A Comparison of Actual and Hypothetical Willingness to Pay of Parents and Non-Parents for Protecting Infants' Health: The Case of Nitrates in Drinking Water

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Abstract

The objective of this research was to estimate adults' willingness to pay to reduce health risks to their or other families's infants, the latter to test for altruism. A choice experiment was conducted by having adults pay for bottled water for infants to reduce infants' exposure to nitrates in drinking water. Since nitrates only affect infants' health, we have isolated the adults' willingness to pay just for infants' health by buying bottled water to avoid infants' nitrate intake. Respondents were separated into two treatments, one with hypothetical choices, and the other where respondents were told that one of their four choices would be binding, and they would actually buy bottled water using money given to them at the beginning of the experiment. Results indicate that the marginal willingness to pay for a .001 reduction in risk of shock, brain damage and mortality in the real cash treatment was $2, $3.50 and $10, respectively. In the hypothetical treatment these amounts were $13, $23 and $64, indicating substantial hypothetical bias for the risk reductions. Nonetheless, in both treatments the relative marginal values across the severity of risk reductions are sensible, with willingness to pay to avoid the less severe health effects (e.g., shock) being much less than for the more serious effects such as brain damage and death. While the ratio of hypothetical WTP to actual WTP was rather high at a factor of nearly seven, such degree of hypothetical bias has been found in other experiments (Neil et al., 1994). This high hypothetical bias may be due to the nature of the good being valued, i.e. infant health. Many people express a very strong desire to protect infants, since infants cannot control their own health outcomes. Several statistical tests consistently confirmed that the marginal WTP for the risk reduction was not influenced by whether the individual was buying for his or her own infant or buying for another infant. This suggests there is a high degree of altruism reflected in our WTP results. This altruism continued to hold even when we focused solely on the consequential treatment where real money was involved.

Keywords: altruism, conjoint, drinking water, validity, willingness to pay,

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Introduction

Increasingly, federal agencies are being called upon to explicitly factor children's health into their regulatory decisions and benefit cost analyses. For example, Executive Order 13045 issued by President Clinton on April 21, 1997 required making children's health a high priority in federal agency decision making. In that same year, the EPA established the Office of Child Health Protection to give increased emphasis to children's health in the agency's many programs. See U.S.E.P.A. (2003) for more details on the Executive Order.

Until the 1990's there have been relatively few studies of the value adults have for protecting children's health, so adult values for protecting their own health were often used as a proxy. Recently, there have been several more studies on adults' valuation of children's health. Agee and Crocker (2002) provide an evaluation of the available methods for valuing children's health. They suggest that stated preference methods such as the contingent valuation method (CVM) are one of two methods that are most theoretically tenable and analytically tractable. Stated preference methods are not only able to measure parents' willingness to pay (WTP) to protect their children, but may also allow elicitation of community public good values toward children's health as well. Yeung and Smith (2005) review several studies using contingent valuation to value childhood immunization in developed and developing countries, and conclude that stated preference techniques such as CVM are a promising tool.

While there is a rising demand for children's health information, there have been relatively few primary valuation studies of children's health issues using stated preference methods. One of the first was Viscusi et al. (1987) where adults were asked their WTP to reduce adverse health effects to children (in this case pesticide poisonings). Dickie and Messman (2004) performed a very thorough stated preference study of parents' WTP to reduce their own acute illnesses versus those of their children. They used WTP for a medicine that would treat acute respiratory symptoms such as cough, chest pain, shortness of breath, fever and the untreated duration of these symptoms. For severe acute illness parents were WTP about $217 to reduce one

symptom day (Dickie and Messman, 2004: 1167). The values for younger children (age three) were nearly double those for children ages 12 to 17.

WTP of parents to reduce latent skin cancer chances were studied by Dickie and Gerking (2003) based on parents' WTP for a sunscreen product. Liu et al. (2000) studied mothers' WTP to reduce their own and their child's multiple day, multiple symptom episodes of colds in Taiwan. Converting WTP into U.S. dollars, average WTP was $71, and upwards of $121 if adjustments were made for differences in income levels and a mid-range income elasticity of WTP.

While not focused on children's health, there have been several CVM studies of willingness to pay to reduce nitrates in groundwater, particularly in the eastern U.S. One of the first was by Edwards (1988), which estimated the option price to prevent uncertain future nitrate contamination. The focus of that study was on the role of income, future use and bequest motives on willingness to pay to prevent future contamination in the Cape Cod area. Poe and Bishop (2001) presented a comprehensive analysis of how respondents' information about the extent of the nitrate contamination problem in one county in Wisconsin influenced their willingness to pay. While the "blue baby" syndrome and the potential for it to be fatal to infants was mentioned as part of the survey, the willingness to pay question was for a general program to reduce nitrates in drinking water to the safety standard, without reference to specific risk reduction levels for effects on infants such as brain damage. Nonetheless, the household willingness to pay was substantial, in the range of $225 to $450 a year depending on whether or not the household lived in an area with elevated nitrate concentrations in groundwater. These authors found that total WTP for the program increased as the baseline levels of nitrates increased. Bergstrom et al. (2001) conducted a comparison of WTP in Georgia and Maine for a program that would protect groundwater from further contamination by nitrates. These researchers included a variable for whether the household had a child present or not. This variable was not statistically significant at conventional levels in any of their regressions, however. The mean WTP was in the range of $200 to $300 per year.

Of course a longstanding concern in any stated preference method is how closely respondents' statements of willingness to pay reflect real economic commitments. A literature search indicates there have been no criterion validity studies dealing strictly with children's or infants' health. However, there have been a couple of criterion or cash validity studies for

insecticide treated mosquito nets in Nigeria (Onwujekwe and Uzochukwu, 2004) and in India (Bhatia and Fox-Rushby, 2003), and a revealed preference versus CVM study for lung cancer prevention (Kennedy, 2002). In addition, there has been a field experiment comparing the percentage of asthmatics who stated they would enroll in an asthma management program at various costs to actual enrollment at these same costs (Blumenschein, et al. 2001). Over the three different cost levels, there were three times as many asthmatics who stated they would enroll as actually did. Thus, our study contributes to advancing our understanding by testing for criterion validity in adults' valuation of a measure that only affects an infant's health. We expect hypothetical bias might be exacerbated by the emotional influence that adults have toward "helpless" infants. Further, this study also investigates altruistic willingness to pay toward an infant at risk in another family by persons with no infant at risk in their own family. To our knowledge only Onwujekwe and Uzochukwu (2004) have investigated altruism in health studies, but their study is not specific to infant health.

Stated Preference Valuation Methodology

The methodological approach used in this study was based on the conjoint or choice experiment approach (Holmes & Adamowicz, 2003). This is a stated preference method, in which a respondent makes a series of contingent choices. These choices are contingent upon the characteristics in the choice set. Our choice set had cost as one attribute, and risk of the child going into shock, risk of the child suffering brain damage, and risk of death as the three key variables we wished to value. By dividing the attribute coefficient by the cost coefficient the marginal value of a one unit change is monetized.

Following the theoretical foundation of Hanemann (1984) on utility difference from random utility models and Roe et al.'s (1996) application to conjoint analysis, we made the first choice a "no action" or baseline risk level associated with no cost. Then the action alternative that would reduce the three health risks to the child was offered at a one-time cost of $X, that varied across the sample. We did this in pairwise fashion, whereby each choice task or choice set was a no-action and a single-action alternative. As Carson et al. suggest, having just two choices increases the likelihood that the choice will be incentive compatible (even in the hypothetical treatment).

The probability a respondent would choose the action alternative should be related to the expected gain in the parents' well being obtained from their infant receiving the health risk reduction, over and above the satisfaction lost due to paying higher cost. To illustrate this with infant death, a state-dependent utility function is posited focusing just on the risk of death, to keep the notation simple. Thus UL and UD is the utility to the parent when the child is alive and dead, respectively. Further, let PD be the baseline probability of the child dying with and without the risk reduction intervention (e.g., bottled water). Baseline expected utility (EU) to the parent can be defined as:

(1) $EU = PD[UD(I)] + (1-PD)[UL(I)]$,

where I is the individual's income. Income represents the total potential amount of available money or other goods that an individual might draw from to buy the risk reduction through purchase of bottled water.

The parents' purchase of bottled water reduces the probability of premature death from PD to P'D, but at a proposed cost to the respondent of $X each year. If the reduction in the probability of premature death from PD to P'D yields more expected utility than the reduction of $X in income or other goods consumed, the parent will select the action alternative in the choice question. Specifically, the expected utility difference (EUD) is given by:

(2) $EUD= \{P'D[UD(I-\$X)]+ (1-P'D)[UL(I-\$X)]\} - \{PD[UD(I)]+(1-PD)[UL(I)]\}$

If this expected utility difference is linear in its arguments, and if the associated additive random error term is distributed logistically, then the probability a respondent would select the action alternative to a question asking him or her to pay $X for the bottled water that would reduce the risk of the child's death from PD to P'D is:

(3) Probability of buying bottled water = $P(Y) = 1 - [\ 1 + e^{Bo-B1(\$X)+B2(\text{Death Risk Reduction})}]^{-1}$

Maximum likelihood statistical routines such as logistic regression can be used to estimate a transformation of this equation in the form of:

(4) $\text{Log}\ \{P(Y)/[1-P(Y)]\} = Bo - B1(\$X) + B2\ (\text{Death Risk Reduction})$

The marginal value to the parent of reducing a child's risk of death (or parental WTP) is: B2/B1. Since reduction in risk of the infant going into shock and risk of brain damage are the other two attributes simultaneously valued in choice experiments, these would be the other attributes included in the logit equation.

Other explanatory variables typically included in such a model of willingness to pay include socio-demographics such as gender and preferences. In addition, we include two variables developed from the Theory of Planned Behavior (TPB). According to TPB, there are certain factors that influence the link between intended behavior and actual behavior (Ajzen, 1991). In particular, an individual's subjective norms (beliefs about whether the behavior is appropriate) and perceived control may have an influence on behavioral intentions (the probability a respondent would choose the action alternative (buying bottled water) or choose to do nothing). In this study, the choices made in the hypothetical valuation task served as a measure of behavioral intentions. Norms and perceived control were measured via responses to a series of questions and included as explanatory variables in our WTP model. TPB has been shown to predict behavior in many different health settings. McCaul, Sandgren, O'Neill, and Hinsz (1993) investigated the role of perceived control to predict intentions to perform health-protective behaviors. They found that perceived control made a significant contribution to the predictive power. TPB has also proven useful in predicted health- and safety-related behaviors that are undertaken on behalf of another individual. Richard, Dedobbeleer, Champagne, and Potvin (1994) investigated the value of TPB to predict the use of seat belts or car seats for children riding in automobiles.

CHOICE EXPERIMENT DESIGN

The choice experiment involved four attributes (cost, risk of shock, risk of brain damage, and risk of death). There were four levels of the risk attributes and seven levels of the cost attribute. We utilized a main effects design to develop an orthogonal choice set with 19 different survey versions. The seven levels of the cost variable ranged from $50 at the low end to $500 at the high end. The consequential choice experiment treatment involved adults who were asked to pay real money for the bottled water. The individuals were given a sufficient amount of money to buy the bottled water, but they were allowed to keep any or all the money they chose not to

spend on the bottled water. Assessing whether altruistic motives toward infants' health entered into choices was tested by whether people without infants at risk would pay for bottled water for other households with infants at risk. The basic experimental design involves four treatments that are illustrated in Table 1.

Table 1. Overview of Experimental Design

PAYMENT TYPE	Adults with Infants	Adults without Infants
Non Consequential (Hypothetical payment)	Treatment #1	Treatment #2
Consequential (Actual cash)	Treatment #3	Treatment #4

This experimental design allows us to test the following hypotheses:

1. Test the external validity of the experiment by evaluating whether the marginal value for risk reduction i from the traditional hypothetical choice experiment ($MV_i(h)$) would equal the marginal value for risk reduction i from the consequential (real money) choice experiment ($MV_i(c)$).
2. Test to see if people have altruism towards others' children; in particular whether there is a statistical difference between willingness to buy bottled water for a needy family's infant child versus their own.

The overall study design evolved with numerous discussions with water quality specialists and economists. Several versions of the survey were reviewed by economists who were experts in the area of contingent valuation and choice experiments. Two focus groups and pretests were run to ensure the instrument was clear and interpreted as intended.

Key Elements of the Survey Design

The key elements of the choice task involved the information provided the respondent and the nature of the alternatives before them. These are summarized in Figure 1 and in the script of information shown to the respondent below.

Figure 1. Key Elements of the Choice Experiment Task Given in the Survey

<u>Section 5</u> → 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	**Option B**
Use tap water	Use bottled water

Effects of Over-exposure to Nitrate Contaminated Drinking Water

Cost	Risk of Temporary Shock	Risk of Permanent Brain Damage	Risk of Death
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

Treatment #1: Adults with infants were told the following in the Non Consequential Treatment: *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.

Treatment #2. In order to test for altruism, households <u>without</u> children in the non-consequential treatment were told exactly the same information as parents except the first paragraph was the following: *In the next part of the survey you will be asked to imagine that you have to choose between purchasing or not purchasing various amounts of bottled water for a needy family in your community to help reduce their infant's exposure to water that may contain excessive levels of nitrate.*

The second and third paragraphs were identical to what was told of parents, and the same visual aids to illustrate the risk reduction was used.

Treatment #3, Adults with infants were told the following in the consequential survey treatment.

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 the 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.*

An example of the Bottled Water Payment Voucher is shown in Appendix A.

Treatment #4. Adults without infants were told the following in the consequential survey treatment:

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 go to a needy family to help to reduce their infant's exposure to water with excessive levels of nitrate.

If you purchased the water, the health risks to the 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 the 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, the 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 the 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 an infant in a needy family using money provided by the 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," a needy family with an infant 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.*

The consequential treatment of the choice experiment had procedures that were consistent with the current experimental economics literature. In particular, so that respondents considered each one of their four choices as potentially consequential, they were told that one of the four choices would be selected at random to be considered binding. This is commonly done when there are multiple rounds or purchases to be made (Shogren et al. 1994).

Figure 2 illustrates the choice matrix presented to respondents with an infant in their household and the nonconsequential treatment. The layouts of the choice matrices for the other

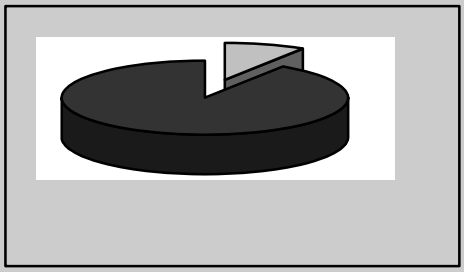
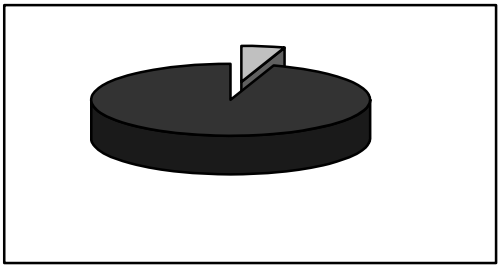
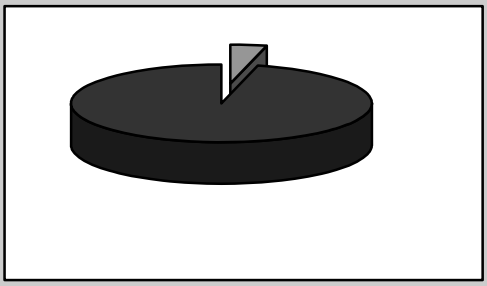
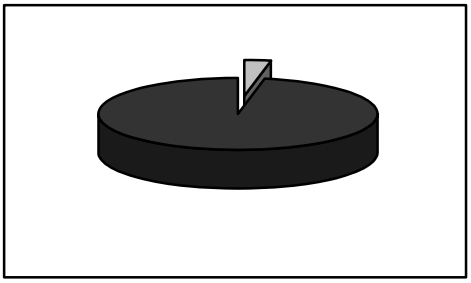
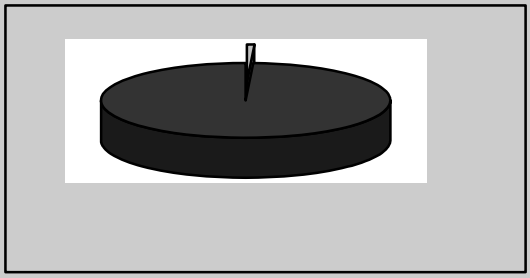
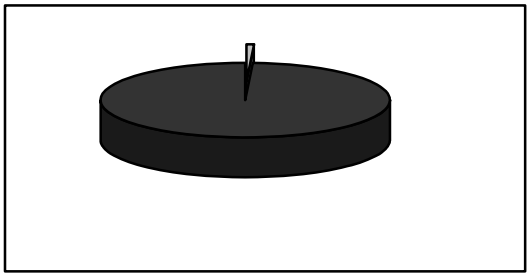
three treatments were identical except they referred to infants “in a low-income household” in Treatment #2 and #4 instead of infants “in your household.”

The relative risks were shown numerically and using pie charts to illustrate the relative magnitude of the risk in a visual way. Pie charts have been successfully used as a risk communication device in previous health valuation studies, such as Smith and Desvousges (1987) as well as Loomis and duVair (1993).

The layout was pretested and reviewed so that it would facilitate respondents making horizontal pairwise comparisons of the risk of temporary shock with Option A (do nothing) and Option B (buy bottled water), risk of permanent brain damage with Option A (do nothing) and Option B (buy bottled water), and risk of death with Option A (do nothing) and Option B (buy bottled water) as well as the costs.

Figure 2. Example Choice Matrix in Treatment #1 for Respondents with Infants

For this task, we want you to compare Option A to Option B and choose the option you would actually pay for at 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**
One-Time Cost	$0	$250
Risk of Temporary Shock*	100/1000 	50/1000 
Risk of Permanent Brain Damage*	40/1000 	30/1000 
Risk of Death*	9/1000 	7/1000 

A☐ **B**☐

Choose Option A or B
Why did you choose that option?

_____

_____

Data Collection

The survey was pilot tested with two groups in the San Luis Valley area of Colorado, an area known for nitrate pollution in drinking water. Due to pilot results, the survey was revised to decrease its length and to improve clarity. Data collection was to take place originally through in-person sessions with participants conducted at various recruitment sites (day care, childbirth classes, etc.). However, both participants and sites proved reluctant to participate in this manner. As a result, the data collection methods were altered to include a mail survey mode and "hosted sessions," as well as recruiting from a broader range of areas in Colorado.

In order to cost effectively target parents with infants for the mail surveys, the survey packets were sent to five early childhood sites, such as Head Start, family centers, or preschools. The packets included a self-addressed stamped envelope for the participants to return the survey. Participants completed a contact sheet when they picked up a packet at the site, and the contact sheets were sent back to the experimenters. Participants were asked to date the slips so that the experimenters knew when to begin the reminder phone calls. Using this survey tracking method, the experimenters called participants who had not returned the survey within two weeks. If respondents had simply forgotten to return the survey, they were reminded to do so. If they had lost the survey and were still interested in participating, they were mailed another. In another two weeks they were contacted by phone again; if they still did not return the survey, they were counted as a non-respondent. Those completing the survey via mail received $15.

Fliers for hosted sessions were given to individuals who attended in-person sessions. An experimenter attended and conducted an in-person session. For the hosted sessions, participants received $25 and the host received $5 for each completed survey.

We recognize the recruitment of these hosted sessions did not necessarily provide a random or representative sample of all target populations. However, given the rarity of some of the target groups (e.g., parents of infants), it would not have been cost effective to use standard sampling procedures such as random digit dialing. Since there was random assignment of respondents to each of the four treatments, we can make valid inferences regarding the effect of hypothetical versus actual cash payment, and altruistic motives. Generalizing our monetary values for risk

reductions to the Colorado or U.S. populations may be problematic, although it is not obvious that our values necessarily overstate population values.

Response Rate

A total of 450 survey packets were sent to nine different sites and at least one survey was returned for all but one of the sites, for a 90% site response rate. Across the nine sites, a total of 95 contact cards were returned. Of the 95 individuals who completed a contact card, 55 returned their completed surveys for a 58% response rate. In addition to those 55 surveys, an additional 54 surveys were returned without a contact card being sent for a total of 109 mail survey respondents. The remaining 79 participants attended either an in-person data collection session (60 participants) or a hosted session (19 participants). The participation rate for the in-person strategy was 100%, in that every person recruited to attend, did attend. This high participation rate may have been due in part to our payment of $25 participation fees. Given the two survey sub-samples that we can track (mail respondents completing contact cards and in-person) the overall response rate is about 77% (55 mail surveys returned out of 95 who completed contact card and 79 in-person completions out of 79 recruited). This is likely an upper bound estimate of our response rate, since we do not know about the response rate of the sub-sample of 54 people who returned mail surveys without contact cards. However, even using a lower bound of the overall mail response rate including the 54 people with no contact cards and the in-person surveys, the overall study response rate would be roughly 60%, a very reasonable response rate. Table 2 presents the distribution of surveys by the consequential and non-consequential treatment and with infants at risk (expecting and Child under 1) and without infants at risk (Children 1 to 3 or no Children). Given four choice tasks per respondent the effective number of sample observations is four times the individual surveys returned.

Response rates to health surveys tend be lower than for other types of valuation surveys. For example, Dickie and Messman (2004) who did a parental health survey regarding themselves and their children, obtained responses from 7.5% of eligible households (those with children). This is on par with other health valuation surveys such as Johnson et al. (1997) who obtained about 8.8%. So our response rate was on par with these other surveys.

Table 2 Completed Surveys by Non Consequential and Consequential (Cash) Treatments, Infant Status

Infant at Risk		No Infant at Risk	
Non[1]	Con[2]	Non	Con
46	18	96	28

1. Non Consequential Treatment (payment hypothetical);
2. Consequential Treatment (payment involves actual cash)

WTP RESULTS

After each choice matrix, a respondent was asked why he or she chose the selected alternative. Despite the potentially emotional nature of infant health, the most common reasons respondents gave for the choices they made focused on the cost level and the risk levels. People faced with the higher costs of $250 to $500 often felt they could not afford to pay that amount of money. People faced with lower costs often felt it was worth the cost, or the costs were cheaper than medical bills. Frequent comments included that it was worth it to protect the child's health, less risk was worth the cost, or reducing the chance of the illness drove the choice. In general it appears that the choice experiment had content validity, in that the vast majority of respondents appeared to understand the choice experiment as a trade-off between the cost of bottled water and the three risks to the health of their or another infant.

Only one person explicitly stated a lack of understanding of the information and choice matrix, and did not answer any of the choice tasks. Only two people gave what would be considered protest responses and were dropped. One of these protest responses was a person who voted for the costly Option B, but said "To set a precedent in society for a bill to provide government subsidy for this kind of water program." Another person indicated not having enough information and the information presented was inconsistent. Such a low protest rate indicates that nearly all respondents accepted the premise of the choice experiment, that they would have to pay to reduce infants' exposure to nitrates in drinking water. As noted below, there was no statistical difference in the likelihood or probability of paying between parents with infants at risk and other adults asked to pay for infants in a needy family (our altruism treatment). However, there were certainly more comments in the altruism treatment that indicated that several people felt it was not their responsibility to pay for bottled water for other children, since they had to pay for their own children. This contrasted with parents with infants usually rejecting paying only at higher bid prices because they could not afford it.

Table 3 provides the results of the logit model on the cost and risk reduction variables and includes variables to control for **survey mode,** how participants rate the smell of their current domestic water supply (**water smell**), whether they think bottled water would reduce risk of nitrates (**bottled**), and **gender (**males coded as one, females as two). In addition, respondents'

perceived control regarding their drinking water (**water perceived ctrl)** was statistically significant.

Note that the one-time cost is negative and statistically significant at the 5% level. However, the Real Cost Dummy is much larger negative and statistically significant at beyond the 1% level. Thus, when the cost is actual or consequential, the net or overall price coefficient becomes much more sensitive to price. In both treatments, however, the higher the price the less likely households are to purchase the risk reduction through bottled water. The difference in the real cash cost coefficient and the hypothetical cost coefficient provides results of our hypothesis test regarding whether there is a statistical difference in responses of people facing a hypothetical cost versus an actual cost. While it will become more apparent comparing marginal values, a comparison of the coefficients indicates that households facing the hypothetical cost are much less sensitive to the cost than households that face an actual monetary opportunity cost. For purposes of comparing marginal values calculated using the actual monetary cost versus the hypothetical cost treatment, we set the Real Cost Dummy to "1" for real; adding its coefficient to the Cost coefficient results in a net Cost coefficient of -.010928. Thus to calculate marginal values for the real cost, we divide the attribute coefficient by Cost variable of -.010928, while for the hypothetical cost we use the -.001632. As will be seen in the next section, this difference in coefficients translates into a ratio of hypothetical bias on the marginal value of the attributes of about 6.7 (which is not an unheard of magnitude of hypothetical bias).

Table 3 Logistic Regression of the Binary Choice Model

Variable	Coefficient	Std. Error	z-Statistic	Prob.
Constant	-4.442306	1.0366	-4.285	0.0000
Cost	-0.001632	0.0008	-1.919	0.0549
Real Cost Dummy	-0.009296	0.0013	-6.989	0.0000
Shock Risk Reduc	0.020893	0.0073	2.862	0.0042
Brain Damage Risk Reduc	0.038276	0.0179	2.135	0.0327
Death Risk Reduc	0.104827	0.0614	1.704	0.0882
Survey Mode	-1.053295	0.2189	-4.810	0.0000
Water Smell	-0.346705	0.1261	-2.748	0.0060
Bottled	0.922683	0.2233	4.131	0.0000
Gender	1.163745	.254960	4.564	0.0000
Water Perceived Ctrl	0.643258	0.2082	3.088	0.0020
Water Norms	0.432030	0.1213	3.561	0.0004
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Mean dependent var	0.695	S.D. dependent var		0.46
Log likelihood	-349.71	McFadden R-squared		0.167
Restr. log likelihood	-419.45			
LR statistic (11 df)	139.48	Probability(LR stat)		0.000000
Obs with Dep=0	208	Total obs		682
Obs with Dep=1	474			

Cost is the one time cost to you.

Real Cost Dummy is whether the survey is hypothetical-consequential dummy variable (Real equals 1) times the one time Cost.

Shock Risk Reduc is the reduction in risk of shock to your child (chances in 1000)

Brain Damage Risk Reduction is the reduction in risk of brain damage (chances in 1000)

Death Risk Reduc is the reduction in risk of death to your child (chances in 1000)

Survey Mode is 1 for in-person or group setting and 0 for mail.

Water Smell is a four-point scale rating with 1= strong unpleasant smell, 2= somewhat unpleasant smell, 3=noticeable smell, 4= no smell.

Bottled is whether the respondent thinks bottled water would reduce risk of nitrates (yes=1)

Gender is coded 1 for male and 2 for female.

Water Norms is subjective norms for being concerned about drinking water quality.

Water Perceived Ctrl is perceived control over drinking water safety.

The coefficients on reduction in risk of shock and brain damage are positive and statistically significant at the 1% level or better, while death risk reduction is positive and significant at the 10% level. The positive signs on Brain Damage Risk Reduction, Shock Risk Reduction and Death Risk Reduction make sense. People are more likely to pay the greater the reduction in risk of shock, risk of brain damage and risk of death by having their infant drink the bottled water. In addition, the relative magnitude of the coefficients indicates that willingness to pay will be larger to avoid a 1 in 1,000 chance of an infant dying, as compared to brain damage, which is still larger than willingness to pay to reduce the risk of shock. Households whose water had no noticeable odor were less likely to pay for bottled water. Females were more likely to buy bottled water than males. The overall equation is highly significant as judged by the probability of the likelihood ratio (LR) statistic being significant well beyond the 1% level.

Calculating Marginal Values of Risk Reduction

Marginal willingness to pay to reduce the risk of shock, brain damage, or death is the risk reduction coefficient divided by the absolute value of the cost coefficient. It is the willingness to pay to reduce shock or brain damage by 1 per 1000 infants or .001. Performing such calculations with our data yields the following results.

A typical respondent would pay $1.91 in the real cash treatment and $12.80 in the hypothetical treatment for bottled water that would result in a .001 (1 in 1,000) reduction in the chances of an infant going into shock from nitrate in water. A household would pay $3.50 in the real cash treatment and $23.45 in the hypothetical treatment for bottled water that would result in a .001 (1 in 1,000) reduction in the chances of an infant experiencing permanent brain damage from nitrate in water. A household would pay $9.59 in the real cash treatment and $64.23 in the hypothetical treatment for bottled water that would result in a .001 reduction in the chances of an infant dying from nitrate in water. The relative values are sensible, with willingness to pay to avoid the less severe health effects (e.g., shock) being much less than for the more serious effects such as brain damage and death. The ratio of hypothetical WTP to actual WTP is rather high at a factor of 6.7, although such degree of hypothetical bias has been found in other non-health experiments (Neil et al. 1994), and infant health may be a more susceptible good than others used in most experiments. As such, infant health may be a more emotional topic for respondents, and their best intention is to want to pay to protect infants, especially when there is no direct cost

to them. Originally, we had hoped to employ the cheap talk design of Taylor and Cummings (1999) but the length of the survey and need to adapt it to a mail survey mode precluded this. The cheap talk design may have mitigated some of this hypothetical bias and should be tried in future health surveys.

Testing for Altruistic Motives

To ascertain if the probability of buying bottled water was influenced by whether the individual was buying for his or her own infant or buying for another child, an intercept shifter variable was tested in the logistic regression models and it was non-significant (p=.33). We also tried interacting whether the respondent had an infant at risk with the cost of the program and it, too, was non-significant (p=.78). A likelihood ratio test confirmed that the logistic WTP coefficients between those with and without infants were not statistically different (calculated $\chi^2 = 17.06$ versus critical of 19.67 with 11 dof). These results reflect the fact that almost identical proportions of respondents with a child (72%) and without a child (69%) would pay for the bottled water. A chi-square test suggests these proportions are not statistically different ($\chi^2 = .47$, while critical is 3.84). This suggests there is a high degree of altruistic motivation reflected in our WTP results. These results also hold even when we focus solely on the consequential treatment where real money was involved. The percentage actually purchasing the bottled water for their own children (35.3%) and those without children (44.6%) was not statistically different at the 5% level in a chi-square test ($\chi^2 = 1.34$, while critical is 3.84). This suggests that altruism toward other infants is quite strong and on par with parental concern toward their own infants. However, willingness to pay for one's own or others' children is by far stronger in women than in men. Gender is consistently statistically significant, and indicates that women are more likely to pay than men. As indicated by the size of the gender coefficient, the differential is quite substantial.

Conclusions

The choice experiment results indicate that respondents' likelihood of buying bottled water was negatively correlated with one-time cost of the bottled water and positively correlated with risk reduction to the infant's health (e.g., risk of shock, brain damage, and death). However, respondents in the consequential treatment (facing real cash opportunity costs) were more cost sensitive than respondents in the hypothetical treatment. Nonetheless, in both treatments higher

"prices" (whether real cash or hypothetical) for reducing risk caused both parents and non-parents to reduce purchases of bottled water and tolerate more health risks to infants. Future research might try utilizing the "cheap talk" protocol of Taylor and Cummings (1999) to reduce the hypothetical bias. The length of our survey precluded our initial efforts to include a cheap talk script in this research study. Perhaps the respondent certainty approach of Champ et al. (1997) and Bluenschein et al. (2001) may be a more compact way of ex-post calibration to yield valid estimates of willingness to pay. In both the consequential and hypothetical treatments, the ranking of the marginal value of reducing risk is sensible: the lowest marginal willingness to pay being to reduce the risk of temporary shock, a higher WTP to reduce the risk of permanent brain damage, and the highest WTP to avoid death. There also appears to be substantial altruistic feeling toward other people's infants. There was no statistical difference in probability of purchasing the bottled water for one's own infant or a needy family's infant. Women's WTP was substantially higher than men's. Overall the empirical results indicate that not only do parents have a high willingness to pay to protect their own infant's health, but adults have a high willingness to pay to protect the health of others' infants as well. Thus broad based taxes or general fund appropriations may be a fair way to pay for prevention of infant exposure to nitrates in groundwater.

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Appendix A – Sample Risk Group Voucher

_____ State University
Family and Youth Institute Study on Valuation of Infant Health
Voucher

$250

Sign this voucher where indicated and return with your completed survey. Once the choice has been randomly selected, **you will be sent one of three things**:

--A check for the full amount of this voucher (you chose "Do Nothing" on the selected choice)

--A pre-paid punch-card for bottled water worth the dollar amount listed as the cost for the choice (you chose "Purchase Bottled Water" and the randomly selected choice was the one with the highest dollar amount)

--A pre-paid punch-card for bottled water worth the dollar amount listed as the cost for that choice **and** a check to make up the difference between the worth of the punch card and the amount listed on this voucher (you chose "Purchase Bottled Water" and the randomly selected choice was not the one with the highest dollar amount)

_____ _____

Staff Signature Participant Signature