 chi2=110.3860***	0.801282051	0.679012346 chi2=41.9366***	0.921568627
Use a filter (% yes)	0.346153846 chi2=3.6701*	0.446540881	0.543209877 chi2=33.3073***	0.288461538
Use bottled water while nursing (% yes)	1 (only 8) chi2=1.6800	0.825	0.777777778 chi2=4.7122**	0.923076923
Age (mean)	38.48 z = -5.478***	31.27097	33.625 z = -3.167***	31.07843
Schooling (mean)	13.30769 z = 1.927*	13.59211	15.0679 z = -11.545***	11.04167

Table 3.3 also suggests that women and Hispanics not only perceive more risk from the high nitrate levels, but also are more likely to support further public action to reduce the risks than men and whites. Both groups believe that more public funds should be used to promote infant health and that infant health should be more of a public issue, where not all of the responsibility for maintaining infant health lies on parents. Assuming that individuals believe that devoting more public funds to infant health would mean either an increase in tax revenue or a decrease in other public projects, individuals understand that supporting more funds will be costly. These findings suggest that women and Hispanics would be more likely to pay for insurance to reduce infant health risks. Since Hispanics are more likely to take costly action, they are predicted to have higher levels of risk perceptions.

³ Pregnancy, Kids under 18, Use a filter, and Use bottled water while nursing are coded: Yes=1, No=0. Age and Schooling are coded in years and refer to the respondent. Income refers to stated household income. The rank variables are based on a 5-point scale with a 5= 'Strongly Agree' with the statement, 4='Agree', 3='Don't Know', 2='Disagree', and 1='Strongly Disagree' with the statement.

⁴ Chi² and Z-statistics measure differences between the stated groups. The sample difference statistics were determined using Chi² tests for dichotomous variables and Wilcoxon-Mann-Whitney tests for categorical variables.

⁵ *** p<0.01, ** p<0.05, * p<0.1

Looking at the interaction between gender and race, the results (Table 3.4) show greater differences. The strongest demographic differences are between white women and Hispanic women, with Hispanic women being more likely to have infants and children, be younger, have less years of schooling, and have significantly lower family incomes. Due to the relatively small sample size of men—specifically Hispanic men—the results do not indicate the same level of differences with regard to men, but do show differences between white women and white men. The Hispanic women sampled reported a higher level of pregnancy and children, a lower age, and a lower household income.

Table 3.4 also indicates that Hispanic women perceive more risks from drinking water and—although they spend less money on bottled water overall—will be more likely to use bottled water when nursing than white women. Hispanic women are also more supportive of public programs for improving infant health. Interacting gender and race reveals the extent of differences between groups. These results highlight the need to account for both gender and race differences in any similar study. In particular, they support the inclusion of a wide range of explanatory variables that should be included into econometric modeling, especially people’s perceptions of health risks.

The results from Tables 3.3 and 3.4 suggest heterogeneity in the perceptions and beliefs amongst the respondents in the sample. Therefore, pooling all the data without proper interaction terms may lead to inaccurate results. We believe, like Loomis et al. (2009), that individual valuation should depend on the cost of bottled water and the associated risks. But unlike the previous authors, we include socioeconomic and demographic information to reduce the risk of omitted variable bias, and add variables

Table 3.4: Gender and Race Differences

Variable	White Women	Hispanic Women	Hispanic Men	White Men	White Women vs White Men	Hispanic Women vs Hispanic Men
Pregnancy (% yes)	0.6875 chi2=14.7975***	0.816327 0.938776 chi2=23.4921***	0.5 chi2=0.3846	0.384615	chi2=17.135***	chi2=5.134*
Kids under 18 (% yes)	0.772727	0.938776 chi2=23.4921***	0.5 chi2=1.8511	0.266667	chi2=57.445***	chi2=20.473***
Use a filter (% yes)	0.575758 chi2=40.2458***	0.28	0.5 chi2=0.2914	0.4	chi2=6.0863**	chi2=1.8139
Use bottled water while nursing (% yes)	0.764706 chi2=5.3213**	0.923077	0.77778 chi2=4.7122**	0.923077	chi2=1.2101	
Age (mean)	32.16667 z = -1.956*	30.73469	39.5 z = -0.652	40.5	z = -4.830***	z = -1.126
Schooling (mean)	15.11364 z = -10.815***	11.06522	10.5 z = -4.035***	14.86667	z = 1.001	z = 0.788
Income (mean)	41923.08 z = -11.502***	21744.19	22500 z = -4.022***	47000	z = -2.335**	z = 0.172
Money spent on bottled water (mean)	16 z = -6.637***	6.64	8.5 z = -0.172	14.73333	z = 1.354	z = -1.452
My community has safe drinking water (rank)	z = -6.397***		z = -2.577***		z = -4.940***	z = -0.592
Important to test water quality (rank)	z = 4.391***		z = 2.979***		z = 1.419	z = 1.288
More state funding should be used for infant health (rank)	z = 5.516***		z = -0.518		z = 1.073	z = 1.340
Parents, not the public have sole responsibility for infant health (rank)	z = -3.920***		z = -3.703***		z = -3.189***	z = 1.572
It is normal for infants to be ill more often than adults (rank)	z = -1.116		z = 2.110**		z = 1.132	z = -1.110

*** p<0.01, ** p<0.05, * p<0.1

that indicate the level of perceived risks associated with water quality, and other specific perceptions. The dependent variable is based on the choice of ‘no action’ (choice = 0) or to pay the stated amount for bottled water (choice = 1). The econometric model is:

$$Prob (WTP > cost) = f(cost, infant risks, perceived risk, norms, demographics, socioeconomics)^6$$

From Table 3.5, the sign on the coefficient for cost, although not always significant, is in the expected direction, indicating that when the cost of bottled water increases, people are less willing to pay the stated amount. Also the results for risk of shock, brain damage, and death, when significant, are in the hypothesized direction; when risks associated with bottled water decrease, respondents are more likely to be willing to pay for the good. The impact of schooling is not significant for any group, and income is only significant for Hispanics. Age² is highly significant for Hispanics and Hispanic women, but is insignificant for all other group.

Chow likelihood ratio tests were performed to determine the differences between the groups within the survey. A Chow test is a form of a likelihood ratio test that is used to determine the significance of differences between coefficients of disjoint subgroups within a sample when estimated using the same model. In this case, each of the subgroups are disjoint subgroups of the overall sample and the same model is used to estimate the behavior of each group. The results of the chow test are reported in Table 3.6.

⁶ Wald tests have been conducted that determine the ‘mode’ and ‘hypothetical’ variables are not necessary in the econometric model.

Table 3.5 Logistic Regressions of Probability of 'Pay' by Group⁷

VARIABLES	Men	Women	White	Hispanic	White Women	Hispanic Women	White Men
Cost	-0.00821 (0.00601)	-0.0108*** (0.00277)	-0.00977*** (0.00363)	-0.0137 (0.0101)	-0.0128*** (0.00482)	-0.00637 (0.00822)	-0.00505 (0.00511)
Risk of infant shock	-0.0477 (0.0469)	-0.0229 (0.0186)	-0.0535* (0.0276)	-0.189 (0.136)	-0.0453 (0.0309)	-0.128 (0.108)	-0.0499 (0.0455)
Risk of infant brain damage	0.157 (0.138)	-0.0953* (0.0539)	0.0446 (0.0643)	-0.135 (0.212)	-0.00476 (0.0770)	-0.138 (0.204)	0.0312 (0.118)
Risk of infant death	-0.535 (0.415)	0.120 (0.140)	-0.139 (0.201)	0.310 (0.674)	0.0765 (0.236)	0.590 (0.579)	-0.398 (0.318)
My community has safe drinking water	-4.663* (2.388)	-0.122 (0.849)	-3.044** (1.332)	6.861*** (2.107)	-2.959** (1.480)	4.069*** (1.243)	-2.347 (2.003)
It is normal for infants to be ill more often than adults	-0.0862 (2.361)	-0.240 (0.463)	-0.927 (0.758)	6.833*** (1.615)	-0.997 (0.842)	5.566*** (1.586)	0.703 (1.035)
Income	1.50e-05 (0.000139)	-3.09e-05 (4.05e-05)	-4.77e-05 (7.13e-05)	0.000271** (0.000114)	-2.06e-05 (8.09e-05)	0.000157 (0.000130)	4.16e-05 (0.000106)
Schooling	0.295 (0.495)	0.353 (0.245)	0.258 (0.356)	-0.598 (0.766)	0.271 (0.374)	-0.392 (0.481)	-0.484 (0.648)
Age ²	0.00190 (0.00170)	-0.000447 (0.00147)	0.00157 (0.00122)	-0.0141*** (0.00262)	0.00333 (0.00208)	-0.0265*** (0.00489)	-0.000136 (0.000830)
Kids Under 18	-4.474 (3.508)	2.419 (1.896)	4.005 (2.812)	9.714 (8.701)	6.710* (3.951)	6.841 (13.25)	-1.378 (2.167)
Parents, not the public have sole responsibility for infant health	0.330 (1.241)	0.668 (0.648)	0.668 (1.256)	2.312*** (0.804)	-0.328 (1.418)	2.662*** (0.854)	6.148*** (2.084)
Constant	16.35 (12.39)	3.738 (6.021)	14.92* (8.190)	-26.40 (17.79)	13.82 (9.333)	-4.813 (19.71)	-6.843 (8.419)
Log likelihood	4.154*** (0.859)	4.008*** (0.322)	3.990*** (0.454)	4.814*** (0.441)	4.117*** (0.502)	4.943*** (0.515)	-13.06 (815.7)
Observations	95	542	298	156	247	148	51

⁷ Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Risk of infant shock, brain damage, and death are associated with the choice=1. Hispanic Men logit model did not converge, due to sample size.

Table 3.6: Chow Likelihood Ratio Tests on Differences between Groups

Women v Men	Whites v Hispanics	White Women, Hispanic Women, White Men
LR chi2 = 14.29	LR chi2 = 255.26***	LR chi2 = 227.38***
Prob > chi2 = 0.3539	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000

There is no significant difference between the coefficients of men and women, and therefore in theory these two groups of data could be pooled. On the other hand, Whites and Hispanics have significantly different estimates on coefficients and therefore the data should not be pooled. The same result is found between White Women, Hispanic Women, and White Men. These results suggest that influences on choice of paying for bottled water are significantly different among these groups and pooling the data is inappropriate. Since many of the subsequent results and tables rely on the estimates from the logit regressions, the likelihood ratio tests suggest that significant differences exist amongst the groups.

The mean willingness to pay for bottled water can be calculated for each group based on the logit regression, as long as the group exhibits a downward sloping demand curve for bottled water. Unfortunately, only the groups White, Women, and White Women have a significantly downward sloping demand curve, and thus the mean values of willingness to pay are limited to these groups. Using the Hanneman technique, a common tool used in the CVM literature, Table 3.7 gives the mean willingness to pay amongst these groups.

Table 3.7: Mean Willingness to Pay for Bottled Water by Group

	Women	White	White Women
Mean WTP	\$631.33	\$1610.40	\$759.06

Due to the lack of a significantly downward sloping demand curve for some groups, the mean willingness to pay for bottled water cannot be calculated for each group, limiting the usefulness of this measure in comparing behavior among the groups. The mean probability of being willing to pay the stated amount can be calculated for each group and be used for appropriate comparisons. Using the technique introduced in equation 3.3, the probabilities of groups' willingness to pay for bottled water is:

$$Prob (WTP > cost) = 1 - \left(\frac{1}{1 + e^{\beta_0 + \beta_1(cost) + \beta_2(risk) + \beta_3(perceptions) + \beta_4(norms) + \beta_5(demographics) + \beta_6(socioeconomics)}} \right) \quad (3.10)$$

Probabilities of WTP are given in Table 3.8. The results indicate that women are more likely to pay for bottled water than men, whites more likely than Hispanics, and white women more likely than both Hispanic women and white men. Each group's mean probability of paying is based on the coefficient estimates from the group's logit regression reported in Table 3.5 and the mean value of each of the variables. Therefore the mean probabilities reflect group differences in each of the included variables such as income, schooling, and perceptions of risk.

Table 3.8: Probabilities of Mean WTP by Group^{8,9}

Group	All Women	All Men	All Hispanics	All Whites	White Women	Hispanic Women	White Men
Prob. of WTP	0.967	0.925	0.812	0.9996	0.9975	0.966	0.888

⁸ These results are only an estimation. The insignificant coefficient on cost prohibits precise probability calculations. Probability for Hispanic men is unavailable due to the lack of associated logit results.

⁹ The values of the mean probability of WTP and the mean WTP by group presented in Table 3.7 seem to be very high. Based on the logit regression, the results are estimated based on a very small cost for bottled water. When the cost of bottled water was low, a high percent of respondents were willing to pay for its availability. Thus the seemingly high values are based on the logit results of a low cost on bottled water.

Contrary to the apparent robustness of the finding on willingness to pay from Table 3.8, results from the logit model suggest a possible problem with these findings. Potentially, the most interesting result from Table 3.5 relates to ‘My Community has Safe Drinking Water’. Although many questions were asked that assessed the safety of the available drinking water, the authors believe that ‘My Community has Safe Drinking Water’ was best proxy for infant health risks associated with drinking water since it is not specific to the respondents’ own water source, and measures the overall level of risk throughout the community. Other questions were asked about respondent’s own water quality, but these were felt not to capture a communal water quality since there are multiple sources of water for those included in the survey. Therefore, those respondents without infants can assess the quality of drinking water available to infants in other households. For men, whites, and white females, the significant negative coefficient on ‘My Community has Safe Drinking Water’ indicates that those who perceive the quality of their drinking water as better have a lower probability of being willing to pay for bottled water. This is the relationship that is expected between these two variables. On the other hand, Hispanics and Hispanic women have a significantly positive coefficient on ‘My Community has Safe Drinking Water,’ indicating that those who have a higher probability of willingness to pay for bottled water perceive their drinking water to be safer than those with a lower probability, even when controlling for income. For Hispanics, especially Hispanic women, those with higher perceptions of risk are less likely to take steps to reduce those risks. Within the content of a CVM study, in terms of the consistency between risk perceptions and WTP, we find consistencies for some groups – men, whites, and white women – but inconsistencies for Hispanics and Hispanic

Women. This finding signifies a need to further study the theories to find the source of the discrepancy.

3.3.3.3 Empirical Example

The survey used by Loomis et al. includes the probabilities associated with infant shock, brain damage, and death due to high nitrate levels in drinking water. Specific to the risk of infant death, the associated probability is given as 9/1,000 deaths for all infants. In terms of the empirical model, $P_b=9/1,000$. The level of individual risk perception, π_i can take on values based on $0 < \pi_i \leq \frac{1}{P_{b_i}}$. Given this specific case, $0 < \pi_i \leq \frac{1}{9/1,000}$, or $0 \leq \pi_i \leq 111.11$. The variable ‘My community has safe drinking water’ was the best variable for capturing perceptions of risk associated with infant health and drinking water. As stated above, this variable was chosen because of its appropriateness for all respondents in the sample, not just those with infants in the household. ‘My community has safe drinking water’ is a categorical variable ranging from 1 to 5. To ensure that π_i has the proper range and maintains the perceptions of respondents, the transformation $\pi_i=5/\text{rank}$ was chosen. Although the upper bound for π_i is 111.1, and lower bound of 0, the current transformation was chosen to prevent overestimating, or underestimating perceptions of risk. For an individual i , who stated that their water quality was safe by giving a rank of 5, their associated perception of risk would be 1. The perception of risk measures ranged as higher as 5 for those individuals indicating that their water quality was unsafe by giving a rank of 1. These transformed measures are presented in table 3.9.

Table 3.9: Transformation of Risk Perceptions Variables

My community has safe drinking water (rank)	1	2	3	4	5
π Transformation	5	2.5	1.67	1.25	1

Using the data based on the responses to ‘My Community has Safe Drinking Water’, mean values for risk perceptions are calculated for gender and race groups. The transformed values are given in Table 3.10.

Table 3.10: Mean Risk Perception by Group

Group	All Women	All Men	All White	All Hispanic	Hispanic Women	White Women	White Men	Hispanic Men
Original mean of rank	3.25	3.92	3.56	2.77	2.76	3.46	4	3
π Transformed	1.5385	1.2755	1.4045	1.8051	1.8116	1.4451	1.25	1.6667

As seen from Table 3.4, the levels of risk perceptions vary for each group, with Hispanic women perceiving the most risk and white men perceiving the least risk. Since, the mean level of π is a transformation of the original mean rank, the tests from Table 3.4 indicate that these values do vary between groups.

From equation 3.8, the mean level of absolute risk aversion can be calculated and perceived probabilities of bad health outcomes can be calculated from equation 3.6 for each group. Since the value of α is not specific to the individual, any value can be chosen for explanatory purposes. A survey of the risk aversion literature finds that the actual level of relative risk aversion ranges between $\alpha=.44$ (Goeree, Holt, and Palfrey, 2000) to $\alpha=.67$ (James Cox and Ronald Oaxaca, 1996)¹⁰. Based on this range, the initial value $\alpha=.5$ is chosen. The results are shown in Table 3.11.

¹⁰ Empirical evidence suggests that the level of relative risk aversion is within a range including .5. For the present purposes the choice of α does not impact the results since altering the value leads to a monotonic

Table 3.11. Mean Risk Perception, Risk Aversion, Perceived Probabilities of Bad Outcome, and ‘Pay’

Group	Mean π	Mean r	Mean $P_b\pi$	Probability of ‘Pay’
All Women	1.5385	0.7693	0.01385	0.967
All Men	1.2755	0.6378	0.01148	0.925
All Whites	1.4045	0.7023	0.01264	0.9996
All Hispanics	1.8051	0.9026	0.01625	0.812
Hispanic Women	1.8116	0.9058	0.01630	0.966
White Women	1.4451	0.7226	0.01301	0.9975
White Men	1.2500	0.6250	0.01125	0.888
Hispanic Men	1.6667	0.8334	0.01500	*

The results from Table 3.11 show that, not only are there seemingly differences between perceptions of risk amongst the groups, but there are also possible differences in levels of absolute risk aversion, perceived probabilities of bad health, and probability of ‘Pay’. The results from the group perceptions of risk support findings from the risk perception literature, and show a direct link between perceptions of risk and group levels of absolute risk aversion. Women are found to have a higher degree of absolute risk aversion when compared to men. This finding is also consistent with the risk aversion literature. On the other hand, whites are found to, on average, have a lower degree of absolute risk aversion than Hispanics, which contradicts the results from the risk aversion literature. When gender and race are integrated, Hispanic women are found to perceive the most risk, resulting in the highest level of risk aversion, while white men having the lowest level of risk aversion. Again, these results are consistent with the risk aversion literature with respect to gender, but not for race.

From Table 3.11, the level of perceived probability of infant death (bad health outcome) with current water is relatively high. Including perceptions of risk increases the perceived probability from 9/1,000 or .009 to .0163 for Hispanic women. This shows not

transformation of the mean absolute risk aversion levels and therefore will not impact the interpretation of the results based on gender and race differences.

only that the inclusion of risk perceptions greatly influence perceived probabilities, but also that it has the potential to significantly increase the concavity of the utility function. Again, the results show that Hispanic women have the highest perceived probability of infant death, while white men have the lowest.

From the survey, the probability of ‘Pay’ differs among the groups, although each is very high. The results noted in Table 3.11 suggest a possible inconsistency between the three variables: risk perception, risk aversion, and probability of ‘Pay’ for certain groups. The findings for women and men are coherent with the empirical model. Women are found to perceive more risk, have a higher level of risk aversion, and also have a higher probability of ‘Pay’ than men. The data conflicts with the empirical model comparing whites to Hispanics. Whereas Hispanics perceive more risk and have a higher degree of absolute risk aversion, they have a lower probability of being willing to pay for bottled water than whites. The results and empirical model are also consistent with respect to white men, but are again inconsistent with respect to Hispanic women.

The apparent inconsistency between the findings for perceptions of risk, risk aversion, and perceived probabilities and the estimated probability of ‘Pay’ for certain cultural subgroups may be due to an assumed role of government. From Table 3.4, Hispanics and Hispanic women believe that more state funds should be devoted to infant health when compared to whites and white women, respectively. Since water is usually supplied through municipal sources, it may be assumed that the state government should be responsible for increasing water quality. Since CVM methodology assesses valuation through WTP from individual income constraints, the assumed funding for increased water quality is through individual payment, not through public funds. The groups that

believe more state funds need to be devoted may not state a high WTP even in the face of high perceptions of risk, because personal spending is not believed to be the mechanism for increased water quality. This is a possible explanation for the disassociation between CVM and risk perception findings for goods that have a public aspect of funding. Possible misestimations of valuation from CVM studies for certain subgroups for these goods may result.

3.5. Conclusion

The subject of gender and race and their relation to environmental and public health decisions are increasingly becoming a topic of interest to those in many fields, especially economics, sociology, and psychology. The results from previous empirical studies on and gender race give mixed results across these fields. This study uses data previously collected by Loomis et al. (2009) on willingness to pay for increased water quality. In contrast to their results, the results of the present analysis reconfirm the possible inconsistent results of individual perceptions of risk, levels of risk aversion, and willingness to pay for cleaner water for some gender and race groups. The results show that for whites in general, men, and specifically white women, those with higher risk perception are willing to pay more for cleaner water and reduced risks. However the results suggest that for Hispanics in general and Hispanic women specifically, those who perceive more risks are less likely to be willing to pay to reduce the risks. This finding for Hispanics and Hispanic women are contradictory to theory and motivate further research into the anomalous finding.

To further evaluate the findings, this paper creates an empirical model of risk perception that is consistent with the existing models of willingness to pay and risk

aversion. Using the stated risk of infant death, mean group perceptions of risk, perceived probabilities of infant death, rates of absolute risk aversion, and willingness to pay for increased water quality are calculated. For men, whites, and white women, these calculations are consistent with the theoretical model, but are inconsistent for Hispanics and Hispanic women.

The data shows a consistency between group perceptions of risk and levels of absolute risk aversion. The estimates of the probability of paying the stated amounts are consistent with perceptions of risk and risk aversion for whites, white women, and men, suggesting that the estimates are possibly a good measure of valuation for these groups. On the other hand, for Hispanics, especially Hispanic women, the estimates of the probability of paying are inconsistent with group perceptions of risk and risk aversion. These findings suggest that for certain cultural subgroups, CVM may not elicit accurate measures of valuation for certain types of goods.

From a policy perspective, the results from this study suggest a possible misestimation of valuation for certain cultural subgroups by CVM studies with respect to goods that are publicly funded. Because of the use of CVM in benefit costs analyses on public policies, these results imply a possible inaccuracy of measurements of benefits, and ultimately may impact the adoption decision for health-related public policies.

An important area of future work is to create a survey that can capture not only perceptions of risk, level of risk aversion, and willingness to pay, but also the reason behind the inconsistency for certain groups. Future research is also recommended that determines the extent to which the results of this study extend to other cultural subgroups, different regions, and for different types of goods.

The results of this study are limited to the San Luis Valley of Colorado and should not be applied to the general population. The findings only apply to issues of water quality specific to high levels of nitrates in drinking water and should be extended to other goods with caution. Also, the sampling method led to a small sample of men, specifically Hispanic men that limited the results for these groups.

Chapter 4: Theoretical Models of Social Preference-Based Behavior

When determining what motivates respondents' stated WTP in CVM studies, an understanding of the nuances of individual preferences is central. Although the methodology of CVM assumes that individuals are motivated by self-interest only, many motives can affect the choices of individuals. Authors have shown that people deviate from the self-interest assumptions (Henrich, et al., 2004). "Many behaviors are better explained by social preferences; in choosing to act, individuals commonly take account not only of the consequences of their actions for themselves but for others as well" (Bowles, 2006 p. 96). This chapter will delineate these different motives and explain how each enters into WTP.

4.1 Self-Interest

Self-interest is an assumption about human behavior made in neoclassical economic theory. Stated clearly by Edgeworth "the first principle of economics is that every agent is actuated only by self-interest" (1881, p. 104). As outlined in Chapter 2, CVM relies heavily on this assumption in the methodology and modeling of WTP. Respondents are assumed to maximize the utility they receive through the direct consumption of market goods and the given level of the nonmarket good. Since the nonmarket good in question can be consumed by other individuals, the stated WTP

depends on the amount individuals want to consume themselves and the amount consumed by other people.

Simple Case: Two individuals

Assume that there are only two agents: Individual i and individual j . Individual i receives utility from the direct consumption of market goods, x_i and nonmarket good p_i , but not utility from the availability of the nonmarket good to individual j , p_j . In the most simplistic case of self-interest, individuals will base their choices on:

$$\max u_i = f(x_i, p_i) \quad (4.1)$$

$$s.t, I = Qx_i + p_i + p_j \quad (4.2)$$

Assuming that the price of x is Q , and the price of p_i , and p_j are one, the optimal level of x and p_i will depend on the functional form of $f(x_i, p_i)$, but $p_j^*=0$. In the basic example where

$$f(x_i, p_i) = a \log x_i + b \log p_i \quad (4.3)$$

the subsequent first order conditions are:

$$\frac{a}{x_i} - \lambda = 0$$

$$\frac{b}{p_i} - \lambda = 0 \text{ and}$$

$$I = Qx_i + p_i + p_j$$

Resulting in $x_i^* = \frac{aI}{Q}$, $p_i^* = bI$ and $p_j^* = 0$. Income is denoted as I .

Contingent valuation techniques are commonly used to estimate the value of public goods-goods that are non-rival and non-excludable-such as clean air and military

defense. In these cases, the amount of good p devoted to individual i is indistinguishable to that devoted to individual j , where $p_i = p_j$. For these goods, individual i 's decision will be based on:

$$\begin{aligned} &\text{Max equation 4.1} \\ &\text{s.t. } I = Qx_i + p \end{aligned} \tag{4.4}$$

Where $x_i^* = \frac{aI}{Q}$ and $p_j^* = p_i^* = bI$

In reality, the majority of goods and services provided and estimated through contingent valuation techniques are not pure public goods. Many goods and services, such as health vaccinations may be both rival and excludable, but still have a public aspect to them. For these types of goods, decisions are based on the budget constraint presented in equation 4.2 where individual i can choose the level of p_i and p_j independently. The results of both types of goods are included in each model below.

If this assumption of self-interest holds true, then CVM studies should report that the valuation respondents place on the amount of good, p , for others to consume, p_j , should be zero. But many economists are not naïve enough to assume that any stated preference relies solely on self-interest. There are a large number of motives that influence individuals besides that of pure self-interest. Some of these preferences have been estimated by previous CVM studies, like altruism (e.g Loomis et al., 2009), but evidence suggests that many more motives exist that influence decision-making (e.g. Falk and Fischbacher, 1998, Fehr and Schmidt 1999).

4.2 A Theory of Altruism

Generally speaking, the implication of altruism is that an individual's utility depends not only on her own welfare, but on the welfare of others as well (Popp, 2001, p. 341). Altruism can be incorporated into neoclassical theory since individuals are still maximizing their own utility. Unlike pure self-interest, those acting out of altruistic motives "take costly actions to increase the payoff of another actor, irrespective of the other actor's previous action" (Camerer and Fehr, 2002). Therefore no strategic interaction needs to occur for altruism to enter into preferences. Because of the public nature of goods in which CVM estimates values, motives without strategic interaction are important.

A lot of work has been done that measures the existence of altruism in stated valuation. Some studies find that altruism plays little to no role in decision-making, and that individuals are motivated by self-interest (e.g. Deacon and Shapiro, 1975). But more recent, and possibly more sophisticated studies find that altruistic motives shape preferences especially for environmental and health related goods (e.g. Loomis et al., 2009; Guagnano, Dietz and Stern, 1994; Popp, 2001).

Below is a very simple model that includes altruism and self-interest motivations in decision-making. Like the pure self-interest case, the objective of the individual is to maximize utility, which depends on personal consumption of x_i and p_i from $f(x_i, p_i)$, and the utility that individual j receives from p_j , noted $g(p_j)$. The income constraint is the same as in the self-interest case.

$$\max u_i = \alpha_i f(x_i, p_i) + \beta_i g(p_j) \quad (4.5)$$

s.t. equation 4.2

where α is the degree to which an individual favors self-interest and β is the degree of altruism. Where $0 \leq \alpha \leq 1$ and $0 \leq \beta \leq 1$. When $f(x_i, p_i)$ is defined as in equation 4.3 and

$$g(p_j) = c \log p_j \quad (4.6)$$

the subsequent first order conditions are:

$$\frac{\alpha a}{x_i} - \lambda = 0$$

$$\frac{\alpha b}{p_i} - \lambda = 0$$

$$\frac{\beta c}{p_j} - \lambda = 0 \text{ and}$$

$$I = Qx_i + p_i + p_j$$

The optimal level of x_i , p_i , and p_j , depend on income, I , the level of self-interest, α and altruism, β . Note that if individual i is completely self-interested then $\alpha=1$ and $\beta=0$, and the objection function u_i , collapses down to the self-interested model noted above.

On the other hand, if $\alpha=0$ and $\beta = 1$ a corner solution is chosen where $p_j^* = I$ and $x_i^* = p_i^* = 0$. Using this simple model of human behavior, if individual i is willing to pay to have $p_j > 0$, then altruism must be the motivation behind the statement of value.

The comparative statics may be the most important implications of behavior. Using the first order conditions, calculating total derivatives, and using Kramer's rule to solve for individual i 's comparative statics give: $\frac{\partial x_i^*}{\partial \alpha} > 0$, $\frac{\partial x_i^*}{\partial \beta} < 0$, $\frac{\partial p_i^*}{\partial \alpha} > 0$,

$\partial p_i^* / \partial \beta < 0$, $\partial p_j^* / \partial \alpha < 0$, and $\partial p_j^* / \partial \beta > 0$. That is, if individual i become more self-interested, then the amount of market goods, x_i , and p_i consumed will increase, while the amount of the public good devoted to individual j will decrease. If on the other hand, individual i becomes more altruistic, then the opposite will happen: the amount of x_i , and p_i consumed will decrease, while p_j will increase. Therefore individual i 's WTP for p_i and p_j will be consistent with these finding in cases where p_i and p_j are distinguishable. In cases of a pure public good where $p_i = p_j$, increases in either self-interest or altruism have inconclusive implication on WTP and will depend on the ultimate magnitudes of α and β .

Although altruism is a common extension of behavior used in CVM and evidence suggests that it plays a large role, there are limitations in assuming that any non-selfish responses must be due only to altruistic motivations. As the next sections will show, numerous studies have found that people are motivated by other social preferences beyond altruism and any model that accurately captures valuation must be flexible enough to account for additional motivations.

4.3 Reciprocity

Altruistic motivations rely on individuals making costly decisions towards others regardless of the others' motivations. Although the addition of altruism improves modeling of decision making, the modeling is still incomplete since many actions are in responses to beliefs of the intentions of others. Reciprocity¹¹ is still another motivation that increases the accuracy of modeling and explaining human behavior. "Reciprocity

¹¹ Some make a distinction between strong and weak reciprocity. The notion of reciprocity that is used here relates to ideas of strong reciprocity.

means that people are willing to reward friendly actions and to punish hostile actions although the reward or punishment causes a net reduction in the material payoff of those who reward or punish” (Camerer and Fehr, 2002, p. 2). “In many cases, such behavior is in conflict with the twin hypotheses of rationality and material self-interest which are the foundations of orthodox economic theory” (Sethi, 2003, p. 2).

Reciprocity is commonly modeled using the models introduced by Bolton and Ockenfels (2000), Rabin (1993), Fehr and Schmidt (1999), and Levine (1998). The model introduced by Levine is used in this paper since it incorporates self-interest, altruism, and reciprocity¹². Here individuals act to:

$$\max u_i = \alpha_i f(x_i, p_i) + \delta_i g(p_j) \quad (4.7)$$

s.t. equation 4.2

where $\delta = \frac{\beta + \tau\epsilon}{1 + \tau}$. α and β have the same interpretation as above, but with different parameters with $0 \leq \alpha \leq 1$ and $-1 \leq \beta \leq 1$ since altruistic behavior is extended to punish as well as to reward. The coefficient, τ , $0 \leq \tau \leq 1$, represents the motivation of individual i to reward individual j when individual i sees individual j behaving well, and punish individual j when individual i believes individual j is acting out of spite. Also ϵ , $0 \leq \epsilon \leq 1$, represents the belief of the motivations behind other individuals. If $\tau=0$, then the level of believed behavior of individual j plays no role in the behavior of individual i , and u_i reduces down to that of a pure altruistic (if $\beta>0$ or pure spite of $\beta<0$). Adding τ allows the model to explain why in some cases an individual is altruistic, and in another spiteful. Suppose that individual i has $\beta>0$ and therefore is altruistic, and cares about individual j 's

¹² Levine's model is augmented to include α .

intentions; i.e. $\tau > 0$. If individual i feels that individual j is spiteful, i.e. $\varepsilon < 0$, where $\beta < \tau\varepsilon$, then individual i will act in spite. Whereas if $\beta > \tau\varepsilon$, no matter the size of τ , then individual i will act as an altruist.

The subsequent first order conditions are:

$$\frac{\alpha a}{x_i} - \lambda = 0$$

$$\frac{\alpha b}{p_i} - \lambda = 0$$

$$\frac{\delta c}{p_j} - \lambda = 0 \text{ and}$$

$$I = Qx_i + p_i + p_j$$

Assuming that $\beta + \tau\varepsilon > 0$, $\frac{\partial x_i^*}{\partial \alpha} > 0$, $\frac{\partial p_i^*}{\partial \alpha} > 0$, and $\frac{\partial p_j^*}{\partial \alpha} < 0$. When

incorporating reciprocity into the behavior of individual i , if individual i becomes more self-interested, the level of private goods and amount of personal consumption of the public good consumed by individual i increase, while the amount devoted in individual j

will decrease. Also, since $\frac{\partial x_i^*}{\partial \beta} < 0$, $\frac{\partial p_i^*}{\partial \beta} < 0$, and $\frac{\partial p_j^*}{\partial \beta} > 0$, if individual i

becomes more of an altruist, then the consumption of market goods and personal consumption of the public good will decrease, while the amount that individual i devotes

to j of the nonmarket good will increase. If $\beta < \varepsilon$, then $\frac{\partial x_i^*}{\partial \tau} < 0$, $\frac{\partial p_i^*}{\partial \tau} < 0$, and

$\frac{\partial p_j^*}{\partial \tau} > 0$. That is, if the drive of altruism is less strong than that of the belief of

individual j 's motivations, the amount of x_i and p_i will decrease, while p_j increases if

individual i becomes more likely to reward (or punish) individual j . Also $\frac{\partial x_i^*}{\partial \varepsilon} < 0$, $\frac{\partial p_i^*}{\partial \varepsilon} < 0$, and $\frac{\partial p_j^*}{\partial \varepsilon} > 0$ if $\beta > 0$. When individual i incorporates his or her feelings about the intentions of individual j at a higher level into his or her decisions, then the amount of x_i and p_i will decrease while p_j will increase. Therefore WTP decisions will be consistent with these findings in cases where individual i can distinguish p_i from p_j . Again for pure public goods, where $p_i = p_j$, then changes in any of the above variable will lead to inconclusive implication on WTP.

If $\tau = \beta = 0$, then the utility function will collapse down to the pure self-interested behavior model. But studies have found that this is not the case. Individuals commonly act with altruistic, spiteful, and reciprocal behaviors. Laboratory experiments are commonly conducted to determine the extent of altruism, self-interest, and reciprocity in experimental decisions. To test for the presence of social preferences, many experimental games have been conducted including prisoners' dilemma (Sethi, 2003; Dawes, 1980), public goods, ultimatum (Camerer, 2003), dictator (Camerer, 2003), and third party punishment games (Fehr and Fischbacher, 2001). Because of the nature of the public goods game, this paper will go into depth on these studies and conclusions of reciprocity.

Public goods games

Public good games are a test of reciprocity and elucidate behaviors of punishment and generosity. In these games, subjects are grouped with other players under strict anonymity. Each player is given points redeemable for real money. In each round, each player places an amount of their points into a common account and the remainder in a

personal account. The total amount in the common account is the sum of all player's contribution increased by a set percent known to the players before the start of the round. At the end of the round, players receive an equal portion of the common account plus the amount that was set aside in their personal account.

Free riding, where players put the entire amount of initial points into their personal account, is the dominant strategy and corresponds to complete self-interest. However, public goods games find that only a fraction of players contribute nothing to the common account, with an average of one half of endowments being placed in common accounts (Fehr and Schmidt, 1999). This shows that players exhibit some form of initial altruism in that they were willing to risk some of their endowment for the benefit of others. When the game is repeated for many rounds, studies find that most players contribute nothing in the final period (Gintis, 2000). This finding does not support theories of self-interest, as first thought, since in a surprise second public goods game after the final period of the first game is complete, players start again with a high level of common contributions (Andreoni, 1998). This behavior supports the explanation that in each group, there most likely are selfish players and other who behave reciprocally. Since those reciprocal players are willing to contribute if other players contribute, the existence of self-interested players causes those with reciprocal motives to notice and stop contributing to the common fund (Camerer and Fehr, 2002).

Reciprocal behavior is prevalent when punishment is added to public goods games. Players are able to punish non-contributors at a cost to themselves. In these games, the first stage is the same as described in the standard public goods game. In the second stage, each player is informed of the contributions by all players in the group. Each

player can punish other members by assigning punishment points that decreases the other member's points. This punishment costs the punisher a set amount of points. If members are self-interested, then players should contribute nothing to the common account in the first round, and since punishment is costly, should also not punish other members in the second round. Studies find that not only do the majority of players contribute to the common account, but when the game is repeated, the number of players that contribute increases so that in latter periods close to 100% of the initial endowments are contributed (Camerer and Fehr, 2002; Gintis, 2000).

The findings from public goods games indicate that people are not only motivated by self-interest. Altruism and reciprocity are motivations that influence behavior even at a personal cost. Further work into public goods games show that social motivations go beyond simplistic reciprocity, but conformity to social norms play a large role in contributions (Shang and Croson, 2005). The need to include other social motivations will be incorporated by allowing for fairness and commitment.

Although these games are called public goods games, they are not designed to measure the amount that individuals actually would be willing to contribute to public goods. Public goods games have not been implemented to measure the valuation of nonmarket goods. One of the limitations for these games is the use of strategic interactions between players which is not seen in public goods provisioning. But the use of strategic interaction can be an integral part of stated valuation in CVM studies if social norms or forms of identification influence valuation. The next two sections will introduce other social preferences that influence behavior and potentially stated valuation in CVM studies.

4.4 Fairness

The notion of fairness is often important in personal interaction with family members, friends, and peers. Considerations of fairness are not limited to personal interactions with others. Social behaviors are strongly related by notions of fairness including tax schedules (Andreoni, Erard and Feinstein, 1998), support of public policies (Bowles and Gintis, 2000), and support for regulations of private industries (Zajac, 1995). Therefore fairness enters into strategic as well as non-strategic choices.

Many authors do not distinguish behaviors motivated by reciprocity and those motivated by fairness (Fehr and Schmidt, 2000). But the definitions of the two indicate that there are differences between the two motivations that need to be examined. Whereas reciprocity is based on generosity and punishment, the main motive is not for fairness per se. Due to the motivation to promote fairness, the models of fairness presented here have also be labeled inequality aversion (Fehr and Schmidt, 2000). One commonly used fairness/inequality aversion model was introduced by Fehr and Schmidt (1999). The model can explain self-interest and inequality aversion. A fair utility for individual i function is given by:

$$U_i = \pi_i - \varphi_i \max(\pi_j - \pi_i, 0) - \eta_i \max(\pi_i - \pi_j, 0) \quad (4.8)$$

where π_i and π_j are the material payoffs for the two individuals in question, $\varphi_i \geq \eta_i$ and $\eta_i \in [0, 1]$. Since $\varphi_i \geq \eta_i$, an ‘unfair’ distribution of material payoffs where individual j receives more than i , the utility of individual i is affected more than an ‘unfair’ distribution where individual i receives more than j . The upper bound on η_i disallows

individual i to be self-punishing. Given i 's own material payoff, his utility will be maximized when $\pi_i = \pi_j$.

Although adding the aversion to inequitable payoffs is an improvement to orthodox models, this specification has limitations. From a mathematical perspective, the max operator may make the utility function not twice continuously differentiable leading to solutions that are not unique. Knowledge about the material payoffs of each individual is required, which may be an unrealistic assumption when there are numerous individuals. The model is used to explain strategic behavior in interactions, and may not be appropriate for non-strategic behavior. Also, the model can be defined such that some individual's payoffs are more important to individual i than others. This is contradictory to the basic idea of an inequality aversion concept of fairness, in which concerns about the identity of the other individuals should not impact an individual with high levels of fairness. The model is also limited to explaining self-interest and aversion to inequality and cannot explain other forms of social preferences. These limitations could be substantial when explaining stated preferences in CVM. Therefore the model introduced in this paper uses the idea of fairness, but tries to minimize the limitations of existing models. Behavior is based on:

$$\max u_i = \alpha_i f(x_i, p_i) + \delta_i g(p_j) - \phi_i (p_j - \bar{p})^2 \quad (4.9)$$

s.t. equation 4.2

where α and δ are the same as above, and \bar{p} is the average level of the nonmarket good available to individual i and j . Utility depends positively on the level of self-interest,

altruism, reciprocity, but negatively on the spread of the distribution of the nonmarket good¹³. If $\phi=0$, then the utility function collapses down to that of reciprocity behavior.

Similar to the Fehr and Schmidt model, utility is maximized when $p_i=p_j$, *ceteris paribus*: the most fair and equitable distribution. But, unlike the Fehr and Schmidt model, this theory makes a strict distinction between motivations of reciprocity and fairness.

Reciprocity is behavior that is based on the believed intentions on others, whereas fairness is the effect of how equitable the distribution of goods are to all. The benefit of modeling fairness this way is that it may be more applicable to instances of public goods and other nonmarket goods, where the identity of each individual is not known or plays no role in valuation.

The subsequent first order conditions are:

$$\frac{\alpha a}{x_i} - \lambda = 0$$

$$\frac{\alpha b}{p_i} - \lambda = 0$$

$$\frac{\delta c}{p_j} - 2\phi_i(p_j - \bar{p}) - \lambda = 0 \text{ and}$$

$$I = Qx_i + p_i + p_j$$

The comparative statistics of the fairness decisions are generally hard to interpret in such a way to give meaningful results and implications. Of those meaningful

comparative statistics, in general $\frac{\partial x_i^*}{\partial \phi} < 0$, $\frac{\partial p_i^*}{\partial \phi} < 0$, and $\frac{\partial p_j^*}{\partial \phi} > 0$. Only when

$p_j > p_i$ and β is large enough, will $\frac{\partial p_j^*}{\partial \phi} < 0$. When the amount of the good devoted to

¹³ The use of variance is similar to the mean variance utility described by Varian

individual j is greater than that of individual i , increases in fairness behavior will decrease the amount of the good devoted to individual j and increase personal consumption of the good, i.e. $\partial p_i^* / \partial \phi > 0$.

In cases of pure public goods, since $P_i = P_j = \bar{P}$, the utility function collapses to that of reciprocity. Therefore in cases of pure public goods, motives of fairness do not enter into WTP decisions.

Each of the behaviors mentioned above introduces motivations that directly effect the utility of individuals. Most models of self-interest and social preferences stop at this point and do not augment the constraints that individuals face in decision-making, and use the mainstream income constraint as the only binding constraint. Although this constraint is critical in explaining behavior, other constraints may exist that are central to understanding choices.

4.5 Commitment

Sen's theory of commitment offers a determinant of decision-making that may explain social preferences. Commitment can be defined as "a person choosing an act that he believes will yield a lower level of personal welfare to him ... when [he] acts on the basis of a concern for duty ... [and] the action is really chosen out of the sense of duty rather than just to avoid the illfare resulting from the remorse that would occur if [he] were to act otherwise," (Sen, 1977, p. 327) or "a sense of obligation going beyond the consequences" (Sen, 1977, p. 342). In essence, commitment can cause people to choose an action that will not maximize personal utility in order to fulfill a social or cultural goal for a group with whom the person has a sense of identity (Sen, 1985).

There is a divergence between seemingly unselfish choices that are influenced by altruism and that of commitment. Altruism concerns actions that are restricted to the extent that they will enter into a person's own welfare function. Commitment goes beyond the constraints of altruism and allows choices that decrease a person's welfare when the choice is made out of a sense of obligation (Sen, 1994) "(Altruism) alone does not require any departure from individual-welfare: but commitment does involve rejection of that assumption (Sen, 1982, p.81).

Altruism is a motive discussed heavily in environmental economics but the discipline has been silent regarding the role of commitment. But—as noted by Sen—commitment can help in understanding the behavior in environmental valuation (Sen, 2005). Environmental movements and policies such as sustainable development, the reduction of emissions, and increased water quality can be better understood in the context of commitment since the benefits on an individual level in many cases do not outweigh the costs to the individuals striving for these environmental policies. Therefore a model of valuation must also include commitment.

Primary to commitment is the concept of identity. The identity of an individual is that of social identity, or how individuals identify with others. Sen states that the emphasis on self-interest leaves mainstream economic theory unable to include ideas that individuals might identify with others in deciding their choices (Sen, 1999). Although many individuals identify with their class, race, gender, or other demographic groups, the existence of multiple social identifications, makes a control for these variables insufficient to measuring the effect of commitment. It is nearly impossible to assume how an individual will act because of "conflicting demands [that] arises from different

identities and affiliations,” (Sen, 1999, p.30). But this is not to overstate the role of commitment and identity, choice may be influenced but is not determined by social identification. “Social identities are indeed important. So is choice.” (Davis, 2004).

Sen’s concept of commitment has not been fully explored in explaining motivation in willingness to pay decisions. Only one relevant study, conducted by Shiell and Rush (2003) explores the ability of CVM studies to capture motivations of commitment. The authors make the assumption that given a willingness to pay for vaccines decision, an individual motivated by commitment will have difficulty valuing a decision that only benefits others. This difficulty arises from the inability of individuals motivated by commitment “to internalize the trade-offs required to calculate the *personal* value of a health care good that only benefits other people, [since] respondents motivated by commitment are, instead, likely to report what they think is a reasonable contribution towards the cost of the program” (Shiell and Rush, 2003, p, 657). Findings suggest the existence of commitment amongst respondents that hindered their ability to accurately capture stated valuation in CVM studies.

Since commitment is not the only influence on behavior, a model needs to include what Sen called self-centered welfare, self-welfare goal, and self-goal choice (Sen, 2002, pp.33-34). Although lumped together in standard economic theory, these three aspects are included in assumptions of self-interest. When modeling human behavior, these aspects of self-interest are incomplete without adding the motivation of commitment. But unlike the self-interest motivations, commitment does not enter into an individual’s utility, but the sense of identity places an additional constraint on choice. Including influences of commitment leads to the following model:

Max equation 4.9

s.t. equation 4.2

$$p_j \geq P_{ij}$$

Where P_{ij} represents the level of commitment towards individual j . This level will be unique to individual i , since everyone has different levels of commitment towards others. The identity of individual j that receives p_j will dictate the level of commitment. If an individual i identifies with individual j , then P_{ij} may be relatively high. But if individual i does not identify with individual j , then P_{ij} will approach 0. In essence, Sen states that to understand commitment we must understand how individuals identify with groups.

The subsequent first order conditions are:

$$\frac{\alpha a}{x_i} - \lambda_1 = 0$$

$$\frac{\alpha b}{p_i} - \lambda_1 = 0$$

$$\frac{\delta c}{p_j} - 2\phi_i(p_j - \bar{p}) - \lambda_1 + \lambda_2 = 0$$

$$I = Qx_i + p_i + p_j \quad \text{and}$$

$$p_j \geq P_{ij}$$

When the constraint $p_j \geq P_{ij}$ is binding, then $\frac{\partial p_j^*}{\partial P_{ij}} > 0$. In this simple case, the existence of binding commitment can only increase the amount individual i is willing to devote, or the stated WTP to the consumption of the good by individual j . Even in cases of a pure public good, binding commitment can only increase WTP for the good. In

general, this simple case does not explore the effect that commitment for other goods has on decisions.

Market Goods Case

In reality, individual i may have the option to provide market goods for individual j , especially if there is a relationship between the two. Assume that the consumption of market goods by individual j that are provided by i is represented by the vector x_j . Assuming the utility of individual i is that described in equation 4.9, then i 's utility does not depend on individual j 's consumption of market goods, x_j . Expanding the idea of commitment to include individual j 's consumption of x_j , i 's decisions are based on:

$$\begin{aligned}
 &\text{Max equation 4.9} \\
 &\text{st } I = Qx_i + p_i + p_j + Qx_j \\
 &p_j \geq P_{ij} \\
 &x_j \geq X_{ij}
 \end{aligned} \tag{4.10}$$

where X_{ij} represents the minimum amount of market goods that individual i must provide to j , based on commitment.

The subsequent first order conditions are:

$$\frac{\alpha a}{x_i} - \lambda_1 = 0$$

$$\frac{\alpha b}{p_i} - \lambda_1 = 0$$

$$\frac{\delta c}{p_j} - 2\phi_i(p_j - \bar{p}) - \lambda_1 + \lambda_2 = 0$$

$$I = Qx_i + p_i + p_j$$

$$p_j \geq P_{ij} \quad \text{and}$$

$$x_j \geq X_{ij}$$

If $x_j \geq X_{ij}$ is a non-binding constraint, then i 's decisions will be the same as in the simple case with no market commitment to individual j . When $x_j \geq X_{ij}$ is binding, then

$$\frac{\partial x_i^*}{\partial X_{ij}} < 0, \quad \frac{\partial p_i^*}{\partial X_{ij}} < 0, \quad \frac{\partial p_j^*}{\partial X_{ij}} < 0, \quad \text{and} \quad \frac{\partial x_j^*}{\partial X_{ij}} > 0. \quad \text{Therefore, when}$$

commitment exists for market goods, this may decrease the amount individual i is willing to pay to have p_i and p_j available, even when the consumption of these are positively associated with individual i 's utility. Extrapolating this idea to CVM, if individual i has a binding commitment to individual j , then the stated willingness to pay out-of-pocket will be lower than when the commitment is non-existent or non-binding. Binding commitment to market goods, X_{ij} , will reduce the amount of disposable income allocated to all other goods and services by individual i . In the context of willingness to pay for a nonmarket good, this binding commitment will reduce the amount of disposable income allotted to the payment of the good, thus reducing the stated willingness to pay. This finding also holds for individual i 's WTP for pure public goods since both $\frac{\partial p_i^*}{\partial X_{ij}} < 0$ and

$$\frac{\partial p_j^*}{\partial X_{ij}} < 0.$$

To show how the existence of commitment can decrease disposable income, and therefore, the stated willingness to pay for a nonmarket good, even when it is positively related to utility, an example will be used. Assume that there are now three individuals: individuals 1, 2, and 3. Individuals 1 and 2 are asked to pay for the nonmarket good, p , for their direct consumption and that of individual 3. Assume that individual 1 is very

self-interested, has little sense of altruism and reciprocity, and no sense of fairness. On the other hand, individual 2 is motivated very little by self-interest, but is highly motivated by altruism and positive reciprocity. For simplicity, also assume that individual 2 is not motivated by fairness. Using the utility function from equation 4.9, assume that the following represents the utility of individual 1 and 2 respectively:

$$u_1 = .5f(x_1, p_1) + .5g(p_3) - 0(p_3 - \bar{p})^2 \quad (4.11)$$

$$u_2 = .1f(x_2, p_2) + .5g(p_3) - 0(p_3 - \bar{p})^2 \quad (4.12)$$

If $f(x, p_i)$ and $g(p_j)$ are assumed to be of the form in equations 4.3 and 4.5 respectively, $a=b=c=.5$, and $P_1=P_2=0$ where commitment to x_j is not accounted for, then the decisions of individual 1 and 2 will be based on:

$$\max u_1 = .5(.5 \log x_1 + .5 \log p_1) + .5(.5 \log p_3) - 0(p_3 - \bar{p})^2 \quad (4.13)$$

$$\text{st } I = Qx_1 + p_1 + p_3 + Qx_3 \quad (4.14)$$

$$p_3 \geq 0$$

and

$$\max u_2 = .5(.5 \log x_2 + .5 \log p_2) + .5(.5 \log p_3) - 0(p_3 - \bar{p})^2 \quad (4.15)$$

$$\text{st } I = Qx_2 + p_2 + p_3 + Qx_3 \quad (4.16)$$

$$p_3 \geq 0$$

For individual 1, $x_1^*=22.7$, $p_1^*=45.5$, and $p_3^*=9.1$. Because of the difference in behavior of individual 2, $x_2^*=7.1$, $p_2^*=14.3$, and $p_3^*=71.4$. Since individual 2 is motivated less by self-interest and more by altruism and positive reciprocity, then he or she should be willing to pay more for a higher quantity of p , than individual 1.

When integrating commitment for x_3 into decision-making, an inconsistent result can be found. Assuming the same behavior as before, but now commitment for x_3 is added. Suppose that individual 1 has no commitment for x_3 , but individual 2 has a very high level of commitment where $X_{13}=45$. Now, decisions for individual 1 and 2 will be based on:

Max equation 4.13

st 4.14

$$p_3 \geq 0$$

$$x_3 \geq 0$$

and

max 4.15

st 4.16

$$p_3 \geq 0$$

$$x_3 \geq 45$$

In this case individual 1 will behave the same as when commitment for x_3 was not incorporated; $x_1^*=22.7$, $p_1^*=45.5$, and $p_3^*=9.1$. Whereas the behavior of individual 2 will drastically change and $x_1^*=7.14$, $p_1^*=1.43$, and $p_3^*=7.14$. Now comparing the willingness to pay to have p available for oneself and for individual 3, when including commitment for market goods, individual 1 should now willing to pay more than individual 2, since individual 1 demands more of the public good than 2.

In this example, it becomes obvious that with high levels of commitment towards the consumption of market goods by others, individuals may be willing to pay very little for nonmarket goods, even when the consumption of those goods adds to individual

utility. This example shows the importance of properly incorporating commitment behavior into utility models, but also presses the question of the appropriate payment vehicle in CVM methodology. When individuals are asked their willingness to pay for a good out of their own pockets, the opportunity cost is the decrease in consumption of market goods, and the decrease in providing market goods for others. But, in most cases, the nonmarket good is not provided by out-of-pocket payments from individuals, but funded by existing tax funds. When the good is provided by tax funds, then the opportunity cost is a decrease in other public goods. With this payment vehicle, the level of commitment that one has towards the consumption of market goods by others will not influence one's willingness to pay for the nonmarket good. Since—as seen in the example—incorporating this commitment can decrease willingness to pay, when the good in question is provided by tax funds using CVM methodology that uses an individual payment vehicle may give incorrect valuations of the publicly funded good. In these cases, using the correct payment vehicle is essential to measuring valuation for public goods.

4.6 Conclusion

Although mainstream economic theory relies on assumption of self-interest in modeling behavior, studies show that human behavior is influenced by much more than pure self-interest. Social preferences play a substantial role in the choices made by individuals. Inclusion of altruism, reciprocity, fairness, and commitment are critical for modeling human behavior. This chapter shows that in the presence of social preferences, identifying the proper constraints to decision-making is critical to understanding and properly modeling choice, especially in the presence of commitment. The use of proper

constraints becomes even more important in the context of contingent valuation where choice of income constraint may have critical effects on valuation measurements. The next chapter will explain why accurate modeling and using proper income constraints are important to CVM. The chapters will also explore a study to determine the extent to which motivations discussed in this chapter enter into valuation.

Chapter 5: Gender Differences in Willingness to Pay for Vaccination Programs

The prevalence of social preferences influencing behavior in experimental studies suggests that behavior is subject to more than just pure self-interest (e.g. Fehr and Schmidt, 1999; Andreoni, 1998). Public goods games give ample evidence for social preferences along with self-interest as strong influences on behavior (e.g. Shange and Croson, 2005). There is no reason to assume that behavior within these controlled experiments deviates from real world experiences and individual decisions. It would therefore be expected that social preferences, along with self-interest, influence individual public goods decisions in the real world.

Experimental economics has captured the motivations and decisions made by subjects in a controlled environment (e.g. Camerer and Fehr, 2002; Gintis, 2000). Although the experimental literature gives a convincing idea of how individuals act in situations with strategic interactions, it has not addressed actions with non-strategic interactions of public goods. In many cases a non-strategic framework may be of more importance since many public good decisions are made at a public level-such as referendum voting-where choices are private and strategic interactions are non-existent.

One way to quantify the influences of choices with public implications without strategic interactions is through CVM. CVM is a method that measures valuation, but can also include measures of preferences if designed correctly. Because of the ability to

construct the CVM survey instrument to measure influence on decisions, it is a good tool to use as a counterpart to public good games in experimental economics. Since decisions in CVM studies should expose similar motivations as in public goods games, social preferences are likely to also influence stated valuation for nonmarket goods.

The findings from Chapter 3 suggest an inconsistent result for valuation for certain cultural sub-groups: specifically Hispanics and Hispanic women. One potential explanation for this inconsistent result is that Hispanics and Hispanic women believe that more state funds should be devoted to infant health when compared to whites and white women, respectively. Since water is usually supplied through municipal sources, it may be assumed by these groups that the state government should be responsible for paying and providing increased water quality. For groups that believe more state funds need to be devoted to infant health and increased water quality, a high WTP may not be stated-even in the face of high perceptions of risk, because they may believe that the government, not individuals should pay. Generalizing this finding suggests that when in practice, public funds are used to pay for the nonmarket good in question, a more realistic payment vehicle of a reallocation of existing public funds may extract more accurate estimates of valuation in CVM studies. This study will explore the effect of alternative payment vehicle choices.

This chapter will analyze a CVM study measuring the value that Colorado State University students place on meningococcal disease and Human papillomavirus (HPV) vaccinations. This study will be used to estimate the extent to which social preferences influence stated valuation. Using the theoretical model introduced in chapter 4, the extent

of self-interest, altruism, reciprocity, fairness, and commitment will be separately estimated for multiple different treatments within the sample.

This study utilizes two treatments, each including two willingness to pay questions. These different WTP questions will be used to assess the effect that the payment vehicle has on stated valuation. One treatment measures individual willingness to pay for an out-of-pocket payment for vaccinations, while the second treatment uses a referendum payment vehicle of willing to vote for an universal increase in communal fees that provide vaccinations and the willingness to vote for a reallocation of already existing communal fees.

5.1 Augmented Willingness-to-Pay Methodology

Traditional CVM models typically assume that an individual's willingness to pay for a nonmarket good or service is based on the following:

$$\text{Max } U = f(\text{market goods, public good in question; socioeconomic status, demographics})$$

$$\text{St. Income Constraint}$$

There is no specific inclusion of preferences that influence behavior. It is commonly assumed that self-interest is the only determinant of behavior, but is not specifically included in the modeling of willingness to pay (Champ, 2003). Socioeconomic and demographic variables are typically used as a proxy for preferences. Some specific studies have incorporated altruistic motives in models of willingness to pay. But as mentioned in chapter 4, this is generally the limitation of social preference modeling within CVM studies.

Standard CVM methodology assumes that decisions about nonmarket goods are made subject to an individual's income constraint. Because of this assumption,

individuals are typically asked their willingness to pay for increased quality or quantity of the nonmarket good given an out-of-pocket payment either through a market-like transaction or an increase in tax fees.

The current study differs by incorporating social preferences outlined in chapter 4 and by augmenting the payment vehicles to include reallocation of existing public funds to pay for the change in the nonmarket good. To capture these changes, the general model of decision-making will be dependent on:

$$\text{Max } U = f(\text{market goods, public good in question; socioeconomic status, demographics, preferences})$$

St. Budget Constraint

Where preferences are social preferences and motivations of self-interest. The budget constraint can be either personal income or a communal budget depending on the situation given.

The methodology utilized in chapter 3 will also be used here. The method adopted in the present study uses a logit model for approximations of dichotomous choice based willingness to pay. Instead of including dummy variables for gender, separate logit regression models are completed for each gender. As stated in Chapter 3, running separate regressions is an improvement over adding gender as a dummy variable since gender has been shown to interact with other independent variables in significant ways (Figart, 1997). Not adequately controlling for these interactions runs the risk of using underspecified modeling.

5.2 Survey Background

The study conducted by Shiell and Rush (2003) suggests that commitment plays a role in behavior, but the traditional methodology utilized by CVM cannot capture value in the presence of commitment when the good in questions affects others. Using this conclusion reached by the authors and integrating in forms of social preferences, this study uses a similar methodology as Shiell and Rush (2003) but augments it to fit the goals of the current study and the limitations of the current data. In the previous study individuals were asked two valuation questions regarding various vaccination programs. To separate motives of self-interest and motives of commitment, individuals were first asked a dichotomous choice willingness to pay question about out-of-pocket payments for a vaccination program that will only pay for the individual to be vaccinated. Results of this valuation question were used to separate self-interest motivations from the second dichotomous choice asking willingness to pay for a communal vaccination program for only the poorest 10%, used to measure commitment motivations. To further capture motives influencing willingness to pay choices, respondents were asked follow-up questions in an interview. The responses to these questions were used to determine the extent that commitment influences behavior and the limitation it places on traditional valuation methods.

Using the methodology presented by Shiell and Rush (2003), this study also uses vaccination programs to measure motivations of behavior. Because of current limitations on data collection, this study assesses valuation amongst college students at Colorado State University. Therefore vaccination programs for diseases that affect college students were utilized. Time limitations also prohibited the use of follow-up interviews. To assess

the influences on behavior, but work within the time constraints, statements were created that encompassed these influences on behavior in an attempt for respondents to indicate the influence that each had on their WTP decisions. The specifics of the present study are included in the following sections.

Based on the age and experience of most college students at Colorado State University, meningococcal disease and human papillomavirus (HPV) vaccination were chosen. HPV was chosen because of the recent medical awareness and its prevalence amongst college age individuals. Within the last year, Fort Collins has been the center for a meningococcal disease epidemic. Colorado State University health services provided vaccinations, free of charge to all students and faculty under the age of 29. Numerous emails and statements were disseminated to students and faculty members that included information about meningococcal disease and the current outbreak.

5.2.1 Meningococcal disease

Meningococcal disease has been the cause of death for four people in Fort Collins and one in Denver from 2010-2011, with many more hospitalized. Although many types of meningococcal disease exist, meningococcal sepsis has been thought to be the cause of the deaths and hospitalizations in Fort Collins.

Even with antibiotics, approximately 1 in 10 victims infected with meningococcal meningitis will die, and may exceed 40% in patients with meningococcal sepsis, that seen in the current epidemic in Colorado. However, about as many survivors of the disease lose a limb or their hearing, or suffer permanent brain damage. The sepsis type of infection is much more deadly, and results in a severe blood poisoning called meningococcal sepsis that affects the entire body. In these cases, bacterial toxins rupture

blood vessels and can rapidly shut down vital organs. Within hours, patient's health can change from seemingly good to mortally ill (Anderson et al, 1997).

The incidence of meningococcal disease during the last 13 years ranges from 1 to 5 per 100,000 in developed countries, and from 10 to 25 per 100,000 in developing countries. During epidemics, the incidence of meningococcal disease approaches 100 per 100,000. There are, on average, approximately 2,600 cases of bacterial meningitis per year in the United States.

Meningococcal disease causes life-threatening meningitis and sepsis conditions. In the case of meningitis, bacteria attack the lining between the brain and skull called the meninges. Infected fluid from the meninges then passes into the spinal cord, causing symptoms including stiff neck, fever and rashes. The meninges (and sometimes the brain itself) begin to swell, which affects the central nervous system. As the bacteria multiply and move through the bloodstream, it sheds concentrated amounts of toxin. The endotoxin directly affects the heart, reducing its ability to circulate blood, and also causes pressure on blood vessels throughout the body. As some blood vessels start to hemorrhage, major organs like the lungs and kidneys are damaged (Goldacre et al, 2003).

College students, especially freshmen are more susceptible to meningococcal disease, mainly due to behavior. Therefore, college students have been the target of meningococcal disease vaccinations. Because of the high mortality rate, the best treatment for meningococcal disease is vaccination. Vaccines for meningococcal disease have been approved by the Food and Drug Administration (FDA) and available since 1981. Each vaccine can prevent 2 of the 3 most commonly occurring strains in the US. The vaccine can reduce the incidence of infection, hospitalization, and death by nearly

70%. Meningococcal vaccines cannot prevent all types of the disease, but they do protect many people who might become sick if they did not get the vaccine. A booster of the vaccine is recommended every 2-4 years.

Up to half of the people who receive meningococcal vaccines have mild side effects, such as redness or pain where the shot was given. These symptoms usually last for one or two days. A small percentage of people who receive the vaccine develop a fever. Severe reactions, such as a serious allergic reaction, are very rare. A nervous system disorder called Guillain-Barré Syndrome has been reported. This happens so rarely that it is currently not possible to tell if the vaccine might be a factor.

5.2.2 Human papillomavirus (HPV)

Human papillomavirus (HPV) is the most common sexually transmitted disease in the United States. Studies have shown that 10% to 46% of all sexually active women are infected at any given point in time, with a potential lifetime risk of infection of 70% or greater. The risk for sexually active men is less well defined, but prevalence has been estimated between 10% and 20%. Men and women in their 20s, particularly the 20- to 24-year age-group, have been found to be at especially high risk, with many of these high rates of infection found among college students (Lambert, 2001).

HPV types that are found preferentially in cervical cancer have been designated as ‘high-risk’ types. Conversely, those found primarily in genital warts and nonmalignant lesions were labeled as ‘low-risk’ types. High-risk types of HPV have been well established as the most important causative factor of cervical cancer in women. Every year, around 12,000 women are diagnosed with cervical cancer and around 5,000 die from the disease. In addition, more than 700,000 cases of high-grade cervical dysplasia

are detected every year in the United States, the precursor of cervical cancer. Cervical cancer accounts for almost 12% of all cancers in women, and so represents the second most frequent gynecological malignancy in the world (zur Hausen, 2002).

There are no known treatments for HPV, making prevention of HPV the key factor in the prevention of cervical cancer. On June 8, 2006, the U.S. Food and Drug Administration (FDA) approved the use of a vaccine to prevent infection from two types of 'high-risk' HPV types that are responsible for about 70% of the cases of cervical cancer worldwide. The vaccine consists of three separate vaccination injections and is highly effective in preventing infection with the types of HPV targeted. Currently, the vaccine is only approved for women between the ages of 10 and 26. Studies have shown that vaccination prevents nearly 100% of the precancerous cervical cell changes caused by the types of HPV targeted by the vaccine for up to 4 years after vaccination among women who were not infected at the time of vaccination.

The HPV vaccine work like other immunizations that guard against viral infection. They are thought to protect primarily by causing the production of antibodies that prevent infection and, consequently, the development of cervical cell changes (as seen on Pap tests) that may lead to cancer. Although these vaccines can help prevent HPV infection, they do not help eliminate existing HPV infections. Thus far, no serious side effects have been known to be caused by the vaccines. The most common problems have been brief soreness and other local symptoms at the injection site. These problems are similar to ones commonly experienced with other vaccines. The vaccines have not been sufficiently tested during pregnancy and, therefore, should not be used by pregnant women.¹⁴

¹⁴ US National Institute of Health website. www.cancer.gov.

5.3 Vaccination Survey Format

The data for this analysis come from paper surveys completed by Colorado State University students enrolled in various undergraduate economic courses on a voluntary basis during class time. The willingness to pay for meningococcal disease and HPV were of interest along with the difference between alternate payment vehicles. The surveys included two dichotomous choice willingness to pay questions. With each disease, two treatments were created to capture the effect of the different payment vehicles. In the first treatment (referred to hereafter as treatment ‘Individualist’), respondents were asked a dichotomous choice pertaining to their willingness to pay from their own income (referred to hereafter as Program 1) a stated amount in order to be vaccinated against the chosen disease. Respondents were also asked another dichotomous choice question (referred to hereafter as Program 2), given the same cost as in Program 1, to make a vaccine available to one other Colorado State University student. The second treatment pertained to campus wide vaccination programs (referred to hereafter as treatment ‘Communitarian’). In this treatment, respondents were asked two dichotomous choice willingness to pay questions about implementing a vaccination program that would make available a vaccine for all willing students. The first willingness to pay question (Program 1) included in the Communitarian treatment, had an associated cost of increased student fees for all Colorado State University students, while the second willingness to pay question (Program 2), was associated with a reallocation of existing student fees, with a cost of reduced funds available to other student services. Therefore, four different survey instruments are included in the study: two treatments for each disease¹⁵.

¹⁵ A copy of each treatment is included in the appendix

Respondents were asked if they would be willing to pay a random, but preselected amount of money, ranging from \$10 to \$400 to have the associated vaccination program available. This range was based on a survey of actual costs of the vaccinations. For example, respondents given the Individualist HPV survey were asked about both Program 1 and Program 2 outlined in the top half of Table 5.1.

Table 5.1 Sample WTP Questions from Survey Instruments

<p>A choice of ‘Yes’ for questions 14 or 15 will decrease the risk of cervical cancer by 70% in women vaccinated.</p> <p>If you are female answer question 14. If you are male, proceed to question 15.</p> <p>14. Would you pay an out-of-pocket price of \$X to receive the vaccine yourself?</p> <p>_____ Yes _____ No</p> <p>15. However you responded in question 14, you also have the opportunity to contribute funds for other students to receive the vaccine. The cost of administering one vaccination is \$X. Would you be willing to donate a one time out-of-pocket price of \$X to provide the vaccine free of charge to another Colorado State University student who may not otherwise be vaccinated?</p> <p>_____ Yes _____ No</p>
<p>If either proposal passes, the risk of cervical cancer will be reduced by 70% in women vaccinated</p> <p><u>Proposal 1:</u> An increase in all students’ semester fees by \$X to have the vaccine available for all female students.</p> <ul style="list-style-type: none"> • The program will be funded by a <i>new special student fee</i>. • The costs of the program would have to be paid by you and other Colorado State University students. • Because you would be paying \$X in additional student fees for the program, it would <i>reduce the amount of available money for spending on your personal consumption</i>. <p>Would you vote for the proposed increase in your semester students fees of \$X to have the vaccine available for all Colorado State University students?</p> <p>_____ Yes _____ No</p> <p><u>Proposal 2:</u> A reallocation of existing student fees, amounting to \$X per student, away from other student services (rec center, classroom services, etc.) to fund availability of the vaccine free for all female Colorado State University students.</p> <ul style="list-style-type: none"> • <i>The program will not increase your student fees.</i> • Payments for the program will be in the form of a reallocation of your student fees from other student services (for example, reallocation of fees from the Lory Student Center, Campus Recreation Center, University Facility Fee, Student Legal Services, Conflict and Resolution, Athletics, etc.). • Thus, paying for the program would <i>reduce the amount of other student services that are currently available</i>. <p>Would you vote for this reallocation of student fees that would provide vaccinations for all students at the cost of other student services?</p> <p>_____ Yes _____ No</p>

Respondents were directed that the cost would be an out-of-pocket cost in order to ensure that the respondents assumed the proper opportunity cost. Respondents given the Communitarian treatment of the HPV survey were asked the willingness to pay questions shown in the second part of Table 5.1.

To ensure that respondents were aware of the opportunity cost associated with both willingness to pay questions, the survey used the technique outlined by Bergstrom, Boyle and Yabe (2004). In both willingness to pay questions, the associated costs and opportunity costs were explained to the respondent. In the second valuation question, respondents were given a list of the programs that could have funding decreased if proposal 2 were to pass. As indicated by Bergstrom, Boyle and Yabe (2004), in order to have the respondent understand the true opportunity cost of a reallocation of resources required for proposal 2 (Program 2), an understanding of the trade-offs prior to valuation questions is crucial. Therefore, prior to introducing either potential policy change, respondents were informed of student fees, given a list of programs funded by student fees, and then asked to rank how important each of these programs were to the individual student. Although this assessment was not vital to the valuation for the Individualist treatment, in order to keep the treatments similar, respondents were asked to rank these programs in both treatments.

Social preferences are important in individual decision-making as discussed in chapter 4. To measure the effect of social preferences on valuation for vaccinations, respondents were asked the influence of self-interest and social preferences on their

willingness to pay decisions. Each preference motivation was given as a statement in which respondents were asked to rank their level of agreement to each.

Regardless of the disease or treatment, to capture the extent to which self-interest influenced valuation of vaccinations, each respondent was asked to rank, from 1 to 5, their agreement with the following statement:

'I want to protect myself from (disease)'

The higher the rank, the more influential self-interest was in the respondent's willingness to pay decisions.

Altruism has been indicated, along with self-interest, as another potential motivation in responses to willingness to pay questions. In this study, all respondents were asked the following in order to estimate the influence of altruism on valuation:

'I want others to be able to be protected against (disease)'

This statement was chosen since it incorporates individual decisions that allow-not force-others to be voluntarily vaccinated. This statement associates altruism with providing the vaccine for others, but places the decision of vaccination on the other individuals.

Sen's theory of commitment has seen very little integration in nonmarket valuation studies, excluding that conducted by Shiell and Rush (2003). The current study tries to estimate the influence of commitment on valuation through the following statement:

'We all should be committed to protecting the health and safety of the CSU community'

Where the emphasis is on the respondent's association with the CSU community.

As explained in chapter 4, experimental economics demonstrates the relevance of social preferences in decision-making: specifically reciprocity and fairness. Fairness,

unlike reciprocity, is not dependent on one's beliefs regarding the motivations of others. In this context, fairness is associated with the respondent providing vaccinations for others in order to be fair to all. Fairness motivations in valuation was assessed through respondent's agreement to the following:

'It seems fair to me to contribute a fair share to help others be vaccinated'

To capture the influence of reciprocity in vaccination decisions, respondents gave their level of agreement to the following:

'CSU students deserve protection against (disease)'

This statement encompasses the idea of reciprocity as the motive to aid others who have been deemed to act well and to punish those who have acted badly. The term 'deserve' was selected since it was thought to best capture this motivation.

As the model introduced in chapter 4 indicates, the total effect of reciprocity also depends of the influence that one's beliefs of other's motivations have on individual decisions. To capture the belief of others, after each non-selfish willingness to pay question, individuals were asked the dichotomous choice question:

Do you believe that the majority of Colorado State University students would be willing to vote in favor of 'proposal'?

Respondents were also asked about their experience and beliefs of the particular disease and about their demographic and socioeconomic status. Knowing that many college students either rely on their parents, scholarships, or other external sources of funding, respondents were asked about their personal income, parent's income, and their reliance on these other forms of funds for tuition, fees, and living expenses.

5.3 The Data

Prior to collecting the data for this study, both focus groups and pretests were performed. Two focus groups of 4-5 volunteers were conducted, from which the survey instruments were altered to ensure understanding and validity of the instrument amongst respondents. Pretests were then performed and the data was analyzed. The results from the pretests suggested that the format and questions were appropriate for the purposes of the study. The survey instruments were approved by Human Subjects at Colorado State University and the implementation of the surveys were permitted.

To capture protest votes, questions were included that measured the respondent's belief of the overall safety of vaccines and the belief that socially unacceptable sexual behavior is the primary cause of the diseases. In total, 868 surveys were completed. Those responses that include either a strong feeling that vaccinations are unsafe or the belief that socially unacceptable sexual behavior was the root cause of the spread of the disease were considered protest votes. After discounting protest votes, the effective sample size is 843. Of the 843-sample size, 435 represented meningococcal disease, while the other 408 represented HPV, and 446 represented the Individualist treatment, while 397 represented the Communitarian treatment. The sample includes 403 females and 438 males. Minorities are underrepresented in the data, with 723 respondent's identifying as White, while only 17 identify themselves as Black or African American, 33 as Asian or Asian American, 45 as Hispanic or Latino, 18 as another race or ethnicity, and 5 did not respond. The average age of the sample respondent is 20. Most of the

respondents have very low incomes with 697 respondents reporting an annual income of less than \$10,000 and only 5 reporting an annual income of more than \$100,000. Only 69 reported having a spouse or live-in partner.

5.4. Testable Hypotheses

Based on the interdisciplinary risk perception literature, the feminist literature, and the results from the study reported in chapter 4, we would expect gender and race difference in perceptions of risks associated with the diseases, social preferences, and therefore, willingness to pay for the various vaccination programs. Because of the low sample of minorities, the current study cannot explore racial difference. The following gender based hypotheses will be tested:

H1: There are gender differences in those previously vaccinated for meningococcal disease

H2: Female's beliefs about how susceptible they are to contracting the disease is different than males' beliefs

H3: The influence of social preference and self-interest in vaccination program decisions are different between females and males

H4: The probability that males are willing to pay for a given vaccination program is different than women's probability

The two different treatments (Communitarian and Individualist), and the two willingness to pay questions (Program 1 and Program 2) will be used to compare the impact of different payment vehicles and the differences in willingness to pay for self-vaccination versus non-self vaccination. The following hypotheses will test the differences amongst the different willingness to pay questions:

H5: The probability that respondents are willing to pay for self-vaccination is different than the probability of payment for non-self vaccination for treatment 'Individualist'

H6: The probability that respondents are willing to pay for vaccination proposal 1 is different than the probability of payment for proposal 2 for treatment 'Communitarian'

The diseases included in the study were chosen because of their prevalence among college age students and the potential for gender differences. The impact of meningococcal disease does not seem to have a gender component, but the same is not true for HPV. HPV is only commonly diagnosed in women and the main impact of the disease is only felt by women, as it is the main cause of cervical cancer in women. These ideas are tested using the following hypotheses:

H7: There are no difference in the probability of willingness to pay for Meningococcal disease vaccinations between males and females

H8: There are gender differences between the probability of willingness to pay for HPV vaccination programs

5.5 Results

Gender differences reported are not only based on the hypotheses listed in section 5.4 but include demographic and socioeconomic differences as well.

5.5.1 Mean Gender Differences

Table 5.2 shows the gender difference in demographic and socioeconomic variables along with experience with the given diseases. Test results determining the significance of gender differences are presented in the following tables.

Table 5.2 Gender Differences in Demographic, Socioeconomic Status, and Experience¹⁶

Variable	Category	Men	Women
Income	Below \$10,000	74.61%	89.24%
	\$10,000-19,999	16.85%	8.31%
	\$20,000-49,999	6.07%	1.71%
	\$50,000-100,000	1.57%	0.49%
	Over \$100,000	0.90%	0.24%
	Gender differences	z = 5.599***	
Age		20.6	19.8
		z = 4.247***	
Previously vaccinated (Meningococcal disease)		71%	86%
		chi2 = 14.2026***	
Parent's Income	Below \$10,000	0.01843318	0.017857143
	\$10,000-19,999	0.025345622	0.030612245
	\$20,000-49,999	0.14516129	0.239795918
	\$50,000-100,000	0.387096774	0.397959184
	Over \$100,000	0.423963134	0.31377551
	Gender differences	z = 3.784***	
Know someone who has been diagnosed		5%	14%
		chi2 = 14.453***	

¹⁶ The sample difference statistics were determined using Chi² tests for dichotomous variables and Wilcoxon-Mann-Whitney tests for categorical variables.

*** p<0.01, ** p<0.05, * p<0.1

Based on the results in Table 5.2, women within the sample have a lower mean income, are younger, and have parents with lower mean incomes than the men included in the sample. Women were also found to be more likely to have previously been vaccinated for meningococcal disease than men. This finding supports hypothesis H1: there are gender differences in previous vaccinations. Women are also more likely to have stated that they know someone who has been diagnosed with either meningococcal disease or HPV.

Many variables of interest were included to capture the influences and beliefs of the disease. Because the study includes a potential payment of a reallocation of student fees, respondents were asked how important current uses of student fees are to them. Each of these categorical variables were coded as a 1 if respondents indicated that they strongly disagreed with the statement, 2 indicated the respondent agrees with the statement, 3 if the respondent was neutral, 4 for agree, and a 5 was coded when the respondent strongly agreed with the statement. In Table 5.3, gender differences in general beliefs associated with the diseases and the importance of current programs funded by student fees are shown.

As seen in Table 5.3, there are many differences in the beliefs held by males when compared to those held by females. The women surveyed were much more likely to feel that they had knowledge of the diseases prior to the survey when compared to men. Women also feel that they are more susceptible to contracting both diseases than men, although there is no evidence that women have a higher probability in contracting either disease. This result confirms hypothesis H2 and supports the findings from the risk perceptions literature that women perceive higher risks than men.

Table 5.3: Gender Difference in Beliefs¹⁷

Variable	Category	Men	Women
Information		69%	90%
		chi2= 51.1527 ***	
Susceptible	1	18.36%	15.64%
	2	26.77%	33.80%
	3	30.09%	28.77%
	4	22.12%	31.56%
	5	2.65%	5.87%
		z = -2.127**	
Important for the CSU community to be vaccinated	1	1.77%	0.72%
	2	6.42%	3.14%
	3	27.43%	19.81%
	4	45.13%	47.34%
	5	19.25%	28.99%
		z = -4.487*	
Student legal services	1	5.11%	2.17%
	2	11.97%	8.70%
	3	33.48%	29.95%
	4	38.36%	44.20%
	5	11.09%	14.98%
		z = -3.289***	
Conflict and resolution services	1	11.06%	4.35%
	2	19.25%	13.77%
	3	36.28%	34.30%
	4	26.11%	38.89%
	5	7.30%	8.70%
		z = -4.815***	

Colorado State University student fees are used for many campus wide programs and services. Of the services identified in the survey, gender differences were only found

¹⁷ The sample difference statistics were determined using Chi² tests for dichotomous variables and Wilcoxon-Mann-Whitney tests for categorical variables.

*** p<0.01, ** p<0.05, * p<0.1

in the stated importance of two. Women in the sample believe that student fees used to fund student legal services and Conflict and Resolution services are more important than the men in the sample. There were no gender differences found in the importance placed on student fees funding the Lory Student Center, the Recreational Center, and student athletics.

For each category of behavior influences on program choice, significant gender differences are found. From Table 5.4, women are found to state a higher influence of self-interest on their willingness to pay decisions along with those of altruism, reciprocity, fairness, and commitment. Hypothesis H3 is supported by the data for all social preference, in conjunction with gender differences in self-interest motivations.

Relying on the model developed in chapter 4, the influences of self-interest and social preference should allow an estimate of WTP. Vaccination behavior should depend on:

$$\begin{aligned} \max u_i &= \alpha_i f(x_i, p_i) + \delta_i g(p_j) - \phi_i(p_j - \bar{p})^2 \\ \text{st } I &= Qx_i + p_i + p_j \\ p_j &\geq P_i \end{aligned}$$

But as expressed in chapter 4, it is impossible to determine the effect of these influences on behavior, *a priori*, without information on the functional form of the utility function. Therefore to test hypotheses H4 through H8, logit models will be utilized.

Table 5.4: Gender Difference in Influences of Behavior¹⁸

Self-Interest	1	1.55%	0.48%
	2	2.65%	1.21%
	3	13.05%	6.52%
	4	45.80%	35.75%
	5	36.95%	56.04%
	z = -6.035***		
Altruism	1	0.66%	0.48%
	2	1.11%	0.48%
	3	11.73%	6.76%
	4	53.10%	44.20%
	5	33.41%	48.07%
	z = -4.606***		
Fairness	1	6.86%	3.38%
	2	19.91%	15.70%
	3	31.19%	33.33%
	4	31.86%	34.78%
	5	10.18%	12.80%
	z = -2.494**		
Commitment	1	0.66%	0.72%
	2	2.43%	1.21%
	3	20.35%	15.46%
	4	56.86%	57.25%
	5	19.69%	25.36%
	z = -2.600***		
Reciprocity	1	1.99%	0.24%
	2	3.32%	1.21%
	3	20.58%	13.77%
	4	51.77%	49.76%
	5	22.35%	35.02%
	z = -4.990***		

¹⁸ The sample difference statistics were determined using Chi² tests for dichotomous variables and Wilcoxon-Mann-Whitney tests for categorical variables.

*** p<0.01, ** p<0.05, * p<0.1

5.5.2 Logit Regressions

The methodology adopted for the logit regression modeling will be the same as in chapter 3. Due to data limitations, race differences will not be analyzed, leaving only gender differences to be investigated. The logit regression results are reported in tables below. Gender differences based on logit regressions are reported for each disease, treatment, and willingness to pay question separately, leading to eleven different models.

Based on economic theory, the probability of willingness to pay should depend on the stated cost of the vaccination program and income levels. As described above, respondents were given a cost associated with the particular vaccination program that ranged between \$10 and \$400. Personal annual income (without any external funds) was asked as a categorical variable with income level less than \$10,000 code as 1, incomes between \$10,000 and \$19,999 coded as 2, incomes of \$20,000 to \$49,999 coded as 3, \$50,000 to \$100,000 coded as 4, and annual incomes more than \$100,000 coded as 5. Motivations that influence choice, whether social preferences or self-interest, should also impact the probability of willingness to pay for vaccinations.

For Program 1 of the Individualist treatment for both diseases, the probability that a respondent will be willingness to pay, indicated by a ‘Yes’ response, should be follow:

$$Prob (WTP > cost) = f(cost, self-interest, beliefs of community vaccination, income)$$

Since the choice only directly affects the respondent, the influence of self-interest on behavior was included. Given the information contained in the survey instrument, respondents were aware of the communal health implications of vaccination programs that help halt the transmission of highly communicable disease. Even if only for personal health safety reasons, the variable, ‘It is important for the CSU community to be

vaccinated', also a categorical variable, may substantially influence choice, and was included in modeling. The results are shown in Table 5.5.

Table 5.5 Logit Gender Differences in Individualist Willingness to Pay Vaccination Program 1

	Meningococcal	Meningococcal	HPV
VARIABLES	Women	Men	Women
Cost	-0.0216***	-0.00813***	-0.00739***
	(0.00546)	(0.00214)	(0.00215)
Self-Interest	2.232***	0.810**	0.707
	(0.685)	(0.403)	(0.458)
It is important for the CSU community to be vaccinated	1.132**	1.291***	1.071***
	(0.538)	(0.366)	(0.378)
Income	6.01e-05	1.06e-06	2.13e-05
	(0.000101)	(5.17e-05)	(2.11e-05)
Constant	-14.38***	-8.073***	-6.322***
	(3.630)	(1.990)	(2.230)
Pseudo R2	0.4918	0.2899	0.2652
Log Likelihood	-33.79	-56.49	-48.51
Observations	106	117	96
Standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

Only women's results are reported for HPV since men cannot receive the HPV vaccination and therefore male respondents were instructed to skip the question. Since the cost of vaccination programs is a one-time, out-of-pocket cost for the vaccine only for the respondent, the significant downward sloping demand curve for each logit supports The Law of Demand. It would also seem that the income level of the respondent would also influence willingness to pay. But the results from Table 5.5 do not support this hypothesis since the coefficient on income is not significant in any model. Also, because the willingness to pay for Program 1 will only provide the vaccine for the respondent, it is hypothesized that only influences of self-interest will be indicative of willingness to

pay decisions. This hypothesis is supported by the results for meningococcal disease, but not for HPV. A belief that it is important for the CSU community to be vaccinated was a strong predictor of willingness to pay. This coefficient may suggest that the communicable aspect of the diseases encourages support for community vaccinations, if only out of a desire to protect oneself.

The model of willingness to pay for Program 2 of the Individualist treatment, like that presented in Table 5.5, should also depend on the cost of the vaccination program along with the relevant income level. Since the cost of the vaccination program is to pay for a vaccine for one other Colorado State University student, influences of social preferences, not self-interest are more indicative of respondents' willingness to pay for the program. The willingness of a respondent to pay for another's vaccination may depend on his or her belief of other Colorado State University students' decision to also pay for the same program. The probability of willingness to pay for this program is assumed to be based on:

$$Prob(WTP > cost) = f(cost, social\ preferences, beliefs\ of\ others, income)$$

The results are shown in Table 5.6.

From the results (Table 5.6), only for meningococcal disease is there a significant downward sloping demand curve. This result may be because every student had the opportunity to be vaccinated for free at the Colorado State University health center, making current willingness to pay for the vaccination of another very sensitive to the cost. The belief that others will also be willing to pay is significantly related for meningococcal disease and for women's willingness to pay for HPV vaccinations. The only significant social preference on willingness to pay is that of fairness. Since

Table 5.6 Logit Gender Differences in Individualist Willingness to Pay Vaccination Program 2

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
Cost	-0.0185**	-0.00677*	-0.00601	-0.00268
	(0.00752)	(0.00358)	(0.00423)	(0.00220)
Belief	3.725*	3.461***	1.942**	0.736
	(2.024)	(1.011)	(0.941)	(0.713)
Fairness	2.545***	1.619***	1.641***	1.560***
	(0.741)	(0.477)	(0.534)	(0.383)
Income	-0.000158	-0.000194*	-1.94e-05	-1.16e-05
	(0.000195)	(0.000107)	(4.26e-05)	(1.83e-05)
Constant	-9.043***	-5.578***	-6.770***	-6.563***
	(2.672)	(1.815)	(2.072)	(1.469)
Pseudo R2	0.516	0.4157	0.3678	0.2956
Log Likelihood	-20.03	-33.06	-28.26	-43.09
Observations	106	117	79	119
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1			

respondents are asked their willingness to pay for a vaccine to be available for another student, if the respondent feels that it is his or her responsibility to pay a fair share of others' vaccinations, then this will increase the probability of willingness to pay. Again, income does not play a significant role in willingness to pay, except for men's willingness to pay for meningococcal disease vaccinations.

Many vaccination programs, especially during outbreaks, are similar to the current program at Colorado State University where public funds finance the vaccination of the associated population. In these cases, the use of an individual out-of-pocket payment vehicle for a single vaccine is not in line with reality and may lead to inaccurate estimates of willingness to pay. For Program 1 of the Communitarian treatment, individuals are asked if they would be willing to vote for an increase in student fees of the stated amount. As stated above, respondents are also informed that if the majority of

students vote ‘Yes’ for the program, then vaccines will be available for all willing Colorado State University students.

Economic theory would predict that probabilities of willingness to pay for any program would depend on the associated cost to respondents. Many students do not personally pay for student fees, and may rely on parents, scholarships, or other external sources of funds to pay for student fees. Therefore, personal income may not be a good indicator of behavior. Instead, respondents were asked to rank their agreement to the statement, ‘I pay for student fees out of my own pocket’. This categorical variable was coded as a 1 if the respondent strongly disagreed, a 2 if ‘disagreed’ was specified, 3 if the respondent felt that the statement was neutral, 4 if ‘agree’ was marked, and 5 if the respondent indicated ‘strongly agree’. Because of the communal aspect of the program, decisions should also depend on the beliefs of others’ and the influence of social preferences. Behavior should rely on:

$$Prob (WTP > cost) = f(cost, beliefs\ of\ others, social\ preferences, self-payment\ of\ fees)$$

Results are shown in Table 5.7.

Table 5.7 Logit Gender Differences in Communitarian Willingness to Pay Vaccination Program 1

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
Cost	-0.0119** (0.00462)	-0.00631 (0.00388)	-0.00487* (0.00283)	-0.00103 (0.00219)
Belief	2.942*** (0.988)	1.593** (0.663)	1.295* (0.733)	2.524*** (0.761)
Fairness	1.342*** (0.375)	1.421*** (0.401)	1.655*** (0.448)	1.218*** (0.342)
I personally pay for student fees	-0.322 (0.242)	-0.0798 (0.204)	-0.263 (0.216)	-0.152 (0.217)
Constant	-4.297*** (1.589)	-5.866*** (1.868)	-5.870*** (1.883)	-5.057*** (1.508)
Pseudo R2	0.4929	0.4112	0.3485	0.3571
Log Likelihood	-32.74	-35.48	-37.78	-38.48
Observations	105	103	90	93
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1			

The willingness to pay the stated amount for Program 1 of the Communitarian treatment for meningococcal disease and HPV do not seem to vary much between genders (Table 5.7). Women follow The Law of Demand, wherein this group exhibits a negative coefficient on the cost variable for both diseases. Although not significant, the coefficients on cost for men are negative, indicating a non-positive slope. For both genders the belief that the respondent has of others also being willing to pay for the vaccination program is a strong determinant of the respondent's willingness to pay. Of all of the social preferences, including motivations of self-interest, the only significant influence was that of fairness. For both genders, a higher stated motivation of fairness indicates a higher probability of willingness to pay for the vaccination program. Since the willingness to pay question has a cost of increased student fees, the variable 'fees' was included which measures how much of student fees the respondent pays out of their own pocket. Surprisingly, the coefficient on this variable is not significant for either gender or for either disease.

For both diseases, vaccination Program 2 of the Communitarian treatment asked respondents their willingness to reallocate student fees away from other services already funded by student fees, in order to provide the vaccination program. Therefore, like Program 1 of the Communitarian treatment, decisions should rely on the cost, belief of others, fees, and social preferences. But unlike the other treatments, the opportunity cost of reallocating funds for vaccinations is a decrease in funding for other services financed by student fees. From this, the probability of willingness to pay should follow:

$Prob (WTP > cost) = f (cost, beliefs\ of\ others, self-payment\ of\ fees, social\ preferences, other\ services\ funded\ by\ student\ fee)$

Results are outlined in Table 5.8.

Table 5.8 Logit Gender Differences in Communitarian Willingness to Pay Vaccination Program 2

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
Cost	0.00230	-0.000637	0.00197	2.57e-05
	(0.00211)	(0.00234)	(0.00205)	(0.00253)
Belief	3.389***	3.974***	2.332***	3.988***
	(0.642)	(0.718)	(0.591)	(0.773)
I personally pay for student fees	0.165	0.436*	0.431*	-0.00836
	(0.204)	(0.230)	(0.220)	(0.258)
Conflict resolution	-0.852**	0.166	0.651**	0.594*
	(0.383)	(0.288)	(0.288)	(0.337)
Fairness	1.186***	0.979***	0.835**	0.775**
	(0.325)	(0.359)	(0.336)	(0.367)
Constant	-3.802**	-7.442***	-7.195***	-6.267***
	(1.835)	(2.217)	(1.971)	(1.967)
Pseudo R2	0.4048	0.5235	0.3106	0.5354
Log Likelihood	-43.3	-34.34	-40.81	-29.18
Observations	105	104	89	91
Standard errors in parentheses	*** p<0.01, ** p<0.05, * p<0.1			

Because of the nature of the opportunity cost, it is not surprising that the cost of the program is not a significant indicator of willingness to reallocate funds (Table 5.8). Similar to the findings for the Communitarian Program 1 (Table 5.7), Table 5.8 indicates that the belief that respondents have about others' support for the program is a significant indicator of the respondent's willingness to reallocate. The amount of student fees paid by the respondents is only significantly related to the probability of willingness to support the reallocation of student fees for males for meningococcal vaccinations and females for HPV vaccinations. Motivations of fairness again are significant predictors of the probability of respondents being willing to reallocate funds. Because the opportunity cost of the vaccination program is a reduction in the funds allocated to other student services,

the importance placed on each service by respondents was tested. In the end, only the importance placed on Student Conflict and Resolution Services was found to be related to the probability of being willing to reallocate. Interesting, this relationship for HPV vaccinations is in the opposite direction then would be hypothesized: The higher the stated importance for this service, the more likely respondents are willing to reallocate funds.

Of central importance to the current study are gender differences in support for various vaccination programs. To determine if the men and women sampled have significantly different coefficients of the reported regressions, Chow likelihood ratio tests are conducted to determine significant gender differences. As seen in Table 5.9, men and women responded significantly different from one another to Program 1 of the Individualist WTP question regarding meningococcal disease and to Program 2 of the Individualist WTP question regarding HPV. Although some other differences may seem large that are not significantly different, for many programs, there is absolutely no evidence that men and women value vaccination programs differently.

Table 5.9 Chow Likelihood Ratio Tests of Gender Differences

	Meningococcal	HPV
Individualist Treatment		
Program 1	LR chi2 = 19.86***	*
	Prob > chi2 = 0.0013	
Program 2	LR chi2 = 4.23	LR chi2 = 22.98***
	Prob > chi2 = 0.517	Prob > chi2 = 0.00003
Communitarian Treatment		
Program 1	LR chi2 = 3.6	LR chi2 = 3.58
	Prob > chi2 = 0.609	Prob > chi2 = 0.612
Program 2	LR chi2 = 10.17	LR chi2 = 4.86
	Prob > chi2 = 0.1175	Prob > chi2 = 0.5881

To further explore valuation of vaccination programs and the existence of gender differences, the following section discusses the mean WTP and probabilities of paying.

5.5.3 Mean WTP and Probabilities of Paying for Vaccinations

To test the remaining hypotheses, mean willingness to pay and probabilities of groups' willing to pay for vaccination programs are calculated. Based on the willingness to pay models introduced in section 5.5.2, the mean willingness to pay is calculated by:

$$MeanWTP = \frac{1}{\beta_{Cost}} (\ln(1 + e^{\bar{\beta}}))$$

Where β_{Cost} is the coefficient of cost from the associated logit regression, and $\bar{\beta}$ represents the sum of the other coefficients from the same logit regression. This calculation of mean WTP relies on the principle of a downward sloping demand curve. Therefore, its use is only applicable for those regressions with a significant negative coefficient on the variable 'Cost'. Based on the results of the regressions noted above, Table 5.10 gives the mean WTP for those models fitting this criterion.

Of the limited results presented in Table 5.9, there is a vast difference in mean WTP between women and men for Program 1 of the Individualist treatment for meningococcal disease. Although both mean WTP values are very small, men are willing to pay \$.31 on average, while women are only willing to pay \$.01. Colorado State University implemented a program that vaccinated all willing students, free of charge, which was in place during the application of the survey. Since respondents were aware of a free option to receive a meningococcal vaccine, many may not have been willing to pay for its availability, explaining the very low mean WTP values. Since women are the

Table 5.10 Mean WTP for Vaccination Program by Gender

	Women	Men
Individualist Treatment		
Program 1		
Meningococcal	\$0.01	\$0.31
HPV	\$1.43	
Program 2		
Meningococcal	\$3.28	*
HPV	*	*
Communitarian Treatment		
Program 1		
Meningococcal	\$45.35	*
HPV	\$8.34	*
Program 2		
Meningococcal	*	*
HPV	*	*

ones impacted by HPV infections, it may explain why women seem to be willing to pay more for the HPV vaccine given the same program and treatment. An interesting observation from Table 5.10 is that women seem to have an opposite trend in mean WTP for the Communitarian treatment. For those women sampled, the mean WTP for Program 1 of the Communitarian treatment for meningococcal disease vaccinations is over five times that for HPV vaccinations. Women seem to act very differently under the Communitarian treatment when compared to the Individualist treatment.

The values of mean WTP are restrictive since many of the vaccination programs cannot be valued using this method. Another measure of valuation is the probability that the average individual from the represented group would be willing to pay the stated amount (a 'yes' choice) for a given vaccination program is dependent on:

$$\text{Mean Prob (WTP} > \text{cost)} = 1 - \left(\frac{1}{1 + e^{\beta_0 + \beta_i x_i}} \right)$$

Where $\beta_o + \overline{\beta_i x_i}$ represents the vector of coefficients from the logit regression results in section 5.5.2 and x_i is a vector of the sample means of the associated variables. The probability of ‘Yes’, or WTP for each vaccination program and treatment are shown in Table 5.11.

Table 5.11 Mean Probability of Willingness to Pay for Vaccinations Programs by Gender¹⁹

	Women	Men
Individualist Treatment		
Program 1		
Meningococcal	0.0610	0.3547
HPV	0.4788	
Program 2		
Meningococcal	0.0384	0.2536
HPV	0.1337	0.1283
Communitarian Treatment		
Program 1		
Meningococcal	0.1553	0.1366
HPV	0.2371	0.2452
Program 2		
Meningococcal	0.5170	0.4198
HPV	0.6597	0.5213

Within the sample, women have a lower probability of paying out of their pocket to be vaccinated against meningococcal disease, with only a 6.1% chance of paying, when compared to men who have a much higher probability of paying, with a 35.5% chance. Women seem to be much more likely to pay out-of-pocket for a personal HPV vaccination than for meningococcal disease. From Table 5.11, the probability that women are willing to pay for self-vaccination for HPV is nearly eight times the probability of self-vaccination against meningococcal disease. Many contingent valuation studies limit

¹⁹ Confidence intervals were created at the 1%, 5%, and 10% levels to test the significance between the gender mean probabilities of willingness to pay. Because of the relatively low number of observations, no significant gender difference was found.

methodology to only include that of the Individualist treatment of program 1. With this limited methodology, this study would conclude that women have a lower mean WTP for the meningococcal vaccine, and thus have a lower valuation for meningococcal disease vaccines. But, as recently seen at Colorado State University, when there is an outbreak of infectious diseases, many community programs are instituted to stop the outbreak. In some cases, therefore, an individual out-of-pocket payment vehicle is not the appropriate payment vehicle for valuation estimation.

Program 2 of the Individualist treatment assessed willingness to pay out-of-pocket to provide a vaccine to one other Colorado State University student. The gender difference in willingness to pay for HPV is not significant: women have a probability of paying .1337, while men have a slightly lower probability of .1283. These results suggest that there is no gender difference in valuation of having a HPV vaccination available to another student. Regarding the probability to pay for another's meningococcal vaccination, men have a probability of paying that is nearly seven times higher than women, with a .2536 probability, compared to women's probability of .0384. Similar to the results for the Individualist treatment of Program 1, men seem to have a higher valuation, although not significant in this sample, for meningococcal disease vaccinations when the payment vehicle is an out-of-pocket payment from the respondent.

The results presented in Table 5.11 in conjunction with Table 5.9, specifically for the Communitarian treatments, show a different trend in gender valuation of vaccination programs. Where significant gender differences exist for the Individualist treatment where women were found to have seemingly lower valuation, no significant gender differences are found in the Communitarian treatment.

The results of valuation for vaccinations through the reallocation of student fees is very different from the results for the other programs and payment vehicles. The probability that either gender would pay for either disease is substantially higher than in the other categories. Also, evidence suggests that women respond very differently to the different treatments. Whereas women have very low probabilities of paying for the meningococcal vaccines in the Individualist treatment, those probabilities seem to increase, specifically for Program 2 of the Communitarian treatment.

Although Table 5.9 suggests support for hypothesis H4 for Program 1 for meningococcal disease and for Program 2 for HPV in the Individualist treatment, there are no significant differences in the probability of paying. The same results hold for hypothesis H5. There are no significant differences found between the probabilities of paying for either program for either treatment, although in some cases sample differences are drastic. For instance, the mean probability of women paying for HPV vaccinations in Program 2 is approximately three times their probability of paying for Program 1 of the Individualist treatment. Therefore, hypotheses H4 and H5 cannot be substantiated from the survey data.

Hypothesis H6 is also not supported. Both men and women show increases in their probability of paying for Program 2 compared to Program 1 of the Communitarian treatment for both diseases, but the differences are not significant. Reallocating student fees to fund communal vaccination programs seems to be most popular amongst Colorado State University students.

Since there are no gender differences in contracting, or the effects of meningococcal disease, while there are substantial gender differences for HPV, it was

hypothesized that there would be no gender differences in the probability of willingness to pay for the meningococcal vaccination (H7), but there would be significant gender differences for HPV vaccination programs (H8). Consistent with this reasoning, there are no significant gender differences in the probability of paying for meningococcal disease, giving evidence to accept H7. Although evidence seems to support hypothesis H8 for the Individualist treatment, the insignificant findings on probability of WTP suggests that H8 cannot be supported.

5.6 Discussion

From the results presented in this study, some gender differences are apparent throughout the sample, but are not always statistically significant. Focusing on gender differences in key variables, the sample indicates that even amongst college students, significant gender differences are apparent. Within those surveyed, men are found to have a higher annual income and have parents with higher incomes than the women sampled. Women were significantly more likely to feel that they are susceptible to contracting meningococcal disease and HPV, more likely to have been previously vaccinated against these diseases, known someone that was diagnosed with these diseases, and feel that it is important for the Colorado State University community to be vaccinated against disease. Women were found to state that self-interest was more influential in their willingness to pay decisions than men, along with all other social preferences. These findings suggest that women, on average, should have a higher probability of being willing to pay for vaccinations. But as seen in the programs, this hypothesis is not substantiated, and in some cases, results suggest the opposite. These finding suggest that under the current methodology of contingent valuation and payment vehicles, results may not accurately

capture valuation, especially for women. Using an alternative methodology, Program 2 of the Communitarian treatment tests if altering the payment vehicle to a more realistic payment method and including non-selfish influences of behavior, will create a model that more accurately estimates valuation. From the results of this study, the new methodology does create considerably different valuation for vaccination programs. Whereas the results using the traditional methodology indicate differences in valuation, with women have lower stated valuation, no gender differences are found using the alternative methodology. Although not significant, the sample suggests that when possible gender differences exist using the traditional payment vehicles of out-of-pocket payments and tax referendums (both programs of the Individualist treatment and Program 1 of the Communitarian treatment), men have seemingly higher valuations, as apposed to women having possibly higher valuation using the alternative payment vehicle. Unlike the findings using traditional methodology, this trend supports theory. As presented in Chapter three, those with a higher perception of risk should have a higher probability of paying, controlling for appropriate variables, to reduce those risks. In the current study, women are found to perceive themselves are as being more susceptible, and therefore perceive a higher risk associated with the stated diseases. Using Chapter 3's theory, women should therefore have a higher probability of paying for the vaccination programs. But only in the new methodology is this relationship indicated, even though the results are not statistically significant. These findings show the need for larger sample sizes to determine if any gender differences do exist.

The alternative and newer methodology presented in the current study also assesses the prevalence of behavior influences on choice. As seen in Table 5.2, women sampled

have a higher stated influence of self-interest, altruism, reciprocity, fairness, and commitment on their willingness to pay choices when compared to men. From tables 5.5-5.8, at least one of these preferences directly influence the model of behavior, and indirectly, the belief of other's decision also play a significant role. Social preferences and accounting for self-interest play a significant role in properly modeling behavior. Not including these preferences may lead to underspecified modeling. When the models are reduced to not include influences of self-interest, social preferences, and the belief of others, the results show a convergence of the willingness to pay amongst genders. For example, Table 5.11 shows that for those sampled, the probability of women supporting Program 1 of the Individualist treatment for meningococcal disease was 0.061, while men had only a 0.3547 probability, resulting in magnitude difference between the gender of nearly 5. When these influences on behavior are not included in the model, that magnitude of difference dropped to 1.8655. This result of a more homogenous willingness to support vaccination programs amongst genders was not only found in this example, but was found for all of the programs, except for Program 2 of the Communitarian treatment for HPV, as seen in Table 5.12.

The logit results from all estimates that do not include influences on behavior are presented in the appendix. These findings suggest that by not including these influences on behavior within CVM studies, the models used are underspecified, and not only give inaccurate estimates of valuation, but may also disregard potentially significant gender differences.

Table 5.12 Gender differences in mean prob (WTP > cost) without social and self-interest preferences along with comparisons when including these influences

	Women	Men	Magnitude of Gender Difference w/o Social and Self-Interest Preferences	Magnitude of Gender Differences Including Social and Self-interest Preferences
Individualist Treatment				
Program 1				
Meningococcal	0.061	0.3547	1.8655	4.8148
HPV	0.4788			
Program 2				
Meningococcal	0.0384	0.2536	0.2779	5.6042
HPV	0.1337	0.1283	0.0467	0.0404
Communitarian Treatment				
Program 1				
Meningococcal	0.1553	0.1366	0.0173	0.1204
HPV	0.2371	0.2452	0.0107	0.0342
Program 2				
Meningococcal	0.517	0.4198	0.0650	0.1880
HPV	0.6597	0.5213	0.1683	0.2098

5.7 Conclusions

The results of this study suggest the importance of a realistic payment vehicle and the inclusion of social and self-interest motivations on willingness to pay choices. Traditional payment vehicles of out-of-pocket payments or voting for increases in individual payments towards communal funds may provide correct estimates for valuation of goods and services when these vehicles accurately reflect the mode of payment for the proposed policy or program. But in the case of community based programs like the meningococcal vaccination program at Colorado State University- where funding of the program is not provided by an out-of-pocket payment, but through a

reallocation of already existing communal funds-a payment vehicle that properly represents this reallocation should be taken into consideration, when possible in CVM studies.

This study also indicates that proper modeling of valuation and choice in CVM should include measures of social preferences and motivations of self-interest. Without these influences, distortions of valuation may exist, and gender differences that do exist may be invisible due to underspecified modeling. This study shows that there are gender differences in perceptions, motivations, and valuation. Therefore, the accurate use of payment vehicles and inclusion of social and self-interest motivations may be critical to measuring gender differences in valuation of goods and services.

The sample used in the present study creates many limitations to the extrapolation of the results presented here to other goods and services and to other populations. The limited sample size available for this study leads to very restrictive results from the analyses and suggest the need for larger sample sizes when available. The results only apply to valuation of HPV and meningococcal vaccinations and should not be used as a basis for estimates of valuation for other goods and services. Also, the results only hold for students at Colorado State University enrolled in the specific economic courses sampled, and should not be generalized to other populations. The limited number of minorities in the sample along with the low variation in personal incomes also limits the results. Focusing on gender differences without including class or racial differences may limit full estimations of cultural differences among the sample.

Chapter 6: Conclusions

This dissertation began with an extensive exploration of the theory and seemingly paradoxical results between the economic literatures of contingent valuation method, risk aversion, and the interdisciplinary literature of risk perceptions, specifically with regard to race and gender differences. Although CVM has important policy implications, its traditional methodology brings about numerous critiques that indicate the results of CVM studies may have potential flaws.

To explore the inconsistency between the literatures and in an attempt to correct as many of the critiques as possible, a theoretical model is generated that connects the contingent valuation theory to that of risk aversion and perceptions of risk. Insights from the risk perception literature are used to create a model of absolute risk aversion that is directly tied to valuation from CVM. Data from a previously collected dataset by Loomis et al (2009) is fit to the model. The results reinforce the inconsistency found between the risk perception and contingent valuation literatures and indicate a possible weakness with traditional methodology used by contingent valuation studies. The findings from the data also suggest that one of potential reason for the apparent inconsistent results is the payment vehicle chosen by CVM studies.

The existence of social preferences has been well established in the experimental literature and is formally modeled including influences of self-interest, altruism,

reciprocity, fairness, and commitment in the context of stated willingness to pay in contingent valuation studies. The models suggest that the existence of some social preferences, specifically commitment, may explain some of the inconsistencies between the relevant literatures.

A dichotomous choice stated valuation study on various vaccination programs was conducted among college students at Colorado State University. The findings indicate some gender differences in willingness to pay for vaccination programs and suggest that the payment vehicle may have effects on valuation. The choice of the payment vehicle seems to influence WTP findings, especially in the context of gender effects and may indicate an understated valuation placed on the program by women when the traditional payment vehicle is utilized.

The inclusion of social preferences is a significant improvement to modeling of valuation, and when not included, may lead to underspecified models that ignore existing gender differences. When the probabilities of paying for the various vaccination programs that are based on models that do not include significant social and self-interest preferences, are compared to the models including these influences, there is a convergence of gender differences in WTP when the influences are not included. This finding suggests that the traditional methods used by CVM studies may miss gender differences that truly exist.

This dissertation has discussed some of the issues surrounding the traditional methodology used by CVM, especially with respect to race and gender differences. Solutions to help correct these issues are introduced and tested, giving policy makers

alternative methodologies for use in estimating valuation for nonmarket goods and health programs that will help guarantee proper valuation from all cultural sub-groups.

References

- Akerlof, G. and Kranton, R. (2000) "Economics and Identity." *The Quarterly Journal of Economics* **115**(3): 715-753.
- Andersen J, Backer V and Voldsgaard P. (1997) "Acute meningococcal meningitis: analysis of features of the disease according to the age of 255 patients. Copenhagen Meningitis Study Group." *J Infect.* **34**(3) :227-35.
- Andreoni, J. (1988) "Why Free Ride? Strategies and Learning in Public Goods Experiments." *Journal of Public Economics* **37**(3): 291-304.
- Andreoni, J., Erard, B. and Feinstein, J. (1994) "Tax Compliance." *Journal of Economic Literature* **36**(2): 818-860.
- Arrow, K. (1982) "Risk Perception in Psychology and Economics." *Economic Inquiry* **20**(1): 1-9.
- Backe, R., Jenkins-Smith, H. and Slovic, P. (1997) "Risk Perceptions of Men and Women Scientists." *Social Science Quarterly* **78**(1): 167-176.
- Baumol, W. and Oates, W. (1979) "Economics, Environmental Policy, and the Quality of Life." Englewood Cliffs, NJ: Prentice-Hall.
- Beneria, L. (1995) "Towards a Greater Integration of Gender in Economics." *World Development* **23**(11): 1839-1850.
- Bergmann, B. (1981) "The Economic Risks of Being a Housewife." *American Economic Review* **71**(2): 81-86.
- Bergstrom, J., K. and Yabe, M. (2004) "Trading Taxes vs. Paying Taxes to Value and Finance Public Environmental Goods." *Environmental and Resource Economics* **28**(4): 533-549.
- Bernasek, A and Swiff, S. (2001) "Gender, Risk, and Retirement." *Journal of Economic Issues* **35**(2): 345-356.

- Berrens, R., Jenkins-Smith, H. and Silva, C. (2002) "Further Investigation of Voluntary Contribution Contingent Valuation: Fair Share, Time of Contribution, and Respondent Uncertainty." *Journal of Environmental Economics and Management* **44**: 144-168.
- Bolton, G. and Ockenfels, A. (2000) "ERC: A Theory of Equity, Reciprocity, and Competition." *The American Economic Review* **90**(1): 166-193.
- Bord, R. and O'Connor, R. (1997) "The Gender Gap in Environmental Attitudes: The Case of Perceived Vulnerability to Risk." *Social Science Quarterly* **78**(4): 830-840.
- Bowles, S. (2006) "Microeconomics: Behavior, Institutions, and Evolution." New York, NY: Russell Sage Foundation.
- Bowles, S and Gintis, H. (2000) "Walrasian Economics in Retrospect." *Quarterly Journal of Economics* **115**(4): 1411-1439.
- Boxall, P., Adamowicz, W., Swait, J., Williams, M., and Louviere, J. (1996) "A Comparison of Stated Preference Methods for Environmental Valuation." *Ecological Economics* **18**: 243-253.
- Brown, K. and Taylor, L. (2000) "Do as You Say, Say as You Do: Evidence on Gender Differences in Actual and Stated Contributions to Public Goods." *Journal of Economic Behavior and Organization* **43**: 127-139.
- Brown-Kruse, J. and Hummels, D. (1993) "Gender Effects in Laboratory Public Goods Contributions." *Journal of Economic Behavior and Organization* **22**: 255-267.
- Bullard, R. (1983). "Solid-Waste Sites and the Black Houston Community." *Sociological Inquiry* **53**(2-3): 273-288.
- Byrne, M., O'Malley, K. and Suarez-Almazor, M. (2004) "Ethnic Differences in Health Preferences: Analysis using Willingness to Pay." *The Journal of Rheumatology* **31**(9): 1811-1818.
- Camerer, C. (2003) "Behavioral Game Theory: Experiments on Strategic Interaction." Princeton, NJ: Princeton University Press.
- Camerer, C. and Fehr, E. (2002) "Measuring Social Norms and Preferences using Experimental Games: A Guide for Social Scientists." *Institute for Empirical Research in Economics: University of Zurich*: Working Paper No. 97.
- Carson, R. (2000) "Contingent Valuation: A User's Guide." *Environmental Science Technology* **34**: 1214-1218.
- Champ, P., Boyle, K, and Brown, T (eds.) (2003) "A Primer on Nonmarket Valuation." Dordrecht/Boston/London: Kluwer Academic Publishers.

Cohen, M., Rust, R., Steen, S. and Tidd, S. (2004) "Willingness-to-Pay for Crime Control Programs." *Criminology* **42**(1): 89-110.

Cox, James C. and Sadiraj, Vjollca. (2001) "Risk Aversion and Expected-Utility Theory: Coherence for Small- and Large-Stakes Gambles," Working paper, University of Arizona,

Darity, W., Mason, P. and Stewart, J. (2006) "The Economic of Identity: The Origin and Persistence of Racial Identity Norms." *Journal of Economic Behavior and Organization* **60**: 283-305.

Davidson, D. and Freudenburg, W. (1996) "gender and Environmental Risk Concerns: A Review and Analysis of Available Research." *Environment and Behavior* **28**(3): 302-339.

Davis, J. (2004) "Identity and Commitment: Sen's Conception of the Individual." *Workshop on Rationality and Commitment*.

Dawes, R. (1980) "Social Dilemma." *Annual Review of Psychology* **31**: 169-193.

Deacon, R. and Shapiro, P. (1975) "Private Preference for Collective Goods Revealed Through Voting on Referenda." *The American Economic Review* **65**(5): 943-955.

Downey, L. (2005). Assessing Environmental Inequality: How the Conclusions We Draw Vary According to the Definitions We Employ. *Sociological Spectrum* **25**: 349-369.

Dupont, D. (2004) "Do Children Matter? An Examination of Gender Differences in Environmental Valuation." *Ecological Economics* **49**: 273-286.

Edgeworth, F. (1881) "Mathematical Psychics: An Essay on the Application of Mathematics to the Moral Science." London: C. Kegan Paul and Company.

Falk, A. and Fischbacher, U. (2006) "A Theory of Reciprocity." *Games and Economic Behavior* **52**(2): 293-315.

Fehr, E. and Fischbacher, U. (2004) "Third Party Punishment and Social Norms." *Evolution and Human Behavior* **25**(2): 63-87.

Fehr, E. and Schmidt, K. "A Theory of Fairness, Competition, and Cooperation." *The Quarterly Journal of Economics* **114**(3): 817-868.

Fehr, E. and Schmidt, K. "Theories of Fairness and Reciprocity- Evidence and Economic Application" in Dewatripont, M., Hanson, L. and Turnovsky (eds.) (2003) "Advancements in Economics and Econometrics." Cambridge, UK: Cambridge University Press.

- Figart, D. (1997) "Gender as More than A Dummy Variable: Feminist Approaches to Discrimination." *Review of Social Economy* **55**(1): 1-32.
- Finucane, M., Slovic, P., Mertz, C., Flynn, J., and Satterfield, T. (2000) "Gender, Races, and Perceived Risk: The 'White Male' Effect." *Health, Risk and Society* **2**(2): 159-172.
- Flynn, J., Slovic, P., and Mertz, C. (1994) "Gender, Race, and Perception of Environmental Health Risks." *Risk Analysis* **14**(6): 1101-1108.
- Folbre, N. (1993) "How Does She Know? Feminist Theories of Gender Bias in Economics." *History of Political Economy* **25**(1): 167-184.
- Folbre, N. (1994) "Who Pays for the Kids? Gender and the Structures of Constraint." London and New York: Routledge.
- Folbre, N. and Nelson, J. (2000) "For Love or Money – Or Both?" *Journal of Economic Perspectives* **14**(4): 123-140.
- Folbre, N. and Weisskopf, T. "Does Father Know Best? Families, Markets, and the Supply of Caring Labor." in Ber-Ner, A. and Putterman, L. (eds.) (1998) "Economic, Values, and Organizations." Cambridge and New York: Cambridge University Press.
- Gayer, T., Hamilton, J. and Viscusi, K. (2000) "Private Values of Risk Tradeoffs at Superfund Sites: Housing Market Evidence on Learning about Risk." *The Review of Economics and Statistics* **82**(3): 439-451.
- Gerking, S., DeHann, M. and William, S. (1988) "The Marginal Value of Job Safety: A Contingent Valuation Study." *Journal of Risk Uncertainty* **1**(2): 185-199.
- Gintis, H. (2000) "Strong Reciprocity and Human Sociality." *Journal of Theoretical Biology* **206**: 169-179.
- Goeree, J. and Holt, C. (2000) "A Model of Noisy Introspection," Working paper, University of Virginia.
- Goldacre, M., Roberts, S. and Yeates, D. (2003) "Case fatality rates for meningococcal disease in an English population, 1963-98: database study" *BJM* **327**(7415): 596-597.
- Gustafson, P. (1998) "Gender Differences in Risk Perception: Theoretical and Methodological Perspectives." *Risk Analysis* **18**(6): 805-811.
- Hanemann, M. (Autumn 1994) "Valuing the Environment Through Contingent Valuation." *The Journal of Economic Perspectives* **8**(4): 19-43.
- Henrich, J., Boyd, R., Bowles, S., Camerer, Cl. Fehr, E., Gintis, H. and McElreath, R. "Overview and Synthesis." In Henrich, J., Boyd, R., Bowles, S., Camerer, Cl. Fehr, E.

and Gintis, H. (eds.) (2004) "Foundations of Human Sociality." Oxford, UK: Oxford University Press.

Jianakoplos, A. and Bernasek, A (1998) "Are Women More Risk Averse?" *Economic Inquiry* **36**: 620-630.

Johnson, B. (2002) "Gender and Race in Beliefs about Outdoor Air Pollution." *Risk Analysis* **22**(4): 725-738.

Kealy, M., Montgomery, M. and Dovidio, J. (1990) "Reliability and Predictive Validity of Contingent Values: Does the Nature of the Good Matter?" *Journal of Environmental Economics and Management* **19**: 244-263.

Lambert, E. (2001) "College Students' Knowledge of Human Papillomavirus and Effectiveness of a Brief Educational Intervention." *JABFP* **14**(3): 178-183.

Landenburg, J. and Olsen, S. (2008) "Gender-Specific Starting Point Bias in Choice Experiments: Evidence from an Empirical Study." *Journal of Environmental Economics and Management* **56**: 275-285.

Levine, D. (1998) "Modeling Altruism and Spitefulness in Experiments." *Review of Economic Dynamics* **1**: 593-622.

Loomis, J., Bell, P., Cooney, H. and Asumus, C. (2009) "A Comparison of Actual and Hypothetical Willingness to Pay of Parents and Non-Parents for Protecting Infant Health: The Case of Nitrates in Drinking Water." *Journal of Agricultural and Applied Economics* **41**(3): 1-16.

Loomis, J., Ellingson, L., González-Cabán, A. and Hessel, H. (2004a) "The Influence of Ethnicity and Language on Economic Benefits of Forest Fire Prevention From Prescribed Burning and Mechanical Fuel Reduction Methods" Proceedings of the Second International Symposium on Fire Economics, Planning, and Policy : A Global View.

Loomis, J. Gonzalez-Caban, and Hessel, H. (2004b) "Multicultural Evaluation of the Performance of Contingent Valuation for Forest Fire Prevention." *Contemporary Economic Policy* **22**(3) 407-419.

Loomis, J., Lucas, B. and Gonzalez-Caban, A. (2002) "Language-Related Differences in a Contingent Valuation Study: English verse Spanish." *American Journal of Agricultural Economics* **84**(4): 1091-1102.

Ludwig, J. and Cook, P. (2001) "The Benefits of Reducing Gun Violence: Evidence from Contingent-Valuation Survey Data." *The Journal of Risk and Uncertainty* **22**(3): 207-226.

MacDonald, M. (1995) "Feminist Economics: From Theory to Research." *Canadian Journal of Economics* **28**(1): 159-175.

- Magat, W., Viscusi, K. and Huber, J. (1998) "Pared Comparison and Contingent Valuation Approaches to Morbidity Risk Valuation." *Journal of Environmental Economics and Management* **15**: 395-411.
- May, A. (2002) "The Feminist Challenge to Economics." *Challenge* **45**(6): 45-69.
- McFadden, D. (1994) "Contingent Valuation and Social Choice." *American Journal of Agricultural Economics* **76**(4): 689-708.
- McMahon, M. (1997) "From the Ground Up: Ecofeminism and Ecological Economics." *Ecological Economics* **20**: 163-173.
- Mellor, M. (2002) "Ecofeminist Economics: Women, Work, and the Environment." *Women and Environments*: 7-10.
- Miller, J. and Rogers, Y. (2008) "Economic Importance and Statistical Significant: Guidelines for Communicating Empirical Research." *Feminist Economics* **14**(2): 117-149.
- Milne, M. J. (1991) "Accounting, Environmental Resource Values, and Non-Market Valuation Techniques for Environmental Resources: a Review." *Accounting Auditing & Accountability Journal* **4**: 81-109.
- Misra, A. Huang, C. and Ott, H. (1991) "Consumer Willingness to Pay for Pesticide-Free Produce." *Journal of Agricultural Economics* **16**(2): 218-227.
- Mohai, P. (1992) "Men, Women, and the Environment: An Examination of the Gender Gap in Environmental Concern and Activism." *Society and Natural Resources* **5**: 1-19.
- Mohai, P. and Bryant, B. (1998) "Is there a "Race" Effect on Concern for Environmental Quality?" *Public Opinion Quarterly* **62**: 475-505.
- Mohai, P. and Saha, R. (2007) "Racial Inequality in the Distribution of Hazardous Waste: A National-Level Reassessment" *Social Problems* **54**(30): 343-370.
- National Oceanic and Atmospheric Administration (NOAA). (1993) "Natural Resources Damage Assessments under the Oil Pollution Act of 1990." *Federal Register* **58**: 4601-4614.
- Nelson, J. (1995) "Feminism and Economics." *The Journal of Economic Perspectives* **9**(2): 131-148.
- Nelson, J. (1997) "Feminism, Ecology, and the Philosophy of Economics." *Ecological Economics* **20**: 155-162.

- O'Connor, R. Bord, R. and Fisher (1999) "Risk Perceptions, General Environmental Beliefs, and Willingness to Address Climate Change." *Risk Analysis* **19**(3): 461-471.
- O'Connor, R. Bord, R. Yarnal, B. and Wiefek, N. (March 2002) "Who Wants to Reduce Greenhouse Gas Emissions?" *Social Science Quarterly* **83**(1): 1-17.
- O'Neil, A. G., (2007) "Superfund: Evaluating the Impact of Executive Order 12898" *Environmental Health Perspectives* **115**(7): 1087-1093.
- Popp, D. (2001) "Altruism and the Demand for Environmental Quality." *Land Economics* **77**(3): 339-349.
- Rabin, M. (1993) "Incorporating Fairness into Game Theory and Economics." *American Economic Review* **83**(5): 1281-1302.
- Riechard, D. and Peterson, S. (1998) "Perception of Environmental Risk Related to Gender, Community Socioeconomic Setting, Age, and Locus of Control." **30**(1): 11.
- Satterfield, T., Mertz, C. and Slovic, P (2004) "Discrimination, Vulnerability, and Justice in the Face of Risk." *Risk Analysis* **24**(1): 115-129.
- Savage, I. (1993) "Demographic Influences on Risk Perceptions." *Risk Analysis* **13**(4): 413-420.
- Schann, J. and Holzer, E. (1990) "Studies of Individual Environmental Concern: The Role of Knowledge, Gender, and Background Variables." *Environment and Behavior* **22**(6): 767-786.
- Sen, A. (1977) "Rational Fools: A Critique of the Behavioral Foundations of Economic Theory." *Philosophy and Public Affairs* **6**(4): 317-344.
- Sen, A. (1985) "Goals, Commitment, and Identity." *Journal of Law, Economics, and Organization* **1**(2): 341-355.
- Sen, A. (1994) "The Formation of Rational Choice." *The American Economic Review* **84**(2): 385-390.
- Sen, A. (1997) "Maximization and the Act of Choice." *Econometrica* **65**(4): 745-779.
- Sen, A. (2000) "The Discipline of Cost-Benefit Analysis." *The Journal of Legal Studies* **29**(2): 931-952.
- Sen, A. (2005) "Why Exactly is Commitment Important for Rationality?" *Economics and Philosophy* **21**: 5-13.

- Sethi, R. and Somanathan, E. (2003) "Understanding Reciprocity." *Journal of Economic Behavior and Organization* **50**: 1-27.
- Shang, J. and Croson, R. (2005) "A Field Experiment n Charitable Contribution: The Impact of Social Influence on the Voluntary Provision of Public Goods." [http://rcgd.isr.umich.edu/seminars/Fall2006/Croson/Shang%20Croson%20EJ%20\(2\).pdf](http://rcgd.isr.umich.edu/seminars/Fall2006/Croson/Shang%20Croson%20EJ%20(2).pdf).
- Shiell, A. and Rush, B. (2003) "Can Willingness to Pay Capture the Value of Altruism? An Exploration of Sen's Notion of Commitment." *Journal of Socio-Economics* **32**: 647-660.
- Slovic, P. (1993) "Perceived Risk, Trust, and Democracy." *Risk Analysis* **13**(6): 675-682.
- Slovic, P. (1999) "Trust, Emotion, Sex, Politics, and Science; Surveying the Risk-Assessment Battlefield." *Risk Analysis* **19**(4): 689-701.
- Sjoberg, L. (2000) "Factors in risk Perception." *Risk Analysis* **20**(1): 1-11.
- Stern, P., Dietz, T. and Kalof, L. (1993) "Value Orientations, Gender, and Environmental Concern." *Environment and Behavior* **25**(5): 322-348.
- Strober, M. (1994) "Rethinking Economics Through a Feminist Lens." *American Economic Review* **84**(2): 143-47.
- Schubert, R., Brown, M., Gysler, M. & Brachinge, W. (1999) "Financial Decision-Making: Are Women Really More Risk-Averse?" *The American Economic Review* **89**(2): 381-385.
- Swallow, S., Weaver, T., Opsluch, J., and Michelmam, T. (Aug., 1994) "Heterogeneous Preferences and Aggregation in Environmental Policy Analysis: A Landfill Siting Case." *American Journal of Agricultural Economics* **76**(3): 431-443.
- Teal, G. and Loomis, J. (2000) "Effects of Gender and Parental Status on the Economic Valuation of Increasing Wetlands, Reducing Wildlife Contamination and Increasing Salmon Populations" *Society and Natural Resources* **13**: 1-14.
- U.S. General Accounting Office. (1983). Siting of Hazardous Waste Landfills and Their Correlation with Racial and Economic Status of Surrounding Communities. Washington, D. C.; General Accounting Office.
- United Church of Christ Commission for Racial Justice. (1987). Toxic Wares and Race in the United States: A National Report on the Racial and Socio-Economic Characteristics of Communities with Hazardous Waste Sites: Dr. Benjamin F Chavis Jr.
- Viscusi, K. (1993) "The Value of Risks to Life and Health." *Journal of Economic Literature* **31**(4): 1912-1946.

Wager, T., Hu, T., Duenas, G, Kaplan, C., Nguyen, B. and Pasick, R. (2001) “Does Willingness to Pay Vary by Race/Ethnicity? An Analysis using Mammography among Low-Income Women.” *Health Policy* **58**: 275-288.

Zein-Elabdin, E. (1996) “Development, Gender, and the Environment: Theoretical or Contextual Link? Towards an Institutional Analysis of Gender.” *Journal of Economic Issues* **30**(4): 929-947.

zur Hausen, H. (2002) “Papillomaviruses and Cancer: From Basic Studies to Clinical Application.” *Nature Reviews* **2**: 342-35.

Appendix Chapter 3

Below are the survey instruments used by Loomis et. al (2009). Two instruments were developed and utilized by the study; consequential and non-consequential.

A.3.1 Consequential Survey Instrument

The following is the consequential or real instrument in which respondents had to give a certain amount to pay for bottled water:

Section 1 → This section asks some general questions about you and your drinking water.

Note: “Tap water” means water that comes out of the faucet in you kitchen.

- 1) How long have you lived in _____ County, Colorado? _____
- 2) a) Overall, how would you rate the taste of your tap water?
☐ Poor ☐ Below Average ☐ Average ☐ Above Average ☐ Excellent
- b) Overall, how would you rate the smell of your tap water?
☐ Strong unpleasant smell ☐ Somewhat unpleasant smell
☐ Noticeable smell ☐ No smell
- c) Overall, how would you rate the appearance of your tap water?
☐ Colored (brown, red, yellow) ☐ Very Cloudy ☐ Cloudy
☐ Slightly cloudy ☐ Normal appearance
- d) Overall, how would you rate the safety of your tap water?
☐ Poor ☐ Below Average ☐ Average ☐ Above Average ☐ Excellent
Don't Know
- 3) List any problems that you think your tap water has.

- 4) Do you use a water filter system at home to purify your tap water?
☐ Always ☐ Often ☐ Sometimes ☐ Never (Go to question 5)
If you use a filter system in your home, what type is it?
☐ Filter Pitcher ☐ Faucet Mounted ☐ Under-sink ☐ Refrigerator
- 5) How much money do you spend on each of the following over the course of a typical month?

Bottled Water (for use at home only)

- ☐ None ☐ \$1-\$10 ☐ \$11-24 ☐ \$25-\$49 ☐ \$50 or more

Filter System at home (maintenance or replacement filters)

- ☐ No System ☐ Less than \$25 ☐ More than \$25

- 6) Does the water in your home come from a well on your property?
☐ Yes ☐ No (if “No” skip to question 7)
6a) Do you have your well water tested?
☐ Yes ☐ No (if “No” skip to question 7)
6b) How often do you have your well-water tested?
☐ Once a year ☐ Once every two years ☐ Every five years
6c) Does your well water meet standards when tested?
☐ Yes ☐ No

7) Check any of the items below that you think can be a source of nitrate contamination in drinking water.

- ☐ Fertilizer Runoff ☐ Natural Deposits ☐ Decaying Plant Matter
☐ Fossil Fuels ☐ Sewage ☐ Landfill Runoff
☐ Steel Factories ☐ Discharge from Coal-burning Factories
☐ Leaching from Ore-processing Sites ☐ Leaching from Septic Tanks

8) Check any of the items that you think can help you avoid drinking water with high levels of nitrate.

- ☐ Under-sink Filter ☐ Faucet-mounted Filter ☐ Filter Pitcher (e.g., Brita™ filters)
☐ Bottled Water ☐ Boiling Tap Water

- 9) Have you heard about the quality of your community’s drinking water?
☐ Yes ☐ No

- 10) Do you read the water quality information included in your water bill? ☐ Always

☐ Sometimes ☐ Never ☐ Don't receive a water bill

11) Do you prepare formula for an infant (a child under one year old)?

☐ Yes ☐ No (if "No" skip to question 12)

11a) How old is the infant? _____

11b) Do you use bottled water to prepare infant formula?

☐ Always ☐ Often ☐ Sometimes ☐ Never

12) Have you or a woman in your household been pregnant in the last three years?

☐ Yes ☐ No (if "No" skip to question 13)

12a) While pregnant, how often did you or a woman in your household buy bottled water to drink at home?

☐ Always ☐ Often ☐ Sometimes ☐ Never

12b) While nursing, how often did you or a woman in your household buy bottled water to drink at home?

☐ Always ☐ Often ☐ Sometimes ☐ Never ☐ Didn't Nurse

13) Do you have health insurance?

☐ Yes ☐ No (If no, skip to question 14)

13a) Does your insurance cover emergency room care?

☐ Yes ☐ No

13b) Is your family (spouse and/or children) covered?

☐ Yes ☐ No

14) If you have children, how much does a visit to the doctor for your child usually cost you?

☐ \$0 ☐ \$5 - \$20 ☐ \$21 - \$30 ☐ \$31 - \$50 ☐ \$51 - \$70

☐ \$71 - \$90 ☐ \$91 - \$100 ☐ \$100 +

14a) Does an adult in your household have to miss work in order to take a child to the doctor or hospital?

☐ Yes ☐ No

Section 2 → This section asks about your beliefs regarding infants' health (consider infants to be children under 1 year of age).

Please check the box corresponding to your responses for questions 1 through 17.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1) If drinking water is safe for adults, it is also safe for infants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) If infants consume water contaminated with nitrate, it can	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

be harmful to their health.					
3) If adults consume water contaminated with nitrate, it can be harmful to their health.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) It is natural for infants to become ill more often than adults.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) The infants in my community are never ill due to pollution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) My friends and family are concerned with infants' health issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) The parents I know are worried about the health of their infants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) It is possible to reduce the exposure infants have to pollution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) It is possible to prevent infants from becoming seriously ill due to environmentally caused illnesses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) Only people with infants living in their home need to be concerned about pollution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) Parents, not the public, have the sole responsibility for protecting their infants from harm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) More state and community resources need to be devoted to infant health issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
13) There is too much emphasis placed on issues regarding infants' health.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>If you are NOT currently caring for an infant, skip to question 1 of Section 3.</i>					
14) My infant(s) are not exposed to dangerous environmental contaminants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) I can ensure that my infant(s) do not become ill due to environmental contaminants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16) I can afford to take my infant(s) to the doctor when they are ill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

17) I can prevent my infant(s) from becoming seriously ill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Section 3 → This section asks what you think about the quality of your drinking water. Please fill in the bubble corresponding to your responses for questions 1 through 7.

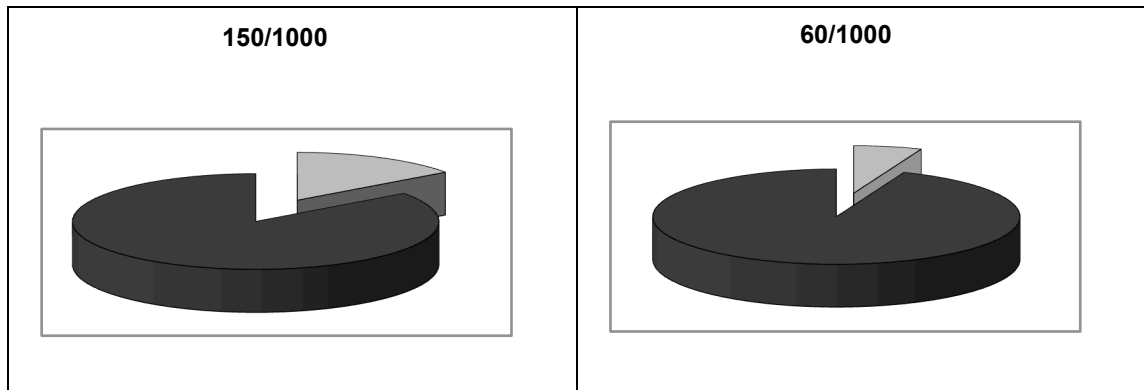
	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1) My community has safe drinking water.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) My home's drinking water (straight from the faucet) does not have unsafe levels of nitrate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) My friends and family are worried about our drinking water.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Most of the people I know would take steps to ensure that their drinking water is safe.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Nitrate in drinking water is an unavoidable occurrence.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) It is important to me to test the quality of my home's drinking water.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) It is the government's responsibility to ensure that my drinking water is safe.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Section 4 → We are now going to illustrate some risk information for you to help you get used to the way in which risk information is presented as pie charts. Please read the information and then choose which chart represents the greatest risk.

In the first example, the gray pie wedge represents the fraction or proportion of 1000 accidents which involve Car A and Car B. The larger the gray slice, the greater the risk. As long as the bottom numbers in the fractions (as in this case, 1000) are the same, the larger the top number, the larger the risk.

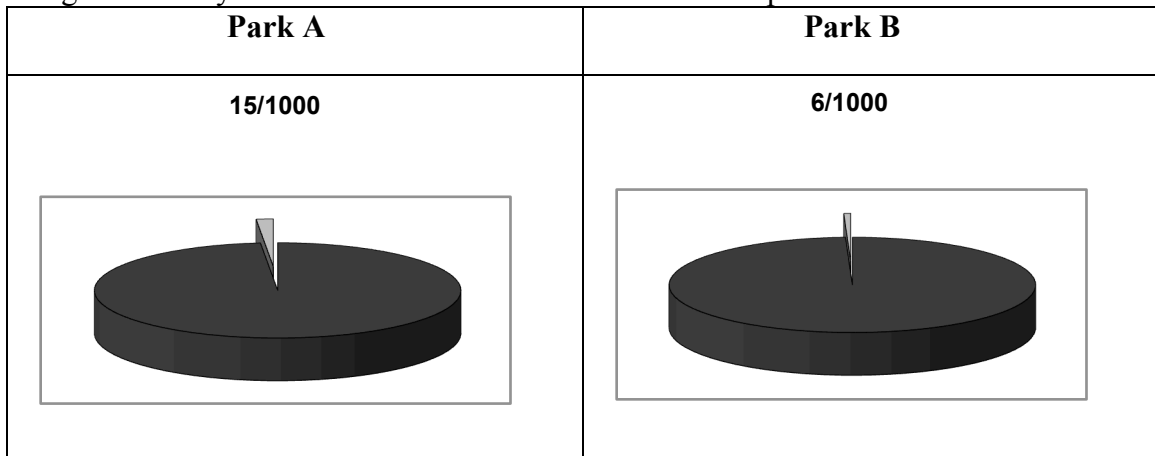
1) The following charts represent the risk (in number of accidents out of 1000) of being involved in a fatal car crash in two different types of car.

Car A	Car B
--------------	--------------



Which car poses the greatest risk? _____

2) The following charts represent the risk (in number of park visitors out of 1000) of being attacked by a mountain lion in two different national parks.



Which park poses the greater risk? _____

1) The correct answer is A. The top number for A (150) is greater than the top number for B (60).

2) The correct answer is A. The top number for A (15) is greater than the top number for B (6).

Section 5 → This section contains a choice task for you to complete. We have listed below some important information, which you may or may not be aware of, about nitrate in water. Please read this information before you continue.

- ✓ Your community is one of many in Colorado that is at risk for nitrate contamination of its drinking water.
- ✓ Both public water supplies and private wells can be affected.
- ✓ Because infants do not have fully developed digestive systems, drinking nitrate contaminated water can have negative effects on infants' health, but it will not affect adults.

- ✓ Consuming nitrate contaminated drinking water places infants at risk for a condition called “blue baby syndrome” that is caused by depleting the oxygen in the blood.
- ✓ Symptoms of “blue baby syndrome” include a bluish tint to the infant’s skin, shortness of breath, shock, brain damage, coma, and death.
- ✓ Using bottled water or water that has had the nitrate removed to prepare formula will eliminate negative health effects caused by nitrate contaminated drinking water for infants, but will not reduce risks from other sources.

What follows is some information concerning different choices you have to reduce health risks to infants associated with exposure to nitrate contamination of drinking water. Please read through the following information and for each pair of options, choose the option that you feel is best.

Options for Preparing Infant Formula

Option A

Use tap water

Option B

Use bottled water

**Option B may have other potential benefits in addition to reducing exposure to nitrate.*

Effects of Over-exposure to Nitrate Contaminated Drinking Water

<u>Cost</u>	<u>Risk of Temporary Shock</u>	<u>Risk of Permanent Brain Damage</u>	<u>Risk of Death</u>
Total, one-time cost of the option in dollars	Risk of infant experiencing decrease in blood pressure and a weak, rapid pulse	Risk of infant experiencing damage to the brain	Risk of infant dying

In the packet containing this survey, you were also given a voucher for \$____. In the next part of the survey you will be asked whether you would purchase or not purchase various amounts of bottled water. This water would help to reduce your infant’s exposure to water with excessive levels of nitrate.

If you purchased the water, the health risks to your child from nitrate contaminated drinking water (as well as other potential drinking water contaminants) would be reduced. The amount by which these risks would go down for a given amount of water is presented on the sheet for each choice. Purchasing the bottled water would not reduce risks to your child to zero because she would still face all of the normal risks that do not come from drinking contaminated water.

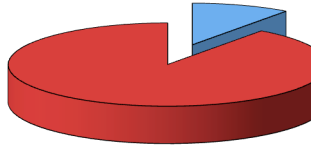
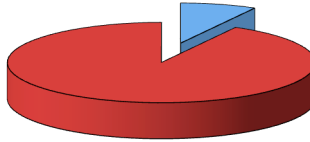
If you would not purchase the water, your child would continue to face the risks associated with drinking contaminated water (either by drinking the water by itself or by drinking formula that was prepared with contaminated water). The total risk that your child would face if you chose not to purchase the water is also presented on the sheet for each choice.

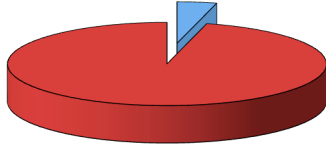
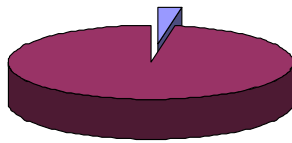
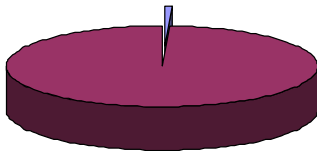
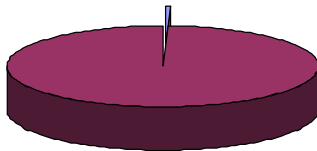
You will be asked to make 4 choices in total. Choosing between Option A and Option B will allow you to either: actually purchase bottled water for your infant using money provided by Colorado State University or keep the money that it would take to purchase the water.

At this time, look over the voucher that was attached to your survey. You will see that it is good for a dollar amount that matches the highest cost given for bottled water on the four choice tasks. Once you have completed the survey, send the completed survey along with the signed voucher back to us in the self-addressed postage-paid envelope that we have provided. Once we have received the surveys and vouchers back, we will randomly select one of your four choices between A and B in Section 5. If on that particular task you chose “Do Nothing,” you will receive a check for the full amount listed on the voucher. If, on the other hand, you chose “Purchase Bottled Water,” you will receive a pre-paid punch-card to obtain the bottled water from a local grocery store. If the value of the punch-card is **less** than the dollar amount given on the voucher, you will be sent a check for the difference.

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

*Risk information is presented in the number of infants in your community out of 1,000 who will be affected.

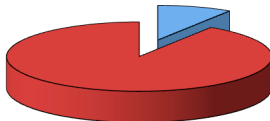
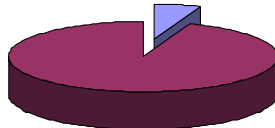
Effects	Option A Do Nothing	Option B Buy Bottled Water for an Infant in Your Household
Cost	\$0	\$300
Risk of Temporary Shock*	100/1000 	80/1000 

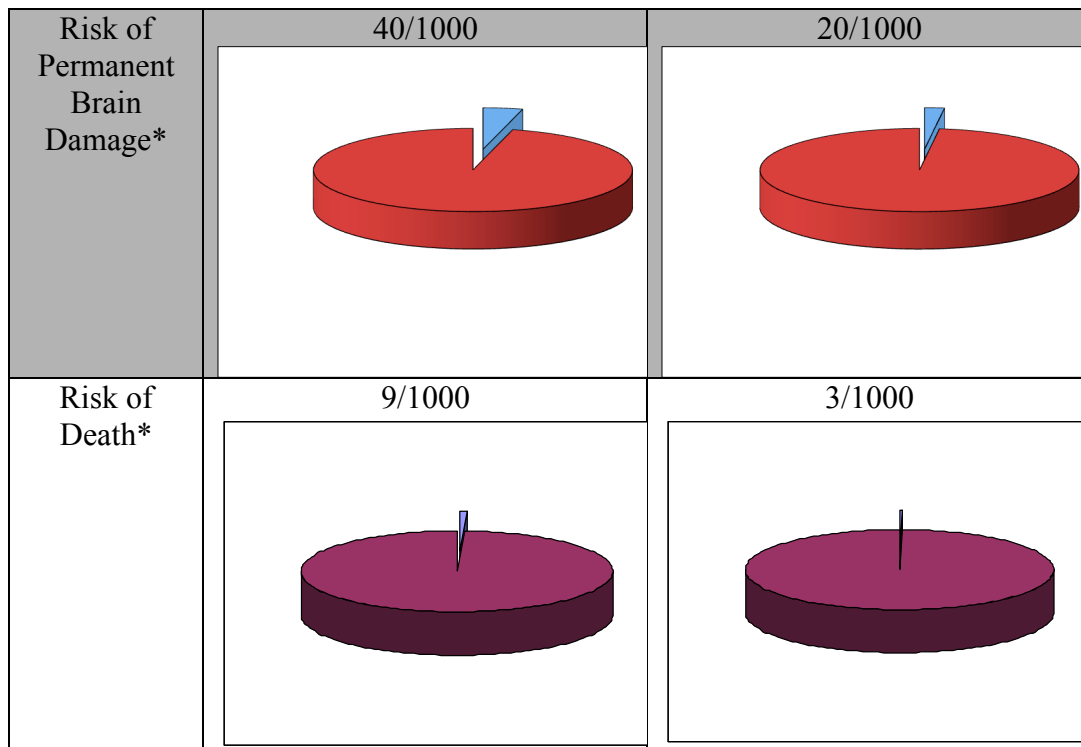
Risk of Permanent Brain Damage*	40/1000	30/1000
		
Risk of Death*	9/1000	6/1000
		

Which option do you choose? _____
Why did you choose that option?

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

*Risk information is presented in the number of children in your community out of 1,000 who will be affected.

Effects	Option A Do Nothing	Option B Buy Bottled Water for an in Your Household
Cost	\$0	\$450
Risk of Temporary Shock*	100/1000 	60/1000 

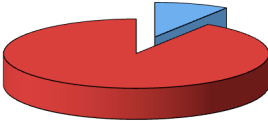
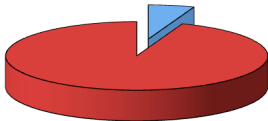
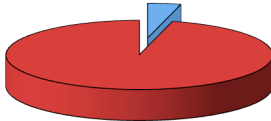
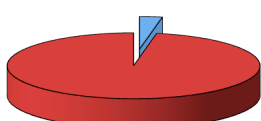
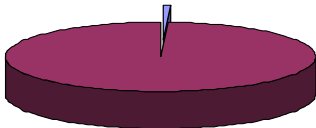
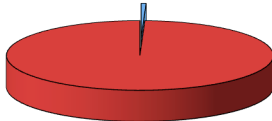


Which option do you choose? _____
 Why did you choose that option?

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

*Risk information is presented in the number of children in your community out of 1,000 who will be affected.

Effects	Option A Do Nothing	Option B Buy Bottled Water for an Infant in Your Household
Cost	\$0	\$400
Risk of Temporary Shock*	100/1000	60/1000

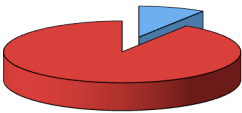
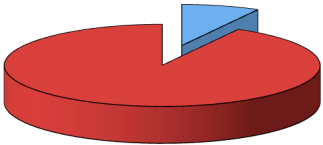
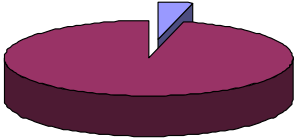
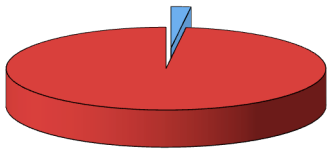
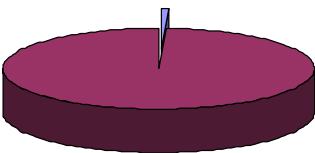
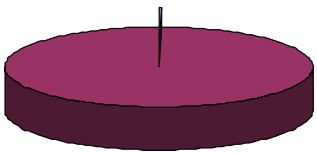
		
	40/1000	30/1000
Risk of Permanent Brain Damage*		
	40/1000	30/1000
Risk of Death*		
	9/1000	6/1000

Which option do you choose? _____
Why did you choose that option?

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

*Risk information is presented in the number of children in your community out of 1,000 who will be affected.

Effects	Option A Do Nothing	Option B Buy Bottled Water for an Infant in Your Household
Cost	\$0	\$500
Risk of	100/1000	80/1000

Temporary Shock*		
Risk of Permanent Brain Damage*	40/1000 	20/1000 
Risk of Death*	9/1000 	3/1000 

Which option do you choose? _____
Why did you choose that option?

Section 5 → This section asks for some general demographic information.

1) Age _____

2) What is your gender? ☐ Male ☐ Female

3) Occupation _____

4) Number of Years of Schooling: _____

5) Ethnicity (Check all that apply)

- ☐ African American
- ☐ American Indian
- ☐ Asian American
- ☐ European American
- ☐ Hispanic/Latino
- ☐ Native Hawaiian/Pacific Islander
- ☐ Other (_____)

6) Do any of your children (under the age of 18) live in your community?

- ☐ Yes
- ☐ No
- ☐ I have no children.

7) Do any of your grandchildren (under the age of 18) live in your community?

- ☐ Yes
- ☐ No
- ☐ I have no grandchildren.

8) Do any of your nieces or nephews (under the age of 18) live in your community?

- ☐ Yes
- ☐ No
- ☐ I have no nieces or nephews.

9) Yearly Household Income from all Sources

- ☐ \$0 - \$10,000
- ☐ \$10,001 - \$20,000
- ☐ \$20,001 - \$30,000
- ☐ \$30,001 - \$40,000
- ☐ \$40,001 - \$50,000
- ☐ \$50,001 +

A.3.2 Non Consequential Survey Instrument

The following is the non-consequential or hypothetical instrument in which respondents did not have an opportunity cost of giving a certain amount to pay for bottled water:

Section 1 → This section asks some general questions about you and your drinking water.

Note: "Tap water" means water that comes out of the faucet in you kitchen.

1) How long have you lived in _____ County, Colorado? _____

2) a) Overall, how would you rate the taste of your tap water?

- ☐ Poor
- ☐ Below Average
- ☐ Average
- ☐ Above Average
- ☐ Excellent

e) Overall, how would you rate the smell of your tap water?

- ☐ Strong unpleasant smell ☐ Somewhat unpleasant smell
- ☐ Noticeable smell ☐ No smell

f) Overall, how would you rate the appearance of your tap water?

- ☐ Colored (brown, red, yellow) ☐ Very Cloudy ☐ Cloudy ☐ Slightly cloudy
- ☐ Normal appearance

g) Overall, how would you rate the safety of your tap water?

- ☐ Poor ☐ Below Average ☐ Average ☐ Above Average ☐ Excellent
- ☐ Don't Know

4) List any problems that you think your tap water has.

4) Do you use a water filter system at home to purify your tap water? ☐ Always

- ☐ Often ☐ Sometimes ☐ Never (Go to question 5)

If you use a filter system in your home, what type is it?

- ☐ Filter Pitcher ☐ Faucet Mounted ☐ Under-sink ☐ Refrigerator

5) How much money do you spend on each of the following over the course of a typical month?

Bottled Water (for use at home only)

- ☐ None ☐ \$1-\$10 ☐ \$11-24 ☐ \$25-\$49 ☐ \$50 or more

Filter System at home (maintenance or replacement filters)

- ☐ No System ☐ Less than \$25 ☐ More than \$25

6) Does the water in your home come from a well on your property?

- ☐ Yes ☐ No (if "No" skip to question 7)

6a) Do you have your well water tested?

- ☐ Yes ☐ No (if "No" skip to question 7)

6b) How often do you have your well-water tested?

- ☐ Once a year ☐ Once every two years ☐ Every five years

6c) Does your well water meet standards when tested?

- ☐ Yes ☐ No

7) Check any of the items below that you think can be a source of nitrate contamination in drinking water.

- ☐ Fertilizer Runoff ☐ Natural Deposits ☐ Decaying Plant Matter

- ☐ Fossil Fuels ☐ Sewage ☐ Landfill Runoff
- ☐ Steel Factories ☐ Discharge from Coal-burning Factories
- ☐ Leaching from Ore-processing Sites ☐ Leaching from Septic Tanks

8) Check any of the items that you think can help you avoid drinking water with high levels of nitrate.

- ☐ Under-sink Filter ☐ Faucet-mounted Filter ☐ Filter Pitcher (e.g., Brita™ filters)
- ☐ Bottled Water ☐ Boiling Tap Water

9) Have you heard about the quality of your community's drinking water?

- ☐ Yes ☐ No

10) Do you read the water quality information included in your water bill? ☐

- Always ☐ Sometimes ☐ Never ☐ Don't receive a water bill

11) Do you prepare formula for an infant (a child under one year old)?

- ☐ Yes ☐ No (if "No" skip to question 12)

11a) How old is the infant? _____

11b) Do you use bottled water to prepare infant formula?

- ☐ Always ☐ Often ☐ Sometimes ☐ Never

12) Have you or a woman in your household been pregnant in the last three years?

- ☐ Yes ☐ No (if "No" skip to question 13)

12a) While pregnant, how often did you or a woman in your household buy bottled water to drink at home?

- ☐ Always ☐ Often ☐ Sometimes ☐ Never

12b) While nursing, how often did you or a woman in your household buy bottled water to drink at home?

- ☐ Always ☐ Often ☐ Sometimes ☐ Never ☐ Didn't Nurse

13) Do you have health insurance?

- ☐ Yes ☐ No (If no, skip to question 14)

13a) Does your insurance cover emergency room care?

- ☐ Yes ☐ No

13b) Is your family (spouse and/or children) covered?

- ☐ Yes ☐ No

14) If you have children, how much does a visit to the doctor for your child usually cost you?

- ☐ \$0 ☐ \$5 - \$20 ☐ \$21 - \$30 ☐ \$31 - \$50 ☐ \$51 - \$70

○ \$71 - \$90 ○ \$91 - \$100 ○ \$100 +

14a) Does an adult in your household have to miss work in order to take a child to the doctor or hospital?

○ Yes ○ No

Section 2 → This section asks about your beliefs regarding infants' health (consider infants to be children under 1 year of age).

Please check the box corresponding to your responses for questions 1 through 17.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1) If drinking water is safe for adults, it is also safe for infants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) If infants consume water contaminated with nitrate, it can be harmful to their health.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) If adults consume water contaminated with nitrate, it can be harmful to their health.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) It is natural for infants to become ill more often than adults.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) The infants in my community are never ill due to pollution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) My friends and family are concerned with infants' health issues.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) The parents I know are worried about the health of their infants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8) It is possible to reduce the exposure infants have to pollution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9) It is possible to prevent infants from becoming seriously ill due to environmentally caused illnesses.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10) Only people with infants living in their home need to be concerned about pollution.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11) Parents, not the public, have the sole responsibility for protecting their infants from harm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
12) More state and community resources need to be devoted to	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

infant health issues.					
13) There is too much emphasis placed on issues regarding infants' health.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<i>If you are NOT currently caring for an infant, skip to question 1 of Section 3.</i>					
14) My infant(s) are not exposed to dangerous environmental contaminants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
15) I can ensure that my infant(s) do not become ill due to environmental contaminants.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
16) I can afford to take my infant(s) to the doctor when they are ill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
17) I can prevent my infant(s) from becoming seriously ill.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

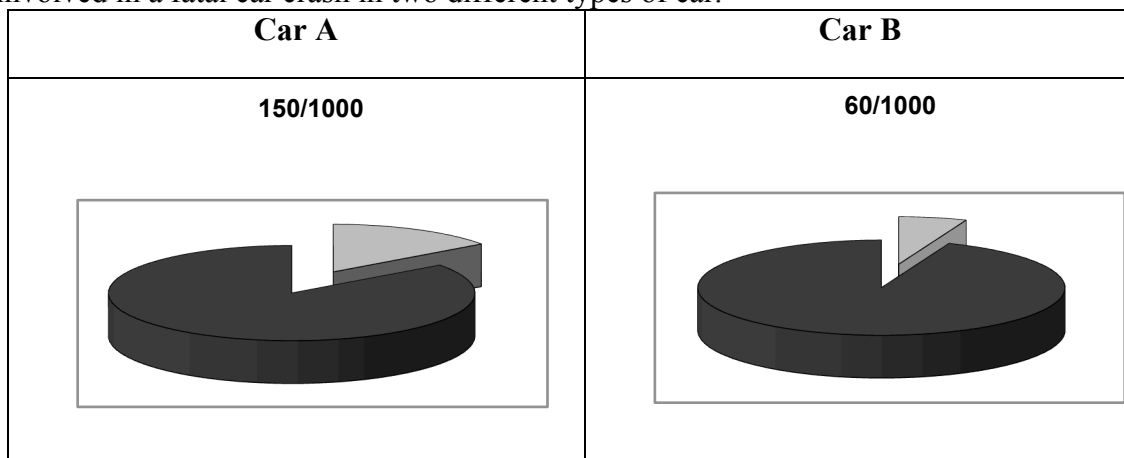
Section 3 → This section asks what you think about the quality of your drinking water. Please fill in the bubble corresponding to your responses for questions 1 through 7.

	Strongly Agree	Agree	Don't Know	Disagree	Strongly Disagree
1) My community has safe drinking water.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2) My home's drinking water (straight from the faucet) does not have unsafe levels of nitrate.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3) My friends and family are worried about our drinking water.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4) Most of the people I know would take steps to ensure that their drinking water is safe.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5) Nitrate in drinking water is an unavoidable occurrence.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6) It is important to me to test the quality of my home's drinking water.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7) It is the government's responsibility to ensure that my drinking water is safe.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Section 4 → We are now going to illustrate some risk information for you to help you get used to the way in which risk information is presented as pie charts. Please read the information and then choose which chart represents the greatest risk.

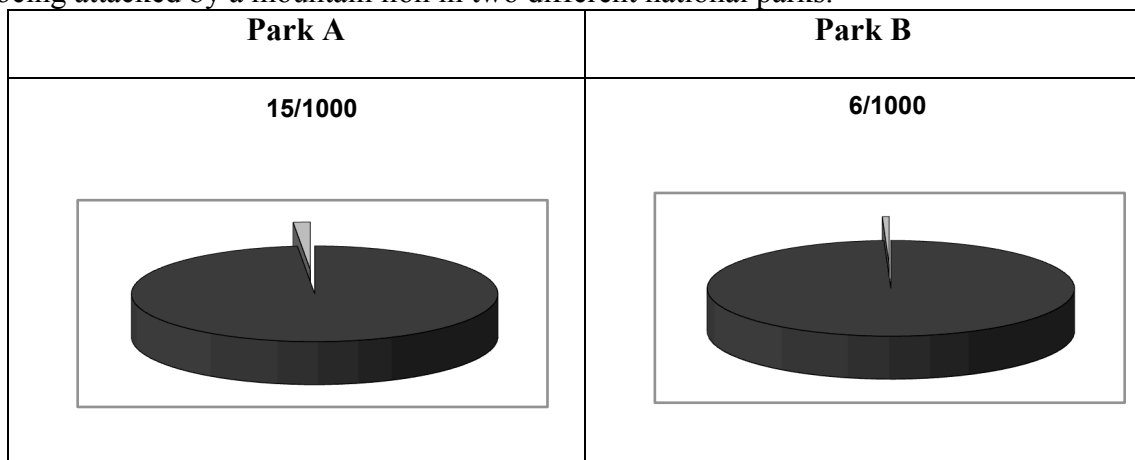
In the first example, the gray pie wedge represents the fraction or proportion of 1000 accidents which involve Car A and Car B. The larger the gray slice, the greater the risk. As long as the bottom numbers in the fractions (as in this case, 1000) are the same, the larger the top number, the larger the risk.

1) The following charts represent the risk (in number of accidents out of 1000) of being involved in a fatal car crash in two different types of car.



Which car poses the greatest risk? _____

2) The following charts represent the risk (in number of park visitors out of 1000) of being attacked by a mountain lion in two different national parks.



Which park poses the greater risk? _____

1) The correct answer is A. The top number for A (150) is greater than the top number for B (60).

2) The correct answer is A. The top number for A (15) is greater than the top number for B (6).

Section 5 → This section contains a choice task for you to complete. We have listed below some important information, which you may or may not be aware of, about nitrate in water. Please read this information before you continue.

- ✓ Your community is one of many in Colorado that is at risk for nitrate contamination of its drinking water.
- ✓ Both public water supplies and private wells can be affected.
- ✓ Because infants do not have fully developed digestive systems, drinking nitrate contaminated water can have negative effects on infants' health, but it will not affect adults.
- ✓ Consuming nitrate contaminated drinking water places infants at risk for a condition called "blue baby syndrome" that is caused by depleting the oxygen in the blood.
- ✓ Symptoms of "blue baby syndrome" include a bluish tint to the infant's skin, shortness of breath, shock, brain damage, coma, and death.
- ✓ Using bottled water or water that has had the nitrate removed to prepare formula will eliminate negative health effects caused by nitrate contaminated drinking water for infants, but will not reduce risks from other sources.

What follows is some information concerning different choices you have to reduce health risks to infants associated with exposure to nitrate contamination of drinking water. Please read through the following information and for each pair of options, choose the option that you feel is best.

Options for Preparing Infant Formula

Option A

Use tap water

Option B

Use bottled water

**Option B may have other potential benefits in addition to reducing exposure to nitrate.*

Effects of Over-exposure to Nitrate Contaminated Drinking Water

<u>Cost</u>	<u>Risk of Temporary Shock</u>	<u>Risk of Permanent Brain Damage</u>	<u>Risk of Death</u>
Total, one-time cost of the option in dollars	Risk of infant experiencing decrease in blood pressure and a weak, rapid pulse	Risk of infant experiencing damage to the brain	Risk of infant dying

In the next part of the survey you will be asked whether you would purchase or not purchase various amounts of bottled water. This water would help to reduce your infant's exposure to water with excessive levels of nitrate.

If you purchased the water, the health risks to your child from nitrate contaminated drinking water (as well as other potential drinking water contaminants) would be reduced. The amount by which these risks would go down for a given amount of water is presented on the sheet for each choice. Purchasing the bottled water would not reduce risks to your child to zero because she would still face all of the normal risks that do not come from drinking contaminated water.

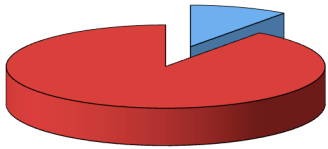
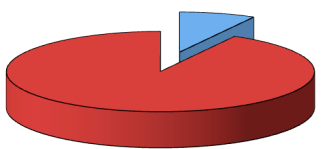
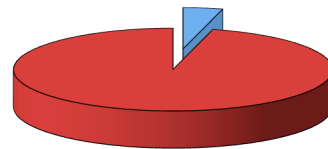
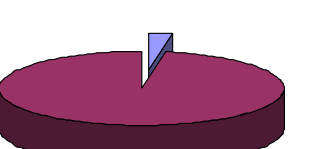
If you would not purchase the water, your child would continue to face the risks associated with drinking contaminated water (either by drinking the water by itself or by

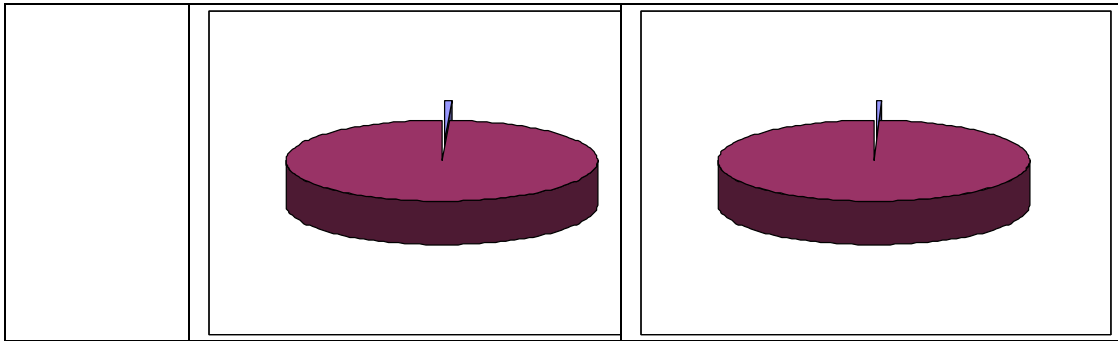
drinking formula that was prepared with contaminated water). The total risk that your child would face if you chose not to purchase the water is also presented on the sheet for each choice.

You will be asked to make 4 choices in total.

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

*Risk information is presented in the number of infants in your community out of 1,000 who will be affected.

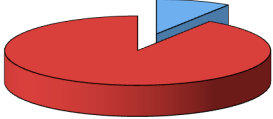
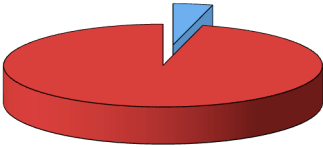
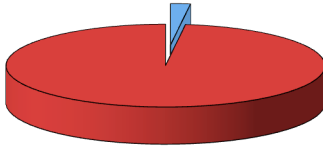
Effects	Option A Do Nothing	Option B Buy Bottled Water for an Infant in Your Household
Cost	\$0	\$300
Risk of Temporary Shock*	100/1000 	80/1000 
Risk of Permanent Brain Damage*	40/1000 	30/1000 
Risk of Death*	9/1000	6/1000

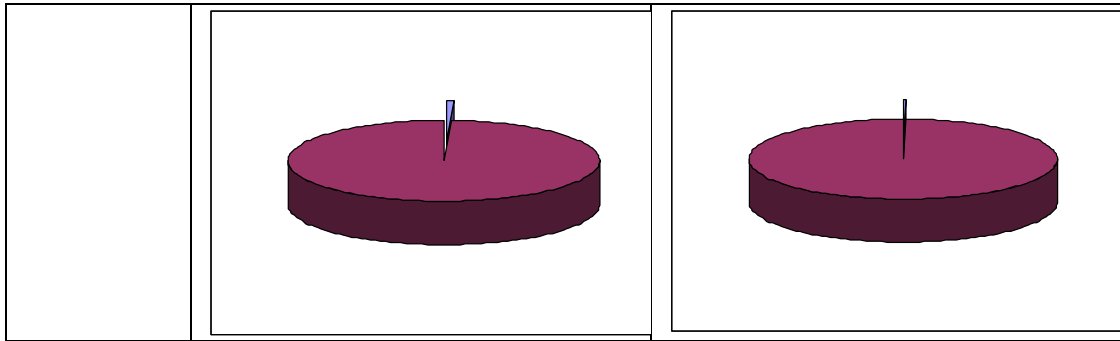


Which option do you choose? _____
 Why did you choose that option? _____

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

*Risk information is presented in the number of children in your community out of 1,000 who will be affected.

Effects	Option A Do Nothing	Option B Buy Bottled Water for an in Your Household
Cost	\$0	\$450
Risk of Temporary Shock*	100/1000 	60/1000 
Risk of Permanent Brain Damage*	40/1000 	20/1000 
Risk of Death*	9/1000	3/1000

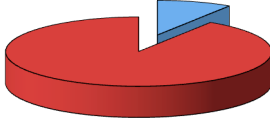
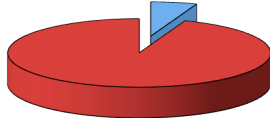
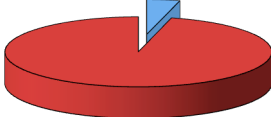
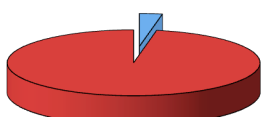


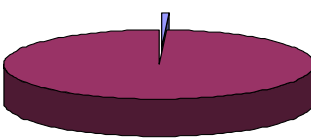
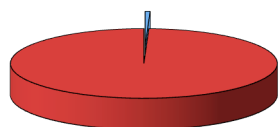
Which option do you choose? _____

Why did you choose that option?

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.

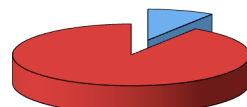
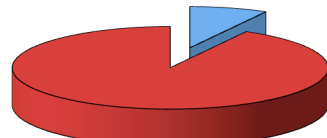
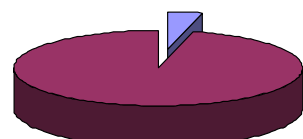
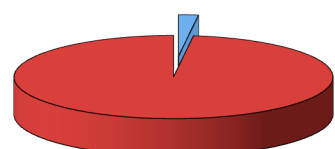
*Risk information is presented in the number of children in your community out of 1,000 who will be affected.

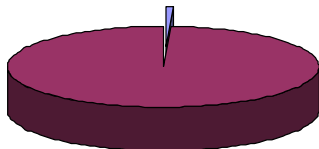
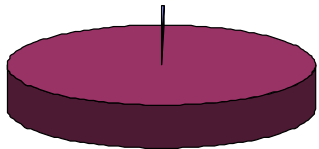
Effects	Option A Do Nothing	Option B Buy Bottled Water for an Infant in Your Household
Cost	\$0	\$400
Risk of Temporary Shock*	100/1000 	60/1000 
Risk of Permanent Brain Damage*	40/1000 	30/1000 
Risk of	9/1000	6/1000

Death*		
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Which option do you choose? _____
Why did you choose that option?

For this task, we want you to compare Option A to Option B and choose the option you would actually pick if you had to pay the cost shown.
*Risk information is presented in the number of children in your community out of 1,000 who will be affected.

Effects	Option A Do Nothing	Option B Buy Bottled Water for an Infant in Your Household
Cost	\$0	\$500
Risk of Temporary Shock*	100/1000 	80/1000 
Risk of Permanent Brain Damage*	40/1000 	20/1000 
Risk of	9/1000	3/1000

Death*		
--------	---	---

Which option do you choose? _____

Why did you choose that option?

Section 5 → This section asks for some general demographic information.

1) Age _____

2) What is your gender? ☐ Male ☐ Female

3) Occupation _____

4) Number of Years of Schooling: _____

5) Ethnicity (Check all that apply)

☐ African American

☐ American Indian

☐ Asian American

☐ European American

☐ Hispanic/Latino

☐ Native Hawaiian/Pacific Islander

☐ Other (_____)

6) Do any of your children (under the age of 18) live in your community?

☐ Yes

☐ No

☐ I have no children.

7) Do any of your grandchildren (under the age of 18) live in your community?

☐ Yes

☐ No

☐ I have no grandchildren.

8) Do any of your nieces or nephews (under the age of 18) live in your community?

☐ Yes

☐ No

☐ I have no nieces or nephews.

9) Yearly Household Income from all Sources

- ☐ \$0 - \$10,000 ☐ \$10,001 - \$20,000 ☐ \$20,001 - \$30,000 ☐ \$30,001 - \$40,000 ☐ \$40,001 - \$50,000 ☐ \$50,001 +

Appendix Chapter 5

Four treatments were created and used for the study in chapter 5. Meningococcal disease HPV both had a individual and community treatment.

A.5.1 Meningococcal Disease Individual Treatment

Campus Vaccination Programs:

The Case of Meningococcal Disease



TELL US WHAT YOU THINK!

**Colorado
State
University**
Department of Economics

Part 1 – Information about meningococcal disease

Please read the following information, which may affect how you answer the questions in this survey.

Who gets it?

Meningococcal disease has been the cause of death for four people in Fort Collins and one in Denver during 2011, with many more hospitalized.

- College students, especially freshmen are more susceptible to meningococcal disease, mainly due to behavior.
- Meningococcal disease is not transferred through the air, but through direct contact with a carrier of the disease, mainly through saliva.
- College students' lifestyle includes very close contact with others and sharing of items that may contain saliva.
- Although many types of meningococcal disease exist, meningococcal sepsis has been thought to be the cause of the deaths and hospitalizations in Fort Collins.

How is it dangerous?

Meningococcal disease is a very dangerous disease with high mortality rates.

- There are approximately 2,600 cases of meningococcal disease per year in the United States on average.
- Even with antibiotics, approximately 1 in 10 victims of meningococcal meningitis will die
- Another 40% of survivors lose a limb or their hearing, or suffer permanent brain damage.
- Within hours, a patient's health can change from seemingly good to mortally ill
- 40% of patients with meningococcal sepsis will die, the variety seen in the current Colorado State University epidemic

How to avoid meningococcal disease?

Because of the high mortality rate even with proper treatment, the best strategy toward meningococcal disease is vaccination.

- A vaccine for meningococcal disease has been approved by the Food and Drug Administration (FDA) and available since 1981.
- This vaccine can prevent 2 of the 3 most commonly occurring strains in the US.
- The vaccine can reduce the incidence of infection, hospitalization, and death by nearly 70%
- A booster of the vaccine is recommended every 2-4 years

Who can get the vaccine?

- Anyone over the age of 2 can receive the vaccine.

Is the vaccine risky?

- Up to about half of people who get meningococcal vaccines have mild side effects, such as redness or pain where the shot was given. These symptoms usually last for one or two days. A small percentage of people who receive the vaccine develop a fever.
- Severe reactions, such as a serious allergic reaction, are very rare.
- A nervous system disorder called Guillain-Barré Syndrome has been reported. However, this happens so infrequently that it is currently not possible to tell if the vaccine might be a factor.

Part 2 – Questions about your experience and belief

1. Have you ever been diagnosed with meningococcal disease?

☐ Yes ☐ No

2. To your knowledge, have any of your close friends or family members ever been diagnosed with meningococcal disease?

☐ Yes ☐ No

3. Prior to reading the information in this survey, were you familiar with meningococcal disease?

☐ Yes ☐ No

4. The meningococcal disease vaccination is not part of the routine set of vaccinations in the US and is not required by the University. Have you ever received a meningococcal disease vaccination?

☐ Yes ☐ No

Keeping in mind the information you have just read, please check the box corresponding to how you agree or disagree with statements 5 through 8

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. I believe that I am susceptible to contracting meningococcal disease					
6. I generally believe that vaccines are safe					
7. I believe it is important for the Colorado State University community to be vaccinated for meningococcal disease					
8. I believe the spread of meningococcal disease is primarily due to socially unacceptable sexual					

behavior					
----------	--	--	--	--	--

A number of campus-wide programs, including some health services, are funded either through out-of-pocket fees paid by individuals, or by student fees paid by all students. We are interested in how highly you value a sample of campus-wide programs funded by student fees (which total \$31 million annually).

For items 9-13, please check the box corresponding to the importance you attach to each of the following campus-wide services:

	Very Important	Important	Somewhat Important	Not very Important	Not Important
9. Lory Student Center					
10. Rec Center					
11. Student Legal Services					
12. Conflict and Resolution Services					
13. Athletics					

Part 3 – Your response to a vaccination program proposal

Colorado State University, in response to the high number of meningococcal disease infections, introduced a program last year that provided vaccines for meningococcal disease free of charge for most students. Due to budget cuts, Colorado State University has to halt the program.

- The risk of death from meningococcal disease is 4 out of 10,000 without the vaccine.
- The risk of death decreases to 1 out of 10,000 when vaccinated.
- A choice of ‘Yes’ for questions 14 or 15 will decrease the risk of death from 4 out of 10,000 to 1 out of 10,000 for the vaccinated person.

14. Would you pay an out-of-pocket price of \$X to receive the vaccine yourself?

_____ Yes _____ No

15. However you responded to question 14, you also have the opportunity to contribute funds for other students to receive the vaccine. The cost of administering one vaccination is \$X. Would you be willing to donate, \$X out of your own pocket to provide the vaccine free of charge to another Colorado State University student?

_____ Yes _____ No

16. Do you believe that the majority of other Colorado State University students would be willing to donate \$X to allow other students to be vaccinated?

_____ Yes _____ No

Part 4 – Attitudes influencing your choices in the part 3

Please check the box corresponding to how you agree or disagree with statements 17 through 21.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
17. I want to protect myself from meningococcal disease					
18. I want others to be able to be protected against meningococcal disease					
19. It seems fair to me to contribute a fair share to help others be vaccinated					
20. We all should be committed to protecting the health and safety of the CSU community					
21. CSU students deserve protection against meningococcal disease					

Part 5 – Other questions

For statistical purposes, this section will ask some confidential demographic information.

22. What is your gender?

_____ Female _____ Male

23. What is your age? _____

24. How would you categorize your race/ethnicity?

- _____ Black or African American
- _____ Asian or Asian American
- _____ Hispanic or Latino
- _____ White or Caucasian
- _____ Other

25. Do you live in a college dormitory?

_____ Yes _____ No

26. Are you married or do you have a household partner with whom you share financial responsibility?

_____ Yes _____ No

Please check the box corresponding to how you agree or disagree with statements 27 through 29.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
27. I pay for CSU tuition out of my own pocket					
28. I pay for student fees out of my own pocket					
29. I pay for living expenses out of my own pocket					

30. In which range is your parent's annual household income?

_____ Under \$10,000
_____ \$10,000 - \$19,999
_____ \$20,000 - \$49,999
_____ \$50,000 - \$99,999
_____ Over \$100,000

31. In which range is your annual personal income (without any contribution from parents)?

_____ Under \$10,000
_____ \$10,000 - \$19,999
_____ \$20,000 - \$49,999
_____ \$50,000 - \$99,999
_____ Over \$100,000

THANK YOU!

A.5.2 Meningococcal Disease Community Treatment

Part 1 – Information about meningococcal disease

Please read the following information, which may affect how you answer the questions in this survey.

Who gets it?

Meningococcal disease has been the cause of death for four people in Fort Collins and one in Denver during 2011, with many more hospitalized.

- College students, especially freshmen are more susceptible to meningococcal disease, mainly due to behavior.
- Meningococcal disease is not transferred through the air, but through direct contact with a carrier of the disease, mainly through saliva.
- College students' lifestyle includes very close contact with others and sharing of items that may contain saliva.
- Although many types of meningococcal disease exist, meningococcal sepsis has been thought to be the cause of the deaths and hospitalizations in Fort Collins.

How is it dangerous?

Meningococcal disease is a very dangerous disease with high mortality rates.

- There are approximately 2,600 cases of meningococcal disease per year in the United States on average.
- Even with antibiotics, approximately 1 in 10 victims of meningococcal meningitis will die
- Another 40% of survivors lose a limb or their hearing, or suffer permanent brain damage.
- Within hours, a patient's health can change from seemingly good to mortally ill
- 40% of patients with meningococcal sepsis will die, the variety seen in the current Colorado State University epidemic

How to avoid meningococcal disease?

Because of the high mortality rate even with proper treatment, the best strategy toward meningococcal disease is vaccination.

- A vaccine for meningococcal disease has been approved by the Food and Drug Administration (FDA) and available since 1981.
- This vaccine can prevent 2 of the 3 most commonly occurring strains in the US.
- The vaccine can reduce the incidence of infection, hospitalization, and death by nearly 70%
- A booster of the vaccine is recommended every 2-4 years

Who can get the vaccine?

- Anyone over the age of 2 can receive the vaccine.

Is the vaccine risky?

- Up to about half of people who get meningococcal vaccines have mild side effects, such as redness or pain where the shot was given. These symptoms

usually last for one or two days. A small percentage of people who receive the vaccine develop a fever.

- Severe reactions, such as a serious allergic reaction, are very rare.
- A nervous system disorder called Guillain-Barré Syndrome has been reported. However, this happens so infrequently that it is currently not possible to tell if the vaccine might be a factor

Part 2 – Questions about your experience and beliefs

1. Have you ever been diagnosed with meningococcal disease?

_____ Yes _____ No

2. To your knowledge, have any of your close friends or family members ever been diagnosed with meningococcal disease?

_____ Yes _____ No

3. Prior to reading the information in this survey, were you familiar with meningococcal disease?

_____ Yes _____ No

4. The meningococcal disease vaccination is not part of the routine set of vaccinations in the US and is not required by the University. Have you ever received a meningococcal disease vaccination?

_____ Yes _____ No

Keeping in mind the information you have just read, please check the box corresponding to how you agree or disagree with statements 5 through 8

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. I believe that I am susceptible to contracting meningococcal disease					
6. I generally believe that vaccines are safe					
7. I believe it is important for the Colorado State University community to be vaccinated for meningococcal disease					
8. I believe the spread of meningococcal disease is primarily due to socially unacceptable sexual behavior					

A number of campus-wide programs, including some health services, are funded either through out-of-pocket fees paid by individuals, or by student fees paid by all students. We are interested in how highly you value a sample of campus-wide programs funded by student fees (which total \$31 million annually).

For items 9-13, please check the box corresponding to the importance you attach to each of the following campus-wide services:

	Very Important	Important	Somewhat Important	Not very Important	Not Important
9. Lory Student Center					
10. Rec Center					
11. Student Legal Services					
12. Conflict and Resolution Services					
13. Athletics					

Part 3 – Your response to a vaccination program proposal

Colorado State University, in response to the high number of meningococcal disease infections, introduced a program last year that provided vaccines for meningococcal disease free of charge for most students. Due to budget cuts, Colorado State University has to halt the program and two new proposals have been initiated to replace the previous program. You will be asked a question about each proposal.

- The risk of death from meningococcal disease is 4 out of 10,000 without the vaccine.
- The risk of death decreases to 1 out of 10,000 when vaccinated.
- If either proposal passes, the risk of death will decrease from 4 out of 10,000 to 1 out of 10,000 for those vaccinated.

Proposal 1: An increase in all students' semester fees by \$X to have the vaccine available for all students.

- The program will be funded by a *new special student fee*
- The costs of the program would have to be paid by you and other Colorado State University students.
- Because you would be paying \$X in additional student fees for the program, it would *reduce the amount of available money for spending on your personal consumption.*

14. Would you vote for the proposed increase in your semester students fees of \$X to have the vaccine available for all Colorado State University students?

_____ Yes

_____ No

15. Do you believe that the majority of Colorado State University students would be willing to vote in favor of Proposal 1?

_____ Yes

_____ No

Proposal 2: A reallocation of existing students fees, amounting to \$X per student, away from other student services (rec center, classroom services, etc.) to fund the availability of the vaccine free for all Colorado State University students.

- *The program will not increase your student fees*
- Payments for the program will be in the form of a reallocation of your student fees from other student services (for example, reallocation of fees from the Lory Student Center, Campus Recreation Center, University Facility Fee, Student Legal Services, Conflict and Resolution, Athletics, etc.).
- Thus, paying for the program would *reduce the amount of other student services that are currently available.*

16. Would you vote for this reallocation of student fees that would provide vaccinations for all students at the cost of other student services?

_____ Yes

_____ No

17. Do you believe that the majority of Colorado State University students would be willing to vote in favor of Proposal 2?

_____ Yes

_____ No

Part 4 – Attitudes influencing your choices in Part 3

Please check the box corresponding to how you agree or disagree with statements 17 through 21.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
17. I want to protect myself from meningococcal disease					
18. I want others to be able to be protected against meningococcal disease					
19. It seems fair to me to contribute a fair share to help others be vaccinated					
20. We all should be					

committed to protecting the health and safety of the CSU community					
21. CSU students deserve protection against meningococcal disease					

Part 5 – Other questions

For statistical purposes, this section will ask some confidential demographic information.

22. What is your gender?

☐ Female ☐ Male

23. What is your age? _____

24. How would you categorize your race/ethnicity?

- ☐ Black or African American
- ☐ Asian or Asian American
- ☐ Hispanic or Latino
- ☐ White or Caucasian
- ☐ Other

25. Do you live in a college dormitory?

☐ Yes ☐ No

26. Are you married or do you have a household partner with whom you share financial responsibility?

☐ Yes ☐ No

Please check the box corresponding to how you agree or disagree with statements 27 through 29.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
27. I pay for CSU tuition out of my own pocket					
28. I pay for student fees out of my own pocket					
29. I pay for living expenses out of my own pocket					

30. In which range is your parent's annual household income?

- ___ Under \$10,000
- ___ \$10,000 - \$19,999
- ___ \$20,000 - \$49,999
- ___ \$50,000 - \$99,999
- ___ Over \$100,000

31. In which range is your annual personal income (without any contribution from parents)?

- ___ Under \$10,000
- ___ \$10,000 - \$19,999
- ___ \$20,000 - \$49,999
- ___ \$50,000 - \$99,999
- ___ Over \$100,000

THANK YOU!

A.5.3 HPV Individual Treatment

Part 1 – Information about HPV

Please read the following information, which may affect how you answer the questions in this survey.

Who gets HPV?

Human papillomavirus (HPV) is the most common sexually transmitted disease in America.

- 10% to 46% of all sexually active women are infected at any given point in time, with a potential lifetime risk of infection of 70% or greater.
- The infection rate for sexually active men is estimated to be 10% to 20%.
- Young adults, particularly college students, have been found to be at especially high risk of contracting HPV.

How is it dangerous?

HPV causes several types of secondary health risk.

- The key risk is cervical cancer in women. Nearly all cervical cancer cases have been tied to 'high risk' HPV types.
- Although high risk HPV does not cause cervical cancer in men, they can be carriers and infect future sexual partners.
- Genital warts and non-malignant lesions are found with HPV types labeled as 'low-risk' types.

- High-risk types of HPV have been well established as the most important causative factor of cervical cancer in women.
- Every year, around 12,000 women are diagnosed with cervical cancer and around 5,000 die from the disease.
- More than 700,000 cases of high-grade cervical dysplasia are detected every year in the United States, the precursor of cervical cancer.
- Cervical cancer accounts for almost 12% of all cancers in women, and so represents the second-most frequent gynecological malignancy in the world.

How to avoid HPV?

There are no known treatments for HPV, making prevention of HPV the key factor in the prevention of cervical cancer.

- Aside from abstaining from sexual activity, the only known guaranteed prevention is vaccination.
- On June 8, 2006, the U.S. Food and Drug Administration (FDA) approved the use of a vaccine to prevent infection from two types of 'high-risk' HPV.
- This vaccine prevents infection of about 70 percent of the cases of cervical cancer worldwide.
- Studies have shown that vaccines prevent nearly 100 percent of the precancerous cervical cell changes caused by the types of HPV.
- The vaccine has been proven effective for up to 4 years after vaccination among women who were not infected at the time of vaccination.

Who can get the vaccine?

- The vaccine is only approved for use in women ages 10-26.

Is vaccination risky?

The HPV vaccines work like other immunizations that guard against viral infection.

- Although these vaccines can help prevent HPV infection, they do not help eliminate existing HPV infections.
- Thus far, no serious side effects have been shown to be caused by the vaccines.
- The most common problems have been brief soreness and other local symptoms at the injection site. These problems are similar to ones commonly experienced with other vaccines.
- The vaccine has not been sufficiently tested during pregnancy and, therefore, should not be used by pregnant women.

Part 2 – Questions about your experience and beliefs

1. Have you ever been diagnosed with high risk HPV?

_____ Yes _____ No

2. To your knowledge, have any of your close friends or family members ever been diagnosed with high risk HPV?

_____ Yes _____ No

3. Prior to reading the information in this survey, were you familiar with high risk HPV and its link to cervical cancer?

_____ Yes _____ No

4. The HPV vaccine is not part of the routine set of vaccinations in the US and is not required by the University. Have you ever received a HPV vaccine?

_____ Yes _____ No

Keeping in mind the information you have just read, please check the box corresponding to how you agree or disagree with statements 5 through 8

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. I believe that I am susceptible to contracting high risk HPV.					
6. I generally believe that vaccines are safe.					
7. I believe it is important for the Colorado State University community to be vaccinated for high risk HPV.					
8. I believe the spread of high risk HPV is primarily due to socially unacceptable sexual behavior.					

A number of campus-wide programs, including some health services, are funded either through out-of-pocket fees paid by individuals, or by student fees paid by all students. We are interested in how highly you value a sample of campus-wide programs funded by student fees (which total \$31 million annually).

For items 9-13, please check the box corresponding to the importance you attach to each of the following campus-wide services:

	Very Important	Important	Somewhat Important	Not very Important	Not Important
9. Lory Student Center					
10. Rec Center					

11. Student Legal Services					
12. Conflict and Resolution Services					
13. Athletics					

Part 3 – Your response to a vaccination program proposal

Colorado State University has the HPV vaccine available at a set price for every willing female student currently enrolled at the university. This vaccine is administered at Hartshorn Health center for all willing female recipients.

Currently, Colorado State University has 13,526 female students, making up 51.3% of all enrolled students.

- The vaccine reduces the risk of being infected with high-risk types of HPV by 70% if previously uninfected.
- **A choice of ‘Yes’ for questions 14 or 15 will decrease the risk of cervical cancer by 70% in women vaccinated.**

If you are female answer question 14. **If you are male**, proceed to question 15.

14. Would you pay an out-of-pocket price of \$400 to receive the vaccine yourself?

_____ Yes _____ No

15. However you responded in question 14, you also have the opportunity to contribute funds for other students to receive the vaccine. The cost of administering one vaccination is \$400. Would you be willing to donate a one time out-of-pocket price of \$400 to provide the vaccine free of charge to another Colorado State University student who may not otherwise be vaccinated?

_____ Yes _____ No

16. Do you believe that the majority of Colorado State University students would be willing to donate \$400 to allow others to be vaccinated?

_____ Yes _____ No

Part 4 – Attitudes influencing your choices in Part 3

Please check the box corresponding to how you agree or disagree with statements 17 through 21.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
17. I want to protect myself from high risk.					

18. I want others to be able to be protected against high risk HPV					
19. It seems fair to me to contribute a fair share to help others be vaccinated.					
20. We all should be committed to protecting the health and safety of the CSU community.					
21. CSU students deserve protection against high risk HPV					

Part 5 – Other questions

For statistical purposes, this section will ask some confidential demographic information.

22. What is your gender?

☐ Female ☐ Male

23. What is your age? _____

24. How would you categorize your race/ethnicity?

- ☐ Black or African American
- ☐ Asian or Asian American
- ☐ Hispanic or Latino
- ☐ White or Caucasian
- ☐ Other

25. Do you live in a college dormitory?

☐ Yes ☐ No

26. Are you married or do you have a household partner with whom you share financial responsibility?

☐ Yes ☐ No

Please check the box corresponding to how you agree or disagree with statements 27 through 29.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
27. I pay for CSU tuition out of my own pocket					

28. I pay for student fees out of my own pocket					
29. I pay for living expenses out of my own pocket					

30. In which range is your parent's annual household income?

- ___ Under \$10,000
- ___ \$10,000 - \$19,999
- ___ \$20,000 - \$49,999
- ___ \$50,000 - \$99,999
- ___ Over \$100,000

31. In which range is your annual personal income (without any contribution from parents)?

- ___ Under \$10,000
- ___ \$10,000 - \$19,999
- ___ \$20,000 - \$49,999
- ___ \$50,000 - \$99,999
- ___ Over \$100,000

A.5.4 HPV Community Treatment

Part 1 – Information about HPV

Please read the following information, which may affect how you answer the questions in this survey.

Who gets HPV?

Human papillomavirus (HPV) is the most common sexually transmitted disease in America.

- 10% to 46% of all sexually active women are infected at any given point in time, with a potential lifetime risk of infection of 70% or greater.
- The infection rate for sexually active men is estimated to be 10% to 20%.
- Young adults, particularly college students, have been found to be at especially high risk of contracting HPV.

How is it dangerous?

HPV causes several types of secondary health risk.

- The key risk is cervical cancer in women. Nearly all cervical cancer cases have been tied to 'high risk' HPV types.
- Although high risk HPV does not cause cervical cancer in men, they can be carriers and infect future sexual partners.

- Genital warts and non-malignant lesions are found with HPV types labeled as 'low-risk' types.
- High-risk types of HPV have been well established as the most important causative factor of cervical cancer in women.
- Every year, around 12,000 women are diagnosed with cervical cancer and around 5,000 die from the disease.
- More than 700,000 cases of high-grade cervical dysplasia are detected every year in the United States, the precursor of cervical cancer.
- Cervical cancer accounts for almost 12% of all cancers in women, and so represents the second-most frequent gynecological malignancy in the world.

How to avoid HPV?

There are no known treatments for HPV, making prevention of HPV the key factor in the prevention of cervical cancer.

- Aside from abstaining from sexual activity, the only known guaranteed prevention is vaccination.
- On June 8, 2006, the U.S. Food and Drug Administration (FDA) approved the use of a vaccine to prevent infection from two types of 'high-risk' HPV.
- This vaccine prevents infection of about 70 percent of the cases of cervical cancer worldwide.
- Studies have shown that vaccines prevent nearly 100 percent of the precancerous cervical cell changes caused by the types of HPV.
- The vaccine has been proven effective for up to 4 years after vaccination among women who were not infected at the time of vaccination.

Who can get the vaccine?

- The vaccine is only approved for use in women ages 10-26.

Is vaccination risky?

The HPV vaccines work like other immunizations that guard against viral infection.

- Although these vaccines can help prevent HPV infection, they do not help eliminate existing HPV infections.
- Thus far, no serious side effects have been shown to be caused by the vaccines.
- The most common problems have been brief soreness and other local symptoms at the injection site. These problems are similar to ones commonly experienced with other vaccines.
- The vaccine has not been sufficiently tested during pregnancy and, therefore, should not be used by pregnant women.

Part 2 – Questions about your experience and beliefs

1. Have you ever been diagnosed with high risk HPV?
☐ Yes ☐ No

2. To your knowledge, have any of your close friends or family members ever been diagnosed with high risk HPV?
☐ Yes ☐ No

3. Prior to reading the information in this survey, were you familiar with high risk HPV and its link to cervical cancer?
☐ Yes ☐ No

4. The HPV vaccine is not part of the routine set of vaccinations in the US and is not required by the University. Have you ever received a HPV vaccine?
☐ Yes ☐ No

Keeping in mind the information you have just read, please check the box corresponding to how you agree or disagree with statements 5 through 8

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
5. I believe that I am susceptible to contracting high risk HPV.					
6. I generally believe that vaccines are safe.					
7. I believe it is important for the Colorado State University community to be vaccinated for high risk HPV.					
8. I believe the spread of high risk HPV is primarily due to socially unacceptable sexual behavior.					

A number of campus-wide programs, including some health services, are funded either through out-of-pocket fees paid by individuals, or by student fees paid by all students. We are interested in how highly you value a sample of campus-wide programs funded by student fees (which total \$31 million annually).

For items 9-13, please check the box corresponding to the importance you attach to each of the following campus-wide services:

	Very	Important	Somewhat	Not very	Not
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	Important		Important	Important	Important
9. Lory Student Center					
10. Rec Center					
11. Student Legal Services					
12. Conflict and Resolution Services					
13. Athletics					

Part 3 – Your response to a vaccination program proposal

Colorado State University has the HPV vaccine available at a set price for every willing female student currently enrolled at the university. This vaccine is administered at Hartshorn Health center for all willing female recipients.

Currently, Colorado State University has 13,526 female students, making up 51.3% of all enrolled students. In the face of the impact of HPV on students, Colorado State University has two new proposals that would provide vaccines for all willing female recipients. You will be asked a question about each proposal

- The vaccine reduces the risk of being infected with high-risk types of HPV by 70% if previously uninfected.
- **If either proposal pass, the risk of cervical cancer will be reduced by 70% in women vaccinated**

Proposal 1: An increase in all students' semester fees by \$X to have the vaccine available for all female students.

- The program will be funded by a *new special student fee*.
- The costs of the program would have to be paid by you and other Colorado State University students.
- Because you would be paying \$X in additional student fees for the program, it would *reduce the amount of available money for spending on your personal consumption*.

14. Would you vote for the proposed increase in your semester students fees of \$X to have the vaccine available for all Colorado State University students?

____ Yes ____ No

15. Do you believe that the majority of Colorado State University students would be willing to vote in favor of Proposal 1?

____ Yes ____ No

Proposal 2: A reallocation of existing student fees, amounting to \$X per student, away from other student services (rec center, classroom services, etc.) to fund availability of the vaccine free for all female Colorado State University students.

- *The program will not increase your student fees.*
- Payments for the program will be in the form of a reallocation of your student fees from other student services (for example, reallocation of fees from the Lory Student Center, Campus Recreation Center, University Facility Fee, Student Legal Services, Conflict and Resolution, Athletics, etc.).
- Thus, paying for the program would *reduce the amount of other student services that are currently available.*

16. Would you vote for this reallocation of student fees that would provide vaccinations for all students at the cost of other student services?

_____ Yes _____ No

17. Do you believe that the majority of Colorado State University students would be willing to vote in favor of Proposal 2?

_____ Yes _____ No

Part 4 – Attitudes influencing your choices in the part 3

Please check the box corresponding to how you agree or disagree with statements 18 through 22.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
18. I want to protect myself from high risk HPV					
19. I want others to be able to be protected against high risk HPV					
20. It seems fair to me to contribute a fair share to help others be vaccinated					
21. We all should be committed to protecting the health and safety of the CSU community					
22. CSU students deserve protection against high risk HPV					

Part 5 – Other questions

For statistical purposes, this section will ask some confidential demographic information.

22. What is your gender?

___ Female ___ Male

23. What is your age? ____

24. How would you categorize your race/ethnicity?

- ___ Black or African American
- ___ Asian or Asian American
- ___ Hispanic or Latino
- ___ White or Caucasian
- ___ Other

25. Do you live in a college dormitory?

___ Yes ___ No

26. Are you married or do you have a household partner with whom you share financial responsibility?

___ Yes ___ No

Please check the box corresponding to how you agree or disagree with statements 27 through 29.

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
27. I pay for CSU tuition out of my own pocket					
28. I pay for student fees out of my own pocket					
29. I pay for living expenses out of my own pocket					

30. In which range is your parent's annual household income?

- ___ Under \$10,000
- ___ \$10,000 - \$19,999
- ___ \$20,000 - \$49,999
- ___ \$50,000 - \$99,999
- ___ Over \$100,000

31. In which range is your annual personal income (without any contribution from parents)?

- ___ Under \$10,000
- ___ \$10,000 - \$19,999

- \$20,000 - \$49,999
- \$50,000 - \$99,999
- Over \$100,000

A.5.5 Results Without Social and Self-interest Preferences

Table A.5.2.1 Logit Gender differences in Individual Willingness to Pay Vaccination Program 1 Without Social and Self-interest Preferences

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
Cost	-0.0201*** (0.00502)	-0.00800*** (0.00214)	-0.00712*** (0.00209)	-0.00835* (0.00501)
com	1.618*** (0.457)	1.617*** (0.362)	1.388*** (0.363)	-0.701 (0.613)
Income	-0.191 (0.527)	0.0221 (0.393)	0.236 (0.472)	0.357 (0.506)
Constant	-5.692*** (1.992)	-6.028*** (1.569)	-4.471*** (1.361)	1.720 (2.404)
Observations	107	120	102	26
Standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Table A.5.2.2 Logit Gender differences in Individual Willingness to Pay Vaccination Program 2 Without Social and Self-interest Preferences

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
cost	-0.0131*** (0.00401)	-0.0104*** (0.00341)	-0.00462** (0.00225)	-0.00389** (0.00181)
fees	-0.297 (0.183)	-0.133 (0.162)	-0.408** (0.175)	-0.101 (0.159)
Constant	1.116* (0.641)	0.342 (0.575)	0.980* (0.571)	0.0579 (0.557)
Observations	106	107	93	100
Standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Table A.5.2.3 Logit Gender differences in Community Willingness to Pay Vaccination Program 1 Without Social and Self-interest Preferences

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
Cost	-0.0102** (0.00448)	-0.00683** (0.00327)	-0.00820** (0.00355)	-0.00386* (0.00219)
Income	-0.289	-1.006*	0.363	0.0850

	(0.679)	(0.596)	(0.601)	(0.301)
Constant	-0.570	0.327	-0.816	-1.041**
	(0.870)	(0.760)	(0.695)	(0.488)
Observations	107	120	86	121
Standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		

Table A.5.2.3 Logit Gender differences in Community Willingness to Pay Vaccination Program 2 Without Social and Self-interest Preferences

	Meningococcal	Meningococcal	HPV	HPV
VARIABLES	Women	Men	Women	Men
cost	0.000299	-0.00151	0.00250	5.77e-05
	(0.00145)	(0.00151)	(0.00176)	(0.00145)
resolut	-0.346	0.178	0.576***	0.346*
	(0.260)	(0.179)	(0.223)	(0.182)
fees	-0.0668	0.169	0.0259	-0.0818
	(0.146)	(0.140)	(0.165)	(0.149)
Constant	1.373	-0.929	-1.864*	-0.810
	(1.055)	(0.726)	(0.990)	(0.745)
Observations	106	107	93	98
Standard errors in parentheses		*** p<0.01, ** p<0.05, * p<0.1		