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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

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We estimate adults' willingness to pay (WTP) to reduce health risks to their own or other families' infants to test for altruism. A conjoint analysis of adults paying for bottled water found marginal WTP for reduction in risk of shock, brain damage, and mortality in the cash treatment of $2, $3.70, and $9.43, respectively. In the hypothetical market these amounts were $14, $26, and $66, indicating substantial hypothetical bias, although not unexpected due to the topic of infant health. Statistical tests confirm a high degree of altruism in our WTP results, and altruism held even when real money was involved.

Key Words: altruism, conjoint, drinking water, nitrates, validity, willingness to pay

JEL Classifications: I10, Q53

Nitrate contamination of municipal water supplies and residential wells is a widespread problem throughout much of the southeast, northeast, and central United States (Morgan, Coggins, and Eidman, 2000). Our study area, the state of Colorado, has 15 counties with nitrate levels near or exceeding the Environmental Protection Agency (EPA) standard (Bauder, Waskom, and Ceplecha, 2002). More than a half million people live in these counties in Colorado. In one of the larger agricultural counties in Colorado, half the wells tested exceeded the EPA standard for nitrates (Dubois, 1990). Much of this nitrate contamination is due to leaching of nitrogen fertilizer into the groundwater. Nitrates in drinking water is of particular concern to the health of infants (children less than a year of age). This health effect is commonly known as "blue baby syndrome" and is severe in infants because they do not have the enzyme necessary to eliminate the ability of nitrates to reduce hemoglobin, and hence nitrates deprive infants of oxygen. This can lead to shock, brain damage, and even death if not treated.

Federal agencies are being called upon to explicitly factor children's health into their regulatory decisions and benefit cost analyses. For example, President Clinton's Executive Order 13045 requires making children's health a high priority in federal agency decision making. 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. Environmental Protection Agency (2003) for more details on the Executive Order.

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Agricultural economists have extensively researched changes in cropping practices and livestock production to reduce the amount of nitrates going into groundwater, especially drinking water (Morgan, Coggins, and Eidman, 2000). Research published in this journal has investigated economic policy options to attain this reduction in nitrates that include trade permits (Morgan, Coggins, and Eidman, 2000) and nitrogen taxes (Mapp, 1999; Wu, Mapp, and Bernardo, 1994). However, to set the optimal level of the nitrogen tax, valuation information is needed on the environmental and health damages from nitrates or health benefits of reducing nitrogen.

While not focused specifically on children's health, agricultural economists have investigated public benefits to delay nitrate contamination in drinking water using the Contingent Valuation Method (CVM) (Bergstrom and Dorfman, 1994; Hurley, Otto, and Holtkamp, 1999). But there have been no studies on parents' willingness to pay to reduce nitrates to the population segment most susceptible to nitrates, infants. In one sense it is odd that infants have not received more explicit attention in CVM studies, as they are the ones primarily affected by nitrates, as older children and adults are largely unaffected. This study aims to fill this gap.

While there is a rising demand for children's health information, particularly infant health, there have been relatively few valuation studies of infant health issues using stated preference methods. There have been no studies looking at altruism and infant health. Our paper contributes to filling that gap.

Of course a longstanding concern in any stated preference method is how closely respondents' statements of willingness to pay reflect real economic commitments (Murphy and Stevens, 2004). A literature search indicates there have been no criterion validity studies dealing with children's or infants' health, let alone related to water pollutants such as nitrates. Thus, our research contributes to advancing our understanding of hypothetical bias in health valuation studies of children by testing for criterion validity in adults' valuation of a measure that affects an infant's health. We expect hypothetical bias might be exacerbated by the emotional feelings that adults have toward "helpless" infants.

Incorporating Altruism into Stated Preference Valuation

The methodological approach employed in this study uses the conjoint or choice experiment approach originally developed by Green (1974). This method is based on Lancaster's (1966) view of consumption being based on utility from attributes rather than goods, per se. Conjoint 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 infant going into shock, risk of the infant 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 (Holmes and Adamowicz, 2003).

The theoretical foundation of random utility stated preference models that underlie the empirical discrete choice models used for estimation begins with an individual's utility function. In Equation (1) parent i's utility is a function of his or her own consumption of goods $X1_i, \ldots Xn_i$ as well as their own infants$_{ij}$'s consumption of safe (nitrate free) water ($W1_{ij}$) and formula ($W2_{ij}$) made from nitrate free water. In this specification, the parents' utility is directly tied to the health of their own infant. This utility arising from health of one's own infant may arise out of a sense of responsibility for one's own infant's health. This situation is represented in Equation (1).

$$U_i = U_i\left(X1_i, \ldots Xn_i;\ W1_{ij},\ W2_{ij}\right) \quad \text{where} \quad i \neq j. \tag{1}$$

However, altruism toward the health of others' infants by nonparents may be a motivation for nonparents to pay for reducing nitrate exposure to infants of others. Altruism has been studied starting in the mid 1970s by economists such as Deacon and Shapiro (1975) and Becker (1976). Becker would define altruism through an interdependent utility function of the form:

$$U_a = U_a(X1_a, \ldots Xn_a; W1_{ka}, W2_{ka}) \quad \text{where} \quad a \neq k. \tag{2}$$

Essentially, nonparent a's utility depends not only on his/her consumption ($X1_a, \ldots Xn_a$) but also on the consumption of nitrate free water and formula of infant_k who is the child of an unrelated family_k. As is now noted in microeconomics textbooks such as Nicholson (1992, p. 102) "Nothing in the utility maximization model prevents individuals from deriving satisfaction from philanthropy or generally doing good."

One of the objectives of this paper is to compare the choices of parents and nonparents to determine if nonparents would pay for nitrate reductions of other household's infants, i.e., altruism. In order to empirically implement this utility framework within a dichotomous choice stated preference survey, we follow Hanemann's (1984) exposition of the utility difference foundation of random utility models. In this model the first choice is a "no action" or baseline risk level associated with no cost. Then the action alternative that would reduce the three health risks to the infant is offered to the parent at a one-time cost of \$Z, which 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.

The probability that a parent 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 as compared with the value of parents foregone consumption from paying for the risk reduction. 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 (Loomis and duVair, 1993). Thus, UL and UD is the utility to the parent (i) when the infant (j) is alive and dead, respectively. Further, let PD_j be the baseline probability of infant_j dying without the risk reduction intervention (e.g., bottled water). Baseline expected utility (EU_i) to the parent can be defined as:

$$EU_i = PD_j[UD,(X)] + \left(1 - PD_j\right)[UL,(X)], \tag{3}$$

where X is the parent's consumption of all other goods (e.g., the composite commodity). If there is budget exhaustion in the constrained utility maximization (as is commonly assumed in economic texts,[1] see for example Nicholson, 1992 and Varian, 1990), then income (I) equals X. As such we can replace X with I. Income thus represents the total potential amount of available money or other goods that an individual might draw from to buy the risk reduction through the purchase of bottled water.

The parent's purchase of bottled water reduces the probability of premature death from PD to P'D, but at a proposed one time cost to the respondent of \$Z. If the reduction in the probability of premature death from PD to P'D yields more expected utility than the reduction of \$Z in goods consumed (X), the parent will select the action alternative in the choice question. Thus, the expected utility difference of the parent (ΔEU_i) is given by:

$$\Delta EU_i = \{P'D_j[UD,(I - \$Z)] + (1 - P'D_j) \times [UL,(I - \$Z)]\} - \{PD_j[UD,(I)] + (1 - PD_j)[UL,(I)]\}. \tag{4}$$

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 parent would select the action alternative to a question asking him or her to pay \$Z for the bottled water that would reduce the risk of the infant's death from PD_j to $P'D_j$ is:

$$\text{Probability of buying bottled water} = P(Y) = 1 - \left[1 + e^{B0 - B1(\$Z) + B2(\text{Death Risk Reduction})}\right]^{-1}. \tag{5}$$

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

$$\text{Log}\{P(\text{Yes})/[1 - P(\text{Yes})]\} = B_0 - B_1(\$Z) + B_2(\text{Death Risk Reduction}). \tag{6}$$

The marginal value to the parent of reducing an infant's risk of death (or parental WTP) is:

[1] According to research in consumer demand theory the assumption of complete budget exhaustion fails to satisfy many demand properties (Paris, Caputo, and Holloway, 1993).

B_2/B_1. 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. As illustrated in Equation (2), this overall empirical model can be generalized to allow for altruism of $nonparent_a$ toward others' $children_k$.

Other explanatory variables in the empirical model that are typically included in such a model of willingness to pay include sociodemographics 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 (e.g., 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, and O'Neill (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, and Champagne (1994) investigated the value of TPB to predict the use of seat belts or car seats for children riding in automobiles.

Selection of a Deliverable Good for Reducing Nitrates in Drinking Water for Infants

The overall study design evolved with numerous discussions with water quality specialists. It was from these discussions with water quality specialists that we decided to use bottled water as the means by which the nitrate risk reduction would occur. Originally we considered purchasing and installing water filters, as this could also be a deliverable good in the consequential/actual cash treatment. However, in further discussions with water quality specialists we learned that failure to maintain or replace filters would quickly result in higher levels of nitrate exposure due to build up of nitrates in the filters as they age. Thus we could not in good conscience sell households water filters as part of the choice experiment. Therefore bottled water was chosen by the researchers as the only deliverable good for reducing infant exposure to nitrates. In the survey, prior to the choice experiment respondents were specifically told that bottled water would eliminate an infant's exposure to nitrates. The survey was identified as coming from the state's land grant university as well. Thus it is not surprising that when asked in the survey whether bottled water would reduce the risk of nitrates, 75% of respondents believed the bottled water being offered would reduce infant exposure to nitrates. As will be seen in the results, this variable was positive and statistically significant, indicating if they thought bottled water would reduce exposure to nitrates, they were more likely to pay.[2]

Several versions of the survey were reviewed by economists who were experts in the area of choice experiments. Two focus groups and pretests were run to ensure the instrument was clear and interpreted as intended.

Choice Experiment Design

The choice experiment involved four attributes (cost to the household, risk of shock, risk of brain damage, and risk of death). In the "Do Nothing" Option A, the cost was zero, and the baseline risk of shock, brain damage, and death were set at 100/1,000, 40/1,000, and 9/1,000,

[2] It should be noted that the U.S. Food and Drug Administration's requirement for bottled water is that it should be as good as tap water. See http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation for more details.

respectively, in all of the treatments. These baseline levels of risk were set based on discussions with Colorado Cooperative Extension water quality specialists, data on the large number of wells in Colorado exceeding the safe nitrate levels, and the prevalence of these three health effects in geographic areas that have nitrate contamination in their drinking water.

For Option B "Buy Bottled Water for an Infant," there were five levels of risk, each of the three risk attributes, and eight levels of the cost attribute. To develop the choice sets we utilized a main effects orthogonal design developed using a D-optimal partial (fractional) factorial algorithm. Being a fractional factorial design means that not every combination of attribute levels are included (Holmes and Adamowicz, 2003). In addition, the commonly used (Holmes and Adamowicz, 2003) main effects design does not include attribute level combinations needed to identify any interaction effects between attributes. This fractional factorial main effects design yielded 24 different versions of the choice set. The eight levels of the cost variable ranged from $50 at the low end to $500 at the high end. We used a one time cost because a maximum of one year's supply of bottled water was all that is needed, since after 1 year the infant is no longer at risk from nitrates since they have the enzyme necessary to neutralize the nitrates. Table 1 presents the combinations of the three risks and dollar costs for Option B, purchasing of bottled water for an infant. Option A (do nothing) had the same baseline risk for shock (100/1,000), brain damage (40/1,000), and death (9/1,000) for everyone. As can be seen in Table 1, Option B had lower risks than Option A for all three risks, although the magnitude of the lower risks varied across the 24 survey versions.

Table 1. Choice Set Design: Alternative Risk Levels (number of cases in your community out of 1,000) and One Time Cost in Option B, the Bottled Water Choice

Version	One Time Cost	Shock Risk	Brain Damage Risk	Death Risk
1	50	40	35	4
2	50	50	15	5
3	50	50	30	8
4	50	60	35	8
5	50	70	30	6
6	50	70	35	7
7	50	70	25	8
8	100	30	35	8
9	100	40	25	6
10	150	60	35	6
11	150	70	20	4
12	150	70	35	8
13	200	70	35	5
14	250	30	15	6
15	250	50	30	7
16	250	60	25	8
17	300	40	30	5
18	300	50	25	4
19	300	60	20	7
20	400	30	25	7
21	400	50	20	8
22	400	60	30	4
23	500	30	20	5
24	500	70	15	8

Experimental Design

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 most expensive level of bottled water offered in their choice set, but they were allowed to keep any or all of the money they chose not to spend on the bottled water. Thus there was a real opportunity cost to them of purchasing bottled water.[3] Parents with infants purchasing any amount of bottled water were given a prepaid punch card for the amount they stated they

[3] Giving the real cash treatment group actual money could create an endowment or what Cummings and Taylor (1999) call a "found money" effect. The concern is that people may spend from this money differently than they would from their original income. Economic theory would not predict this, as there is a real opportunity cost of spending any or all of the money on bottled water in the form of reduced payment from the university. Cummings and Taylor (1999) debriefed their respondents in their experiment and found an absence of found money effects. However, we did not and it would be useful to do that in future experiments.

Table 2. Overview of Experimental Design

Payment Type	Adults with Infants	Adults without Infants
Nonconsequential (hypothetical payment)	Treatment #1	Treatment #2
Consequential (actual cash)	Treatment #3	Treatment #4

would pay. The punch card could be used at their local grocery store. 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 2. For the purpose of the experiment infants were defined in the survey as children less than 1 year old, so as to be susceptible to blue baby syndrome.

This experimental design allows us to test the following hypotheses:

1. Evaluate the external validity of hypothetical WTP by assessing 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 (cash) choice experiment ($MV_i(c)$).
2. Evaluate if people have altruism toward others' infants. In particular, whether there is a statistical difference between nonparents likelihood of purchasing bottled water for another family's infant versus parents likelihood of purchasing bottled water for their own infant.

Key Elements of the Survey Design

The survey booklet stressed the focus of the analysis was on infants. This was accomplished in several ways. The cover of the survey was titled "Water Quality and Infant Health" and pictured a baby in a cradle (not something children over the age of one are likely to be in). More importantly, the instructions in Section 2 of the survey (which were prior to the WTP questions), specifically defined infants to be children under 1 year of age. As illustrated in Figure 1 below, it was also explained to respondents in three different bullet points that it is only infants that are at risk from water contaminated with nitrates.

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 needy family" in Treatment #2 and #4 instead of infants "in your household." As can be seen in Figure 2 the respondent was shown all three baseline risks in Option A and all three Option B risks side-by-side on the same page. Each of the respondents was sequentially given four different choice sets (on separate pages) and asked to make four different purchase decisions (one on each page).

The relative risks were shown numerically, using pie charts to illustrate the relative magnitude of the risk in a visual way. Pie charts have been used as a risk communication device in previous health valuation studies, such as Loomis and duVair (1993). The layout was pretested and revised 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 one time costs to the household.

WTP Questions

The script of information and the choices before the respondent in each treatment is as follows.

Treatment #1

Adults with infants were told the following in the NonConsequential Treatment: *In the next part of the survey you will be asked whether you would purchase or not purchase various*

<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

<u>Option A</u>	**<u>Option B</u>**
Use tap water	Use bottled water

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

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

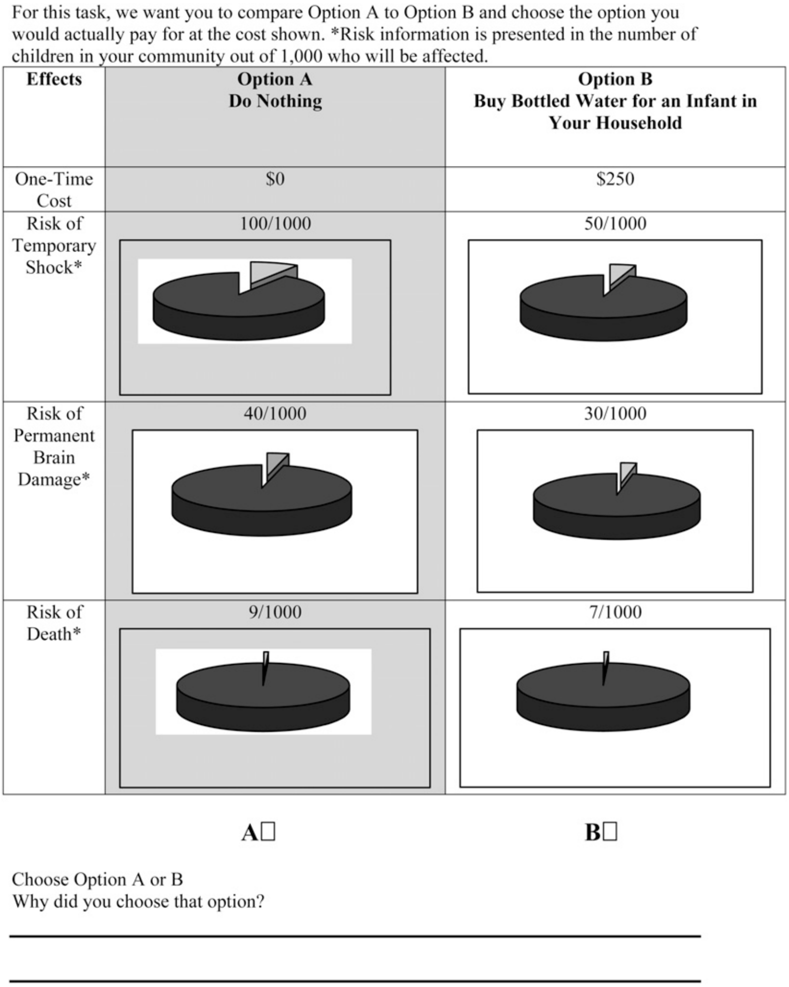
amounts of bottled water. This water would help to reduce your infant's exposure to water with excessive levels of nitrate.

If you purchased the water, the health risks to your child from nitrate contaminated drinking water 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> infants in the nonconsequential treatment were told exactly the same health 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 in treatment #1, and the same visual aids to illustrate the risk reduction were used.



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?

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

Treatment #3, Consequential

Adults with infants were told the identical information as Adults with Infants regarding health risks in Treatment #1, with the addition of the following in the consequential (actual cash) survey treatment:

*In the packet containing this survey, you were also given a voucher for $XX (*this amount varied as explained below*). 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.*

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 prepaid 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, Consequential

Adults **without** infants were told the same health information as adults without infants in Treatment #2, and they were provided the same information as Treatment #3, regarding the consequential nature of their choices, i.e., that they would pay for the bottled water out of the money they were given, and they could choose to keep all or some of the money depending on whether they bought any or some bottled water for other families' infants.

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. Developing a representative sample frame of parents with infants is difficult. Conventional sampling methods of the general population would be inefficient to locate a large number of parents with infants. Thus, data collection was originally planned to take place solely through in-person interviews of parents to be conducted at various recruitment sites (day care, childbirth classes, etc.). However, both parents and sites proved reluctant to participate in this manner. As a result, the data collection methods were broadened to also include a mail survey mode and "hosted sessions," as well as recruiting from a broader range of areas in Colorado. We control for survey mode in our logistic regression. It should be noted that one third of our "in-person" sessions were group sessions in which each respondent completed the survey booklet while seated around the table, but did not report their individual responses to the interviewer as would be done with a face to face interview. In some sense, these group sessions share more similarity with the mail survey mode, than with a traditional "one-on-one" face to face interview.

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 card 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 2 weeks. If respondents had simply forgotten to return the survey, they were reminded to do so. If they had lost the survey, they were mailed another. In another 2 weeks they were contacted by phone again; if they still did not return the survey, they were counted as a nonrespondent. Those completing the survey via mail received $15. There was random assignment to the consequential (real money) and nonconsequential treatments.

In order to expand our sample of parents with infants and to recruit adults without infants, fliers for hosted sessions were distributed in the same communities where we sampled at the Head Start and family centers. In addition, those individuals agreeing to "host" a session were asked to recruit others in specified target groups such as parents with infants and adults without infants. There was random assignment of the hosted sessions to consequential and nonconsequential treatments. One of the researchers attended and conducted in-person group sessions. 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, convenience samples are frequently used in health studies, as complete sample frames for households with a particular malady are usually not available (Hultsch et al., 2002; O'Conor and Blomquist, 1997; Pruchno et al., 2008). 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 sampling sites and at least one survey was returned for all but one of the sites. 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 mail-back surveys. In addition, another 54 mail-back 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 sample 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. In total we had 188 completed surveys out of an estimated 269 contacts that could be tracked (surveys handed out or interviews) yielding an upper bound estimate of our response rate of 70%. If we take our total returned surveys divided by the entire 450 surveys distributed to the nine sampling sites (whether or not they were actually handed out), it yields a 42% response rate. Either of our estimates of response rates is substantially higher than other health surveys. Response rates to health surveys tend be lower than for other types of valuation surveys (often due to the length and personal nature of health surveys). For example, Dickie and Messman (2004), who did a parental health survey regarding parents and their children, obtained responses from 7.5% of eligible households (those with children). This is similar to other health valuation surveys such as Johnson, Banzhaf, and Desvousges (2000) who obtained about an 8.8% response rate.

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 was the primary factor in their 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. As is standard practice in stated preference surveys, we identified individuals that rejected the premise of the constructed market. Using individuals' written responses to their WTP choices, we identified only two people who answered what would be considered rejection responses, and they were dropped from subsequent analysis. One of these rejections 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.

However, there was some item nonresponse, particularly in the mail surveys, with regard to the WTP response variable. Thirty-one people did not answer all four of their four choice set questions, and this reduced the effective sample size from a potential 744 to 713. Item non response on the other independent variables reduced the effective sample size to 689 reported in Table 3.

Table 3 provides the results of the logit model on the cost and risk reduction variables. The dependent variable is coded one if the respondent indicated they would pay for the bottled water and zero if not. The independent variables include variables to control for survey mode (mail versus group sessions) and gender (males coded as one, females as zero). In addition we included a variable for how participants rated the smell of their current domestic water supply (Water Smell), which is a four-point scale rating with 1 = strong unpleasant smell, 2 = somewhat unpleasant smell, 3 = noticeable smell, and 4 = no smell. To evaluate whether respondents believed that bottled water would reduce risk of nitrates, the variable Bottled is included, and coded as one if the respondent thinks bottled water would reduce risk of nitrates. In addition, a variable that averages a respondent's answers to a series of questions regarding the respondent's perceived control over the quality of their drinking water was also included to reflect the theory of planned behavior. The Water Perceived Control variable is coded on a four point scale ranging from strongly agree to strongly disagree.

The coefficient on the one-time cost variable is negative and statistically significant at the 6% level. This indicates that even in the hypothetical cost treatment, respondents were sensitive to the dollar amount they were asked to pay (i.e., their answers conformed to the law of demand). However, the coefficient and marginal effect of the Real Cost Dummy variable is much larger than the hypothetical cost coefficient and marginal effect. Thus, when the cost is actual or consequential, the net or overall price coefficient becomes much more sensitive to price. The significance of the real cash cost coefficient provides results of our hypothesis test indicating there is a statistical difference in responses of people facing a hypothetical cost versus an actual 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 cash; adding its coefficient to the Cost coefficient results in a net Cost coefficient of −0.011084. Thus to calculate marginal values for the real cost, we divide the attribute coefficient by Cost variable of −0.011084, while for the hypothetical cost we use the −0.001569.

The coefficient on Bottled is positive and statistically significant, meaning that respondents who believed bottled water would reduce infant's exposure to nitrates were more likely to pay than those that did not believe this. As can be seen in Table 3, the marginal effect of this variable is quite large as well. The coefficient on Survey Mode is negative and statistically significant. This sign may be considered somewhat surprising, as one would expect a tendency toward social desirability bias pushing up WTP in the in-person interviews compared with a mail survey. As noted in the prior section, about one third of the "in-person" interviewers were group sessions that involved individuals filling out their own survey booklet and not having to verbally report their answers to an interviewer. As such their answers were anonymous and were in some respects more like responses to a mail survey. Another possibly contributing factor to the negative coefficient may lie in the differential response rates between in-person and mail surveys. As noted earlier, the response rate or participation rate for the in-person sessions was 100% while for the mail-back it was 58%. Thus those that chose to return the mail survey may have had higher interest and concern for infant health, contributing to a higher WTP in the mail survey mode.

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, and the marginal effect of this variable is quite large. Those that perceived more control over their drinking water (Water Perceived Control) were more likely to pay. Further, those respondents whose "subjective norms" indicated a greater concern about drinking water quality were also more likely to pay. The overall equation is highly significant as judged by the probability of the likelihood ratio statistic being significant well beyond the 1% level.

The coefficients on reduction in risk of shock and brain damage are positive and statistically

Table 3. Logistic Regression of the Binary Choice Model

Variable	Coefficient	Marginal Effect
Constant (probability)	−1.887061 (0.0331)	
Cost	−0.001569 (0.0629)	−0.00032 (0.058)
Real cost dummy	−0.009515 (0.000)	−0.00185 (0.000)
Shock risk reduction	0.021618 (0.0029)	0.00417 (0.003)
Brain damage risk reduction	0.041088 (0.0211)	0.00818 (0.0018)
Death risk reduction	0.104565 (0.0866)	0.02101 (0.076)
Survey mode	−1.059893 (0.000)	−0.21156 (0.000)
Water smell	−0.338202 (0.006)	−0.0658 (0.006)
Bottled	0.913290 (0.000)	0.1975 (0.000)
Gender	−1.151328 (0.000)	−0.2582 (0.000)
Water perceived control	0.538444 (0.0084)	0.1055 (0.008)
Water norms	0.418873 (0.0005)	0.0818 (0.000)
Mean dependent variable	0.6923	0.461
Log likelihood	−356.6195	0.1614
Restricted Log likelihood	−425.2796	137.3201
Observations	212 = 0	477 = 1

Notes: Cost is the one time cost to an individual.
Real cost dummy is whether the survey is hypothetical-consequential dummy variable (Real equals 1) times the one time Cost. Shock risk reduction is the reduction in risk of shock to the infant (chances in 1,000). Brain damage risk reduction is the reduction in risk of brain damage (chances in 1,000). Death risk reduction is the reduction in risk of death to the infant (chances in 1,000). Survey mode is 1 for in-person or group sessions 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 0 for female. Water perceived control is perceived control over drinking water safety. Water norms is subjective norms for being concerned about drinking water quality.

significant at the 5% level, 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 conform to economic principles. 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 with brain damage, which is still larger than willingness to pay to reduce the risk of shock.

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 1,000 infants or 0.001. Performing such calculations with our data yields the following results.

A typical respondent would pay $1.95 in the real cash treatment and $13.78 in the hypothetical treatment of a sufficient quantity of bottled water that would result in a 0.001 (1 in 1,000) reduction in the chances of an infant going into shock from nitrates in water. A household would pay $3.71 in the real cash treatment and $26.19 in the hypothetical treatment of a sufficient quantity of bottled water that would result in a 0.001 reduction in the chances of an infant experiencing permanent brain damage from nitrates in water. A household would pay $9.43 in the real cash treatment and $66.64 in the hypothetical treatment of bottled water that would result in a 0.001 reduction in the chances of an infant dying from nitrates in water. The relative values are sensible, with willingness to pay to avoid the less severe health effects (e.g., shock) being less than for the more serious effects such as brain damage and death. However, whether the absolute magnitude of the difference between the WTP for each health effect is reflective of the health effect's severity is not known. For example, the WTP to avoid death is three times larger than the WTP to avoid brain damage. Whether this is too small a difference depends on how severe the brain damage would be. Our survey may have lacked sufficient detail on the exact nature of the brain damage (e.g., reduced IQ versus incapacitation of the infant). In part the lack of detail is due to the actual wide range of brain damage that can occur depending on the age of the infant and how long it took the parent to get the infant to the hospital. Some respondents may have interpreted brain damage as nondebilitating, and hence there was a larger difference between WTP to avoid brain damage and to avoid death as one might suspect.

The ratio of hypothetical WTP to actual WTP is rather high at a factor of 7.1 (e.g., \$13.78/\$1.95 for reducing risk of shock), although such degree of hypothetical bias has been found in other nonhealth experiments. As Murphy et al. (2005) note, until a comprehensive theory of hypothetical bias is developed, economists must rely upon their intuition about the factors influencing the bias. While a meta analysis of hypothetical bias by Murphy et al. (2005) found the mean ratio of hypothetical to actual was 2.6, there were about 20% of the studies that had ratios greater than this, including about 10% with ratios of 5 or higher. For example, Neil et al. (1994) found a ratio of hypothetical bias ranging from three to nine for maps and paintings. Infant health may be more susceptible to hypothetical bias than other goods used in past experiments. That is, infant health may be a more emotional topic for respondents, and their preference is to want to pay to protect infants, especially when there is no direct cost to them. However, in the actual cash treatment, there is a real opportunity cost and a real income constraint that tempers this expression of preferences. It is not that individuals in the hypothetical ignore the costs they are asked to pay. The negative sign on hypothetical cost indicates respondents in the hypothetical treatment do pay attention to costs. But the coefficient is just less price sensitive than when the price is actual foregone cash. Further, our first hypothesis is whether there is a statistical difference between hypothetical and actual WTP. If the emotional concern toward infants equally affects both of these treatments, it should not affect our test of differences in WTP, but could inflate the absolute magnitude of WTP.

Testing for Altruistic Motives

We test for altruistic motives by comparing responses of individuals that had an infant, which would be at risk from nitrates in water, and people without infants. The sample of people without infants was nearly evenly split between respondents with children age 1–3 and respondents with either older children or no children at all. 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 family's infant, an intercept shifter variable was tested in the logistic regression models and it was nonsignificant ($p = 0.14$). We also tried interacting whether the respondent had an infant at risk with the cost of the program and it, too, was nonsignificant ($p = 0.63$). 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 degrees of freedom (dof)). These results reflect the fact that almost identical proportions of respondents with an infant (72%) and without an infant (69%) would pay for the bottled water. A chi-square test suggests these proportions are not statistically different ($\chi^2 = 0.47$, 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 infant (35.3%) and those purchasing for another family's infant (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 parents' own infants. Whether this concern by nonparents is pure altruism or altruism combined with some level of guilt if the nonparent was to take the money at the expense of the infant being subjected to higher health risks is unknown. Another factor complicating our interpretation of nonparents WTP for another family's infant is that respondents were told the other family's infant was from a "needy family." As such, the WTP to another family might also combine a "redistributional" motive of helping less fortunate families in general. For both reasons cited above, our measure of altruism may be overstated by these two other confounding effects.

It should be noted that willingness to pay for one's own or others' infants 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 magnitude of the 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 nonparents to reduce purchases of bottled water and tolerate more health risks to infants. 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 the 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 nonparents of infants have a high willingness to pay to protect the health of others' infants as well. Thus broad based taxes or general fund appropriations to cost share with farmers for reductions in nitrate contamination of groundwater from agricultural operations may be an equitable way to pay for prevention of infant exposure to nitrates in groundwater and drinking water.

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Appendix A—Sample Risk Group Voucher

Colorado 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