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VALUING HEALTH FOR ENVIRONMENTAL POLICY WITH SPECIAL EMPHASIS ON CHILDREN'S HEALTH PROTECTION

PROCEEDINGS OF THE SECOND WORKSHOP IN THE ENVIRONMENTAL POLICY AND ECONOMICS WORKSHOP SERIES

--Session Three--

A Workshop sponsored by the
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Disclaimer

Proceedings for Session 3, Thursday, March 25, 1999

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Opening Remarks

by Norine Noonan, Assistant Administrator, Office of Research and Development

I want to welcome you to the second day of this workshop on *Valuing Health,* with today's emphasis on *Children's Health.* The Office of Research and Development is delighted to be working with the Policy Office and the Office of Children's Health Protection to sponsor this workshop. I also want to add my welcome to the members of the EPA Children's Health Advisory Committee who are here today.

I am particularly proud of the fact that this workshop links research funded under our Science to Achieve Results (STAR) program with specific Agency goals in children's health protection, and overall needs in support of cost-benefit analysis. I like to emphasize the fact that the "Science" under STAR is to **Achieve Results,** that address critical Agency needs. This workshop is the second in a series of five workshops that link ORD's economics and policy research to Agency policy issues.

I would like to tell you a little more about the valuation research and other research addressing children's health that ORD is conducting.

1. Some of the research papers being discussed at this seminar has been funded under the ORD Science to Achieve Results Program. The STAR program funds extramural research through competitive grants addressing high priority science needs at a level of approximately $100 million per year.

2. Since FY 95 we have issued a solicitation jointly with NSF called Decision-Making and Valuation for Environmental Policy. 53 grants totaling over $9 million have been funded to date. The FY 99 solicitation closed on Feb. 1 and 93 new proposals were received.

3. Research on approaches to value human health (reduction in morbidity and mortality), including projects related specifically to children's health, have been one of the topics of focus in the Decision-Making and Valuation research. Along with research on valuation of ecological systems, this research addresses one of the priority needs that has been identified by the Agency to support its cost-benefit analysis.

4. ORD is supporting a wide range of other research through both the STAR program and through each of our laboratories and centers addressing children's health. Research areas include:

   – Human studies of exposure and effects

     -Field studies of children's exposure to pesticides, PCBs and air toxics

     -Childhood susceptibility to the effects of air pollutants

-Environmental exposures and human neurological function
-Endemic waterborne disease in children

-the NHANES survey

-In addition, last year through the STAR program, ORD, jointly with NIEHS, funded eight Centers of Excellence for Research on Children's Health and Disease Prevention.

– Laboratory Studies using animal models

-Effects of Pesticides
-Effects of air pollutants
-Developmental tox of PCBs
-Toxicokinetics of TCDD

– Methods Models and tools for risk assessments - examples:

-Exposure factors handbook for adults and children
-Biomarkers for risk assessment in children and mothers

– Risk Management research

-We have identified several areas of risk management research that have applicability to children's health protection, including research on drinking water treatment, particulate matter and indoor air.

Again, thank you for inviting me to share some thoughts with you on this important issue. I look forward to hearing and participating in some of the discussion today.

Opening Remarks

by Ramona Trovato, Director, US EPA Office of Children's Health Protection

Ms. Trovato expressed appreciation for the risk assessment and risk reduction valuation work being done by conference attendees and others in the field of environmental economics, and emphasized how critically important economic analysis has become to EPA decisions. Ms. Trovato stated that the work being done in this area affects the standards set by EPA.

Ms. Trovato described the functions and agenda of the EPA Office of Children's Health Protection, an office with about twelve people, including one economist. The Office has an advisory committee of approximately 40 people, including a subcommittee on economics, which actually came up with the idea for this conference. Ms. Trovato expressed great excitement about the papers being presented in this session and at this conference, in that this work will help the general public better understand the policies of the Office of Children's Health. In particular, it is important that the work be couched in such a way that the public can understand explicitly the inherent trade-offs that are made when EPA establishes standards of exposure. For example, the benefits can be expressed in terms of fewer asthma attacks, or more days that children can play outside.

The Office of Children's Health Protection was created by executive order in May of 1997, and was directed to consider children's health protection in EPA's environmental standard-setting. It is the position of the EPA administrator that all public health standards shall consider the health effects on children, so the Office is in the process of attacking this task from an economic point of view and a risk assessment point of view. One approach is to identify the institutions in EPA that affect children. The Office is thus working with the EPA Office of Risk Assessment to identify special risk assessment issues affecting children, such as pesticide use and regulation. The Office is also working to help educate parents and caregivers about what can be done to improve children's health, such as vacuuming and damp-wiping lead-contaminated walls (if removal of the lead paint is infeasible). The EPA is also further developing methods on standard-setting, and has developed a rule-writing guide for regulations, and economics is particularly important here because of the cost-benefit analysis required for rule-writing. As part of the EPA Office of Policy's economic guidebook for general rule-writing for the entire agency, there will be a special section on rule-writing as it pertains to children's health.

There are a number of areas particularly deserving of attention. Research is needed to apply existing data on adults to draw some inferences on the implications for children. But this is only a short-term solution, because children have different exposure thresholds, and society has special values for children's health. In addition, EPA needs to answer the questions of how pain and suffering can be valued, and the value of avoiding lifelong illnesses and deficiencies. This is particularly challenging research because one cannot simply ask children for valuations, nor can we simply ask parents for their valuations. Thus, new and innovative methods for valuing children's health benefits are of great importance to the Office of Children's Health.

Introductory Remarks for Session III

by Ed Chu, US EPA Office of Children's Health Protection

Mr. Chu pointed out that there are many differences between children and adults in both physiology and their behavior, and emphasized the behavioral differences in particular. Mr. Chu asserted that children are not rational economic agents, are not consumers in a traditional sense, and do not earn income, spend or make economic choices. Also, children have a limited ability to understand the concept of death, future prospects or risk. These differences challenge the fundamental assumptions of economics. While the discussion yesterday focused upon the difficulties of getting adults to reveal their true preferences, getting children to reveal their preferences is likely to be even more difficult. There exist two options for measuring the value of risk reduction for children: to extrapolate adult values to children, or to obtain indirect valuations from parents or caregivers. With respect to the first option, issues arise as to what adjustments will need to be made. With respect to the second option, there is some literature that suggests that the valuation of children's health is consistent with models of a household production function, but there is an issue as to a public good aspect of adult valuations. Although EPA has begun this work, there are no finished studies on this topic at this time. Mr. Chu issued a call for more work to be done in this area as soon as possible. The Office of Children's Health, in addition to developing a part of EPA's guidebook on economic analysis in rulemaking, is working actively with economists to identify the gaps in current understanding, which has led to the commissioning of two of the papers being presented at this workshop.

Valuing a Statistical Child's Life:
The Case of Bicycle Safety Helmets
--Working Paper*--

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The Case of Bicycle Safety Helmets

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1. Introduction

There are many reasons to suspect that the value of a statistical *child's* life (VSCL) is different from the value of a statistical life (VSL) for an adult. The most obvious is that children have longer lives ahead of them. Children also have unknown potential that might be worth a premium to preserve. These factors might suggest that the value of a statistical child's life is actually higher than a statistical adult's. Suggesting just the opposite, however, is that children generally earn no wages at all or, at best, earn very low wages relative to adults.

Results from many different contingent valuation surveys reported by both the public health and economics literatures suggest that VSL and the value of other health benefits do, in fact, depend on the age of the affected population.[1] These surveys do not estimate dollar valuations of statistical lives. Rather, they collect information on the public's preferences for saving lives, or improving health, of individuals who belong to one age group versus another. The public health literature has examined preferences regarding sub-populations of all different ages, including children. Generally, this literature concludes that health benefits are more valuable when bestowed upon children or adults who are rearing children than when bestowed upon people in other stages of life. The economics literature has *not* analyzed preferences for saving very young lives (those under 20 years old), but it has considered preferences for different age categories of adults. Generally, it concludes that preferences regarding the value of life are hump shaped. Cropper et al. (1994) report peak values occurring at age 28; Jones-Lee et al. (1985), at ages 45 to 54. Both literatures suggest not only that the age of a "statistical" person affects valuation of life but that there is a potentially complicated relationship between the two variables; for example, that young children and the parents of young children might be valued more highly than people in other stages of life.

Despite this strong evidence of a link between age and valuation, virtually all of the VSL estimates in the economics literature have been derived from adult populations and thus represent adults better than children.[2] We found only one estimate of the VSCL. Carlin and Sandy (1991) examine mothers' purchase and use of child safety car seats for children aged four or under and estimate in 1985 dollars a VSCL of $526,827. Values of various categories of adult morbidity are also abundant in the economics literature but, again, there are only a handful of morbidity values estimated for children. Those that do exist generally rely on the cost-of-illness approach with some exceptions that rely on the averting behavior or contingent valuation approaches.[3]

Our research helps fill the void of estimates of VSCL by estimating the VSL for two age categories that span the middle years of childhood -- ages 5 to 9 and ages 10 to 14 -- as well as

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[1] Examples from the public health literature include Williams (1988), Busschback et al. (1993) and Lewis and Charney (1989). Examples from the economics literature include Jones-Lee et al. (1985) and Cropper et al. (1994).

[2] For a survey of this literature, please see Fisher, Chestnut, and Violette (1989) and Viscusi (1992).

[3] For a survey of this literature, please see Dickie and Nestor (1998).

for an adult age category. Because we estimate VSL for both children and adults using the same methodology and similar data, we fill another gap by providing the first set of VSL estimates that are directly comparable across child and adult age categories.

There is a pressing need to fill this void. In 1997 President Clinton signed Executive Order (E.O.)13045, "Protection of Children from Environmental Health Risks and Safety Risks" which requires federal agencies to assign a high priority to assessing health and safety risks that disproportionately affect children.[4] It also requires assessment of the health or safety effects on children of many planned health and safety regulations. A common tool for assessing health effects is to estimate *values* of changes in probabilities of death or illness. Such estimates are usually components of a proposed regulation's benefit-cost analysis. In fact, the Office of Management and Budget (OMB), as part of guidance to agencies conducting economic analysis of proposed regulations, states that the age of the exposed population will affect the *value* of reduced risk and should therefore be reflected by the economic analysis of a regulation.[5] Thus, policy makers have an enhanced need for estimates of the VSCL.

We derive our estimates of the VSL for children and adults from price data for bicycle safety helmets – products that reduce a child's probability of death by head injury from bicycle riding by 79 percent (Thompson et al., 1996).[6] Bicycle safety helmets are unique safety devices because they are sized for wearers of different ages; there are helmets for adults and for different age categories of children. Thus, when a parent purchases a helmet we can infer with great certainty the age range of the child for whom the helmet is intended.

A bicycle helmet yields utility strictly by improving safety since it does not generate any other positive effects.[7] A bicycle helmet does confer *disutility* through discomfort and possibly by

[4]Examples of federal regulations likely to disproportionately affect children include Environmental Protection Agency (EPA) rules on drinking water contaminants – because of children's high consumption of water per unit of body weight. EPA rules on pesticides for fruit and vegetables for analogous reasons. EPA rules on lead in paint or gasoline affect children disproportionately because lead ingestion does particular damage to developing brains. Other examples of federal regulations that have large effects on children can be found in the public health arena; including the rules and regulations dealing with inoculations against childhood diseases and illnesses.

[5]Please see the OMB Guidance for Economic Analysis of Federal Regulations Under E.O. 12866, dated January 11, 1996, p. 32.

[6]Head injury is the leading cause of death in bicycle accidents. During the five year period from 1984 to 1988, 62 percent of bicycle accident deaths in the US involved head injury (Sacks et al. 1991). Children are at particular risk. According to the National Safe Kids Campaign (1997), bicycles are associated with more childhood injuries than any other consumer product except the automobile.

[7]This is unlike products such as large cars which confer safety but also confer comfort and possibly prestige. For these products, economists must try to econometrically tease out the portion of price going to purchase safety versus other positive attributes.

reducing the wearer's physical attractiveness. This suggests that the purchase price of a helmet is a lower bound of the willingness to pay (WTP) for the protection it bestows. The actual WTP includes both the purchase price and the value of the disutility.

The combination of these three factors -- that helmets substantially reduce the risk of death from bicycle accidents; are purchased separately for children and, even better, for specific age ranges of children; and yield positive utility solely through safety improvements -- provides a unique opportunity to estimate the value of a statistical child's life (VSCL) using a calculation that relates child bicycle helmet prices to the reduction in the risk of head injury death from bicycle accidents attributable to wearing a helmet.

This paper begins with a review of relevant literature. Section 3 presents a theoretical model. Section 4 empirically implements the model. Section 5 compares our VSL estimates to others. Section 6 discusses conclusions and policy implications.

2. The Safety Product Market VSL Literature

A child's bicycle helmet belongs to a small set of consumer goods whose exclusive purpose is to provide protection from harm. Several existing papers have estimated the VSL by examining purchases of goods from this small set. For our purpose, the most relevant is an examination of mothers' purchase and use of child safety seats by Carlin and Sandy (1991). Other relevant papers include a pair of studies by Dardis (1980) and Garbacz (1989) which examines purchases of smoke detectors and a 1979 paper by Blomquist which analyzes seat belt usage.

Carlin and Sandy (1991) collect data on car seat usage from 10 cities in Indiana. At a site for each city, surveyors, with the help of state troopers, stopped every passing car that carried a child who appeared to be aged four or under. Data was collected as to whether the child was properly restrained and drivers were asked to complete a follow-up questionnaire and return it by mail. Carlin and Sandy combine the following data: drivers' reported wage rates; a price of car seats estimated at about $80 in Indiana; an estimated amount of time spent harnessing and unharnessing the child; and data from the states of Washington and Tennessee on the reduction in the probability of death faced by a child wearing a car seat. They estimate in 1985 dollars a VSCL of $418,597 which they amend to $526,827 by appending the costs of raising a child.

In her examination of smoke detector purchase and use, Dardis (1980) collects information on smoke detector costs and the reduction in the probability of fire death and injury that smoke detectors provide. Costs include purchase price of smoke detectors and annual replacement cost of batteries. Purchase price is based on catalog prices of Sears, Roebuck and Company. She approximates subjective probabilities by actual relative frequencies of fire deaths and injuries. She obtains safety effectiveness data from a study by the National Bureau of Standards that found that smoke detectors provide 45 percent protection against death and 30 percent against injury. Dardis' estimates of VSL range from $101,165 to $676,266 in 1976 dollars. Her estimates vary according to the discount rate assumed, the proportion of the cost of the smoke detector attributed to death risk reduction and not injury risk reduction and the year in which benefits and costs were incurred.

Garbacz (1989) extends Dardis's research by improving the estimate of the effectiveness of smoke detectors. Garbacz criticizes the estimate from the National Bureau of Standards that smoke detectors provide 45 percent protection against death. because it does not take systematic account of factors other than smoke detectors that may alter the probability of a fire death. For decades before smoke detectors were introduced in the US, fire deaths were already experiencing a downward trend. Thus, Garbacz develops an "economic model of accidents" to better explain fire deaths over time.

Garbacz concludes that smoke detectors are much less effective at reducing the rate of home fire deaths than previously thought. Only about 9 percent of fire deaths would be offset if all households had smoke detectors. He re-estimates the VSL with a method similar to Dardis's, but with two adjustments. The first adjustment is to replace her estimate of smoke detector effectiveness with the estimate derived from his model. The second is to only choose fire death classifications that are likely to be affected by a smoke detector. (He asserts that Dardis included inappropriate data.) After making these adjustments to Dardis's 1979 VSL of $153,797, Garbacz obtains a new estimate of $1,073,559 (both are in 1976 dollars).

In a 1979 paper, Blomquist estimates the value of life based on the willingness of individuals to pay to use an automobile seat-belt to reduce the risk of accidental death. Blomquist states that the average value of life could be obtained empirically except that the average costs of using seat belts are unknown. Seat-belt-use costs consist of money costs and disutility costs. In part because there is no sticker price of seat belts, Blomquist spends much effort estimating the time costs of wearing a seat belt. He concludes that over the course of a year, 3.342 hours are spent fastening, adjusting and unfastening seatbelts. His estimate of VSL reflects a disutility cost of zero. He estimates an average value of life of about $370,000 in 1978 dollars.

To facilitate comparison, Table 1 converts the VSL estimates from these four papers, and others based on tradeoffs made outside the labor market, into 1997 dollars. Carlin and Sandy's estimate of VSCL is at the low end. We compare these to our own VSCL estimates in Section 5 below.

3. <u>A Theoretical Model</u>

Consumer safety product markets give information about the VSL because the use of safety products by consumers is an "averting behavior." Economic theory predicts that an individual will consume a protective (or mitigating) good as long as the value of benefits (reduced risk) are greater than the cost of obtaining and using the good. In the case of bicycle helmets, a consumer purchases a helmet if her value for the reduced risk of head injury (whether resulting in death or not) is greater than the cost of the helmet, including the sticker price, time and disutility costs. When a parent is considering purchasing a helmet for a child, it is the parent's value for reduced risk of head injury to the child that must be greater than the cost of the helmet.

We turn to *parent's* valuations of reduced risk just as Carlin and Sandy (1991) did when they estimated VSCL by evaluating mothers' decisions about their own children's use of car seats.[8] For at least two reasons, we make no effort to model (or estimate) a child's *own* willingness to pay for reduced risk. First, children generally do not make independent economic decisions since even if a child has her own wealth, she is not in control of it. Second, children are generally considered too immature to make good safety decisions for themselves, much less to judge trade-offs between wealth and safety. Instead, we rely on parents' WTP for their own child's safety which seems a natural alternative.

In the theoretical development that follows, we assume that a parent makes purchase decisions in an effort to maximize a utility function which she believes represents her child's true well-being/utility. Following Freeman (1993), assume that a child derives utility from the consumption of a composite good, X, with a price normalized to one. Let X^0 represent the initial endowment of X. Suppose that the child faces a risk of death from head injury from bicycling, ρ. The parent can attempt to control this risk by purchasing a child's bicycle helmet.[9] Because the only positive effect of a helmet is reducing the risk of head injury, assume that a helmet affects the child's risk of death but does not convey utility directly; i.e., the quantity of helmets, h, is not an element of X but

(1) $$\rho = \rho(h).$$

Because helmets reduce the risk of death,

(2) $$\partial\rho/\partial h < 0.$$

We construct a simple one-period choice model. Assuming that the utility associated with death is zero, expected utility is

(3) $$E[u] = [1 - \rho(h)] \cdot u(X) \text{ where } X = X^0 - P_h h$$

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[8]In fact there is other precedent for relying on parents' preferences over their own childrens' risks. Agee and Crocker (1996) rely on parents' decisions to treat their children's body burdens of lead to infer WTP for reduced burdens. In a variation on the theme, Viscusi, Magat and Huber (1987) examine the preferences of adults who live with young children rather than of parents. They compare responses from two subsamples: adults who live with young children and those who do not. They discuss differences in the two subsamples' values of reducing health risks to children from misuse of household chemicals. Finally, Joyce, Grossman and Goldman (1989) examine pre-natal and neo-natal intensive care costs to estimate mothers' WTP for improved air quality to benefit their infants' health.

[9]Of course, the risk is not controlled if the child does not actually wear the helmet. Our empirical estimates of VSCL will take account of this possibility.

and where P_h represents the cost of the helmet, specifically its purchase price, P, plus any time or disutility costs, C, associated with its use; that is, $P_h = P + C$. Assume that the parent maximizes equation (3) for the child with respect to h. This gives the following first order condition:

$$[1 - \rho(h)]\ (\partial u/\partial X)\ (-P_h) + u(X)\ (-\partial\rho/\partial h) = 0 \tag{4}$$

which suggests

$$-P_h\ /\ (\partial\rho/\partial h) = u(X)\ /\ \{[1 - \rho(h)]\ (\partial u/\partial X)\}. \tag{5}$$

The right hand side of equation (5) is an expression for parents' marginal willingness to pay (MWTP) for a reduction in the risk of death from head injury that her child will face, obtained by taking the total differential of $E(u)$, setting it equal to zero and solving for $dX/d\rho$. We conclude that an empirical estimate for MWTP is given by the left hand side of equation (5).

The model presented is based on the assumption that helmets are divisible. In fact, the purchase of a helmet involves a 0-1 decision. The helmet is purchased if its marginal benefit (the right hand side of equation (5)) is equal to or greater than its marginal cost (the left hand side of equation (5)). The equality of willingness to pay and marginal cost occurs only for the marginal purchaser of the good.

Empirical implementation of equation (5), suggests that:

$$\text{VSL} = \frac{\text{(annualized cost of a safety good)}}{\text{(change in the probability of death due to purchase of the good)}} \tag{6}$$

4. <u>Estimation of the Value of a Statistical Child's Life</u>

As discussed in the Introduction above, a combination of three factors suggests that the case of child bicycle safety helmets presents a unique opportunity to operationalize the model presented above and estimate VSL for *children*. Recall the three factors -- that helmets substantially reduce the risk of death from bicycle accidents; are purchased separately for children and, even better, for specific age ranges of children; and yield positive utility solely through safety improvements. These three factors and the structure of available data lead us to estimate VSCL for two age categories -- 5- to 9-year-olds and 10- to 14-year-olds and VSL for one adult age category -- 20- to 59-year-olds. Implementation of the model requires two data items for each age group -- the annualized cost of a bicycle safety helmet and the reduction in the probability of head injury death that results from buying a helmet.

4.1 The Annualized Cost of a Bicycle Safety Helmet

To obtain the annualized cost of a bicycle safety helmet we use helmet price data reported by *Consumer Reports* (1997). They provide prices for 10 "youth" helmets and 10 adult helmets collected by a national survey.[10] *Consumer Reports* states that to ensure that safety features are effective, manufacturers recommend replacing helmets after three to five years. Thus, we assume a helmet life of four years.

We calculate annualized cost differently for youth and adult helmets. For the two children's age categories, we start by averaging the 10 youth helmet prices. But recall that besides purchase price, time and disutility costs are potentially an important part of the annualized cost of using a bicycle helmet. In their safety-product-market-based estimations of VSL, Carlin and Sandy (1991), and especially Blomquist (1979), spend substantial effort estimating the time spent fastening and unfastening child car safety seats and seat belts respectively. For helmets also, there is a time cost of fastening and unfastening straps. Disutility costs of helmets include the discomfort of wearing a helmet and other vanity costs like flattened or wrinkled hair. However, for the two child age categories, the time and disutility costs are largely paid by the children wearers. Parents might not assign these costs the same weight they would assign were they to be paid by adults. We assume a zero value for these costs which suggests that our estimates of VSCL are lower bound estimates since true annualized costs would include positive, though probably small, values for these costs.

The estimation of annualized cost for the adult age category is less straight forward. Unlike prices of child helmets, prices of adult helmets vary dramatically. The *Consumer Reports*' adult helmet prices range from $25.00 to $135.00 whereas the "youth" helmet prices range from $9.00 to $40.00.[11] The wide variance in adult helmet prices suggests that these helmets differ more widely than children's helmets. *Consumer Reports'* analysis is that the variance in price is not correlated with safety factors but with ventilation. ". . . the most dramatic contrasts between helmets are in price and how well they ventilate the head." *(Consumer Reports,* p. 34) And, elsewhere, "Unfortunately, the best-ventilated new helmets don't come cheap. The *Helios* costs $135, and its closest rivals in ventilation cost between $60 . . . and about $100." (*Consumer Reports,* p. 34) None of the "youth" helmets in the *Consumer Reports'* survey is priced above $40 leading us to conclude that ventilation is not nearly as important a variable for youth helmets as for adult helmets.

Supporting this assertion is *Consumer Reports'* rating of venting for youth helmets compared to their rating for adult helmets. Out of five possible scores, all but one of the ten

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[10] "Youth" are children aged 5 to 14.

[11] The mean adult helmet price is $68.00 and the variance is $1,390; the mean youth helmet price is $24.20 and the variance, $138.18. A Barlett test (Milton and Arnold 1990) confirms that the variance of adult helmet prices is significantly larger than that for youth prices. The test statistic is X^2_1 and equals 6.93 with an associated P value between 0.01 and 0.005.

youth helmets received the two lowest scores.[12] On the other hand, all but two of the ten adult helmets received the three highest scores.[13] Apparently, and not surprisingly, adults are more comfort conscious than children and must pay a price for the extra comfort.

Important to note, however, is that the more expensive adult helmets do not convey a comfort level above what a helmet-free rider would experience. When one purchases a helmet, one is not purchasing two separate positive attributes – safety and comfort, since even the most comfortable helmets are less comfortable than no helmet. In other words, the portion of the helmet price going towards comfort clearly reflects WTP for *safety* for those purchasers. The adult purchasers of expensive, well ventilated helmets are attempting to buy themselves out of the discomfort costs that purchasers of cheaper helmets must pay. Unfortunately, because we have no information on the percent of the population who buys expensive versus inexpensive helmets, we can not use the information about WTP offered by these high helmet sticker prices. Thus, we estimate the annualized cost of an adult helmet by averaging the prices of the two adult helmets with the second lowest *Consumer Reports* ventilation rating; i.e., the lowest rated adult helmets. This gives the average price of adult helmets which have a comfort level comparable to children's helmets. This estimate of the annualized cost of an adult helmet is an effort to assign a zero value to time and disutility costs which suggests that our estimates of VSL are lower bounds. This parallels our estimates of VSCL.

For all three age categories, then, annualized cost is calculated as the average price of a helmet distributed over four years assuming a discount rate of 3 percent.[14] The second column of Table 2, "Data That Vary By Age" gives the estimated annualized costs for each age category. Note that the estimate is different for children relative to adults but is the same for the two children's age categories.

A final issue regarding annualized cost arises because bicycle helmets decrease the probability of head injury whether or not the injury results in death. Sacks et al. (1991) review death certificates and emergency department injury data for the U.S. for the five year period from 1984 through 1988. They report 1,985 head injury deaths and 905,752 head injuries from bicycle accidents. The predominant injuries were minor. However, a significant percentage of injured people (6.8 percent) were hospitalized. Given the potential importance to helmet purchasers of the prevention of head injury, we follow Dardis's analysis of smoke detectors and estimate a pair of VSLs for each age category; one that attributes the entire purchase price to death risk reduction and a second that attributes half of the price to injury risk reduction. Of course, the greater the proportion of cost attributed to injury risk reduction, the lower the estimated VSL.

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[12] The one exception received the middle score.

[13] The two exceptions received the second lowest score.

[14] Specifically, annualized cost = (average price) x $r/\{1 - 1/(1+r)^t\}$ where t is the average life of the helmet and r is the discount rate.

4.2 The Reduction in the Probability of Head Injury Death

Implementation of the model requires a second data item for each age group -- the reduction in the probability of head injury death caused by purchasing a bicycle helmet. To calculate this reduction, we collect several underlying data items. We review these data for the aged 5 to 9 category. Data and sources for the other age categories are the same except where noted. Please see Table 2 for a summary of data and sources.

The 1997 estimated population of children aged 5 to 9 is 19,668,500 (U.S. Census Bureau 1998).[15] Results from a national survey conducted in 1994 were that approximately 72.7 percent of children ride bicycles (Sacks, et al. 1996). Applying this percentage to 1997 population data gives an estimated bicycle riding population of children aged 5 to 9 of 14,299,000. Based on data from the Centers for Disease Control (CDC) (1998), we estimate that in 1997, ninety-three 5 to 9 year-olds died in pedal cycle traffic deaths.[16,17] Sacks et al. (1991) examine U.S. death certificate data for 1984 through 1988 and report that 64.1 percent of 5 to 9 year-olds experienced "head-related" deaths. If this percentage held for 1997 there would have been 59.77 deaths that were head-related. Based on a 1994 national telephone survey, we assume that of the bicyclists, helmets are worn by 31.8 percent of the 5 to 9 year-olds and 17.5 percent of 10 to 14 year olds (Sacks, et al., 1996).

We circumvent the need to develop an econometric model -- such as the one developed by Garbacz (1989) to estimate the effectiveness of smoke detectors -- by relying on previously published statistics in the public health literature. Thompson et al. (1996) in a case-control study with emergency room controls, find that 79 percent (68 percent) of severe brain injuries suffered by children aged 6 to 12 (adults aged 20 and older) are preventable by wearing a helmet.[18]

Our estimation of VSL would be improved if we had information on how closely the public's perception of the risk reduction caused by helmet wearing matched actual risk reduction. In principle, the perceptions of consumers are what affect purchase decisions. Some error is introduced by relying on actual risk reduction. However, it is limited by education campaigns, helmet standards and mandatory helmet laws that have educated the public about the protection

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[15]Calculated by averaging the 1996 and 1998 estimated populations of children aged 5 to 9.

[16]The CDC reports pedal cyclist traffic-related deaths in *U.S. Injury and Mortality Statistics* (http://www.cdc.gov/ncipc/osp/usmort.htm). However, only pre-1996 statistics are available. The 1997 estimate (93.25) was calculated by averaging the number of deaths for children ages 5 to 9 from 1995 (96), 1994 (91), 1993 (94), and 1992 (92).

[17]This figure represents only the number of motor vehicle involved deaths. In 1995, approximately 20 additional deaths occurred for children aged 14 and under from non-vehicle accidents (National Safe Kids Campaign, 1997). As this statistic is unavailable for our age categories, we adopt the conservative assumption that zero deaths occur from non-vehicle accidents.

[18]A severe brain injury is the category of head injury most likely to result in death.

offered by helmets. Additional error is introduced by our use of a national average risk reduction rather than a risk reduction that varies according to the household's physical setting (proximity of busy roads or safe bicycle trails, for example), other household characteristics, bicycle characteristics, and so on. We were unable to find estimates for how risk might vary according to these factors. We do, however, take into account that the risk reduction bestowed by helmets varies according to the age of a bicyclist.

Given the data values presented above, we estimate that 79.83 head-related deaths would have occurred in 1997 among children aged 5 to 9 in the absence of bicycle helmets.[19] Again, helmets are estimated to prevent 79 percent of fatalities, implying a reduction of 63.06 head-related deaths. When combined with the number of 5- to 9-year-old children riding bicycles, this gives a probability reduction of 4.41×10^{-6}.[20] Table 2 summarizes these data for all three age categories.

There is an important concern regarding risk reduction caused by the *purchase* of a helmet. In practice, helmets are not worn all the time. A variety of sources report that the percent of people wearing helmets is approximately one half the percent who own (Rodgers 1996; Sacks et al. 1996). Thus, we present an additional estimate of VSL for each age category: one assuming that at the time of purchase, parents (or adults purchasing for self) expect the helmet to be worn 100 percent of the time and a second that more closely reflects actual experience by assuming that parents (or adults purchasing for self) expect that the helmet will be worn only 50 percent of the time. The second assumption is similar to one made by Dardis (1980) and Garbacz (1989) that consumers imperfectly replace smoke detector batteries so that smoke detectors are only operational 80 percent of the time.

4.3 Calculation of VSL

Table 3 summarizes estimates of VSL for three age categories. In the first column are estimates for purchasers who at the time of purchase expect that the child or that self will always wear a helmet while bicycling. We believe that the second column gives an improved set of estimates – a set based on an underlying assumption that more closely reflects actual experience; namely, that purchasers expect the helmet to be worn only half the time the bicyclist is riding. It is this second set of estimates that we will discuss below. All estimates appearing in the first two columns are based on the assumption that the purchaser places no value on the reduction in the probability of injury bestowed by a helmet. The third column gives estimates for purchasers who

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[19]The estimated number of head-related fatalities in the presence of helmets is:
$(.682 \times n \times p) + (.318 \times .21 \times n \times p) = 59.77$ where
n = total number of bicycle riding children aged 5 to 9;
p = probability of pedal cycle traffic death from head-injury.
Here, 69 percent of children aged 5 to 9 do not wear helmets. Thirty one percent do wear helmets and have a smaller probability of dying than the non-helmet wearers. The estimated number of head-related fatalities for 1997 in the absence of helmets is $n \times p = 79.83$.

[20](63.06)/(14,299,000)=.00000441.

expect the helmet to be worn half the time *and* who assign equal weight to reducing the probability of death versus injury.

As we discussed when developing the theoretical model, the correct interpretation of our estimates of VSCL is that they apply only to the marginal purchaser of bicycle helmets. The results of a national survey of over 5000 households conducted in 1994 suggest that 57.5 percent of children aged 5 to 9 in the United States owned a helmet (Sacks et al. 1996). This suggests that approximately 45 percent of parents "have" a lower VSCL than our estimate and 55 percent of parents have a VSCL equal to or greater than our estimate. Thus, for the aged 5 to 9 category, our estimate of $2,952,218 is close to the median VSCL.

Our estimated VSCL for the aged 10 to 14 category is $2,117,234, lower than that for the younger children. Driving our result is that the probability of a bicycle accident head injury death for the older age group is greater. Hence helmets bestow greater protection upon these children for the same price.

The same national survey mentioned above found that 42.3 percent of kids aged 10 to 14 owned a helmet (Sacks et al. 1996). This suggests that our VSCL estimate for this age category is higher than the median. This supports the conclusion that VSCL is lower for the older children.

Finally, our estimate of VSL for the aged 20 to 59 category is $3,923,398, the highest of the three estimates. The primary factor driving this result is that relative to the average price of a child's helmet, the price of an adult helmet is higher. Approximately, 35 percent of adults in the U.S. own helmets. Thus, our estimate of VSCL is higher than the median.

Interestingly, our results contradict the popular hypothesis that the value of a life varies directly with the expected number of life years remaining. They suggest a more complicated relationship between age and VSL -- a relationship that might depend, in turn, on the relationship between parent and child. Generally, a parent is wholly responsible for a child's well-being when she is born and gradually transfers that responsibility to the child as the child matures. This could explain why a parent-determined VSCL would decline as a child ages.

There are at least two possible reasons why the adult VSL is highest. One is that despite that we averaged prices of only the lowest comfort rated adult helmets, relative to children's helmets, adult helmets might generally be built with greater attention to comfort. The fact that the average price of even the lowest rated adult helmets is lower than the average price of youth helmets supports this hypothesis. If this is so, part of the adult purchase price is going to decrease the disutility costs of helmet wearing. Because children pay these costs as disutility, our estimates neglect these costs and hence we understate the true VSCL.

A second possible reason for why the adult VSL is highest is that these values are revealed by adults for themselves whereas the children's values are revealed by parents for their own children. Perhaps willingness to pay to preserve one's own life is indeed highest. This suggests that relying on a third party, even when that party is a parent, to estimate values of reduced risk might not be an acceptable alternative to collecting preferences from individuals about themselves. Since one can not expect reasonable formulations of preferences or of market trade-offs from children, perhaps the best estimate of VSCL is a VSL estimated for an adult population.

5. <u>Comparison of VSCL with other VSL Estimates</u>

Tables 4 and 1 present two different sets of VSL estimates in 1997 dollars. Table 4 summarizes 26 high quality estimates from hedonic wage analyses and a few from analyses of contingent valuation surveys.[21] Only adults are represented by these estimates. The hedonic wage analyses tend to focus on specific portions of the adult population; usually, blue collar workers and manual laborers. Our own estimates are in the range presented by Table 4 but at the low end of that range. This is similar to other estimates of VSL based on data from markets other than the labor market.

Recall that Table 1 summarizes VSL studies based on tradeoffs outside the labor market. Many of these studies represent the adult population at large and hence avoid the problem presented by hedonic wage analyses of representing only a small portion of the adult population. Table 1 summarizes several VSL estimates based on safety-product-market analyses. These estimates are most appropriate to compare to our own. In the final row of Table 1 is the only other estimate of VSCL of which we are aware – by Carlin and Sandy (1991). Recall that this VSCL was estimated for children aged 4 and under. Relative to it, regardless of the assumptions invoked, our estimates of VSCL are always at least a third higher. Relative to the entire range of estimates summarized by Table 1, most of which apply to adults, our estimates are in the upper range.

6. <u>Policy Relevance</u>

In response to recent directives such as E.O. 12866, "Regulatory Planning and Review," and the Omnibus Appropriations Act of November 1998 which requires the Thompson Report (a report on the total costs and benefits of an agency's regulations during the year 2000), policy-makers are making a concerted effort to value the benefits and costs of regulations and policies in order to better justify government expenditures. In the past, government analyses were decidedly slanted toward valuing the costs of regulations. Today, policy makers are also interested in obtaining accurate *benefit* estimations. Many such benefits are reduced risks; of contracting a fatal health condition, for example, or of being injured in an automobile accident. One way to measure these benefits is to estimate values of the resulting improvements to human health that save statistical lives.

To refine valuation of health benefits, the population as a whole can be viewed as a

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[21]In 1997, the U.S. Environmental Protection Agency (EPA) completed *The Benefits and Costs of the Clean Air Act, 1970 to 1990* (EPA 1997) wherein an approach for valuing mortality risk, subject to extensive peer review, was developed. Twenty-six high quality, policy-relevant value of life studies were identified. They are summarized by Table 4.

collection of sub-populations, defined along many possible lines. Many federal regulations and policies clearly do not impact all equally (e.g., Occupational Safety and Health Administration's regulation on logging operations affects loggers, primarily adult males, while the Environmental Protection Agency's (EPA's) rules on lead paint have a large effect on children). Despite the long history of the value of life literature, little attention has been paid to estimating values for sub-populations.

To policy-makers, children make up a particularly important sub-population. E.O. 13045, "Protection of Children from Environmental Health Risks and Safety Risks" requires federal agencies to give priority to assessing health and safety risks that disproportionately affect children. In addition, it requires agencies to assess the health or safety effects on children of many planned health and safety regulations.[22] It is not uncommon for a federal regulation to affect children disproportionately. A host of example regulations have been promulgated by the EPA. Due to children's high consumption of water per unit of body weight, EPA rules on drinking water contaminants disproportionately affect children. Rules on pesticides for fruit and vegetables are similar. Other examples can be found in the public health arena; most notably the rules and regulations dealing with inoculations against childhood diseases and illnesses.

Our research is an early effort to estimate the value of a statistical child's life which ultimately could help inform policies specifically concerned with valuing children's health improvements. We do not mean to suggest that our estimates should be adopted by policy makers to represent VSCL. Rather we hope that our estimates are one set of contributions to a growing number of estimates of VSCL derived from many different sources of data and with different methodologies. Further research is needed to construct a range of VSCLs similar to that which exists for adults.

Currently, to estimate the value of a policy's reduced mortality risk to children, economists transfer a VSL estimated for an adult population to the relevant child population. Our results suggest that this practice might over-estimate parents' assessment of those benefits. It might not over-estimate a child's own assessment of benefits. Perhaps a better estimate of a child's own assessment of benefits – better than parent's WTP -- is a WTP estimated from a population assessing their own risks; in other words, an adult WTP for adult risk reductions. To better represent a child's future preferences, transferring adult VSLs to child populations might be preferred to estimates of parent-determined VSCLs. In any case, our results are that the VSL for the age group 20 to 59 is approximately 18 percent greater than for the age group 5 to 9. This suggests that transferring adult VSLs to child populations does not produce gross mis-estimations.

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[22] We recognize that many of the risks associated with federal regulations and policies, particularly environmental regulations, differ significantly from the risks associated with bicycle riding. One such important difference concerns the fact that death is immediate in the case of bicycle riding, whereas deaths associated with cancer (and other similar illnesses resulting from exposure to environmental hazards) often have long latency periods. It is important to note, however, that we compare our VSCL estimates to adult-based estimates also dealing with reductions in risks of immediate death.

Tables

Table 1
VALUE OF STATISTICAL LIFE STUDIES BASED ON TRADEOFFS OUTSIDE THE LABOR MARKET
(values in 1997 dollars)

Study	**Nature of Risk, Year**	**Component of the Monetary Tradeoff**	**Value of Statistical Life**
Ghosh, Lees, & Seal (1975)	Highway speed-related accident risk, 1973	Value of driver time based on wage rates	$0.08 million
Blomquist (1979)	Automobile death risks, 1972	Estimated disutility of seat belts	$1.44 million
Dardis (1980)	Fire fatality risks without smoke detectors, 1974-1979	Purchase price of smoke detectors	$0.72 million
Portney (1981)	Mortality effects of air pollution, 1978	Property values in Allegheny Co., PA	$0.96 million
Ippolito &Ippolito	Cigarette smoking risks, 1980	Estimated monetary equivalent of effect of risk information	$0.84 million
Garbacz (1989)	Fire fatality risks without smoke detectors, 1968-1985	Purchase price of smoke detector	$2.40 million
Atkinson & Halvorsen (1990)	Automobile accident risks, 1986	Prices of new automobiles	$4.80 million
Carlin & Sandy (1991)	Automobile accident fatality risks to children not in a car seat, 1985	Purchase price of car seat	$0.75 million

Except for the last row, this table is from Viscusi, V.K., "The Value of Risks to Life and Health", *Journal of Economic Literature* (December 1993), see article for full references for these studies. Values are updated to 1997 dollars using the Gross Domestic Product deflator.

Table 2
Data That Vary by Age

Age	Annualized cost of a bicycle safety helmet[23]	1997 population (U.S. Census Bureau 1998)	Percent of population who ride bikes	1997 bike-riding population	1997 pedal cycle deaths (CDC 1998)	percent of deaths related to head injury (Sacks et al 1991)	percent wearing helmets all or most of the time	percent of fatalities preventable with helmet use (Thompson et al. 1996)	1997 head-injury related pedal cycle deaths in the absence of helmets	1997 deaths prevented with universal helmets	probability reduction	1997 deaths prevented - helmets worn 50 percent of the time	probability reduction - helmets worn 50 percent of the time
5-9	$6.51	19,668,500	72.7[24]	14,299,000	93.25	64.10	31.8[25]	79	79.83	63.06	4.41e-06	31.53	2.21e-06
10-14	$6.51	19,066,500	72.7	13,861,346	143.50	64.80	17.5	79	107.90	85.24	6.15e-06	42.62	3.07e-06
20-59	$10.76	146,451,000	20.2[26]	29,583,102	351.75	59.40	18.3[27]	68	238.62	160.07	5.41e-06	81.13	2.74e-06

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23 The annualized cost of a bicycle helmet was calculated in the following manner. First, the average price for helmets suitable for "youths" (children aged 5 to 14) was calculated with information from *Consumer Reports* (1997) which lists prices for 10 children's helmets based on a national survey. The average cost of an adult helmet was calculated based on the price of the two helmets receiving the lowest ventilation rating in *Consumer Reports*. *Consumer Reports* states that to ensure that safety features are effective, manufacturers recommend replacing helmets after 3 to 5 years. Assuming a helmet life of 4 years, we calculated annualized cost as: average price * $r/\{1 - 1/(1+r)^t\}$ where $t = 4$ (the average life of the helmet) and r is the discount rate. We assume that $r=0.03$.

24 Sacks et al. (1996).

25 Sacks et al. (1996).

26 Bolen et al. (1998).

27 Bolen et al. (1998).

Table 3
Value of a Statistical Life by Age Range and Assumptions
(1997 dollars)

Age	Helmet worn all the time	Helmet worn 50 percent of the time	Helmet worn 50 percent of the time and equal weight on death and injury[28]
5-9	$1,476,109	$2,952,218	$1,476,109
10-14	$1,058,617	$2,117,234	$1,058,617
20-59	$1,961,699	$3,923,398	$1,961,699

[28] For children it is assumed that the helmet is worn 50 percent of the time. That is, the parent purchasing the helmet, knowing she doesn't have control over the child's actions 100 percent of the time, realizes that the child will not always wear the helmet. Similarly, it is assumed that adults know, at the time of purchase, they will not wear a helmet all of the time.

Table 4
VALUE OF STATISTICAL LIFE ESTIMATES
(mean values in 1997 dollars)

Study	Method	Value of Statistical Life
Kneisner and Leeth (1991 - US)	Wage-Risk	$0.7 million
Smith and Gilbert (1984)	Wage-Risk	$0.8 million
Dillingham (1985)	Wage-Risk	$1.1 million
Butler (1983)	Wage-Risk	$1.3 million
Miller and Guria (1991)	Contingent Valuation	$1.5 million
Moore and Viscusi (1988)	Wage-Risk	$3.0 million
Viscusi, Magat and Huber (1991)	Contingent Valuation	$3.3 million
Marin and Psacharopoulos (1982)	Wage-Risk	$3.4 million
Gegax et al. (1985)	Contingent Valuation	$4.0 million
Kneisner and Leeth (1991 - Australia)	Wage-Risk	$4.0 million
Gerking, de Haan and Schulze (1988)	Contingent Valuation	$4.1 million
Cousineau, Lecroix and Girard (1988)	Wage-Risk	$4.4 million
Jones-Lee (1989)	Contingent Valuation	$4.6 million
Dillingham (1985)	Wage-Risk	$4.7 million
Viscusi (1978, 1979)	Wage-Risk	$5.0 million
R.S. Smith (1976)	Wage-Risk	$5.6 million
V.K. Smith (1976)	Wage-Risk	$5.7 million
Olson (1981)	Wage-Risk	$6.3 million
Viscusi (1981)	Wage-Risk	$7.9 million
R.S. Smith (1974)	Wage-Risk	$8.7 million
Moore and Viscusi (1988)	Wage-Risk	$8.8 million
Kneisner and Leeth (1991 - Japan)	Wage-Risk	$9.2 million
Herzog and Schlottman (1987)	Wage-Risk	$11.0 million
Leigh and Folson (1984)	Wage-Risk	$11.7 million
Leigh (1987)	Wage-Risk	$12.6 million
Gaten (1988)	Wage-Risk	$16.3 million

Table 4
VALUE OF STATISTICAL LIFE ESTIMATES
(mean values in 1997 dollars)

See Viscusi, V.K., *Fatal Tradeoffs* (Oxford University Press, 1992), for full references for these studies. Values are updated to 1997 dollars using the Gross Domestic Product deflator.

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Discussion of Jenkins, Owens, and Wiggins Paper
by Mark Dickie, University of Southern Mississippi -- Summarization

Dr. Dickie complemented the paper, commenting that a bicycle helmet provides a private good within the family, which differs from other work in the safety market literature, which have dealt with smoke detectors and automobile safety features. The bicycle helmet also provides a specific age match for safety for both adults and children, since both adults and children wear helmets, which differentiates it from the literature on child safety seats, for example. The research method is also advantageous in that the approach can be implemented quickly, and that there were not problems with primary data collection.

Dr. Dickie also noted some disadvantages of the approach taken in this paper. This approach gives rise to a problem with joint products, in that bicycle helmets provide both protection from death and protection from injury, making it difficult to sort out valuations for avoidance of each outcome. There are also possible mismatches between parents' perceptions of risk. in that they may under or over-estimate the kinds of risks involved. Finally, there are potential problems in accounting for children's behavior, and the need to monitor their use of bike helmets.

The results are credible, and the estimates are reasonably similar to that of other studies that have been done in this vein of literature. In terms of comparing the adult values with the child values, there is only so much that can be concluded from this study, because it is not known what the median values are for the different age groups. Thus, if the distributions for the various age groups are different, one could be comparing individuals in different percentiles of the age groups.

Another issue pertaining to the comparison across age groups, the ratios for the values of statistical lives is about 1.4 from the younger age group to the older, which is approximately the same as the inverse of the ratio of risk reduction. This raises a question as to whether the data is suggesting that the risk reduction alone is accounting for the willingness to pay; if that is the inference, then the result raises some doubts, since one would think that the value of a statistical life falls with age. This inference can be drawn from the comparison of either of the childrens's age groups with the adult age group.

Dr. Dickie pointed out that the fraction of each age group that wears bike helmets is different. He posed the question as to whether or not the value of a statistical life should be adjusted for the fraction of time that the bike helmet is actually worn. Dr. Dickie also speculated that if better data on disutility costs were available (there is insufficient variation in the discomfort data), some hedonic analysis may be possible. Finally, Dr. Dickie queried whether child-rearing *costs* should be considered along with the value of a statistical life for a child, offsetting some of the benefits of risk reduction. In summary, Dr. Dickie praised the work, which is a logical extension of the earlier paper by Carlin and Sandy[29] on the value of a statistical life.

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29 Carlin, P. and R. Sandy. 1991. "Estimating the Implicit Value of a Young Child's Life." *Southern Economic Journal*, 58(1):186-202.

Valuing Children's Health and Life: What Does Economic Theory Say About Including Parental and Societal Willingness To Pay?

--Commissioned Paper*--

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What Does Economic Theory Say About Including

Parental and Societal Willingness To Pay?

Abstract: Governments can and do adopt many policies that will improve the health and reduce the mortality risks of children. Given this, estimates of the value of improvements in children's health and reductions in their mortality risk are needed so that governments can rationally choose which of the many possible policies to adopt. These estimates should be based on an appropriate measure of value that is based on economic theory. This paper examines what economic theory has to say about what sorts of elements should be counted in that value, and how that value should then be used in decision-making.

1. Introduction:

Governments can adopt many policies that will improve the health and reduce the mortality risks of children. Given this, estimates of the value of improvements in children's health and reductions in their mortality risk are needed so that governments can rationally choose which of the many possible policies to adopt and how far to pursue them. These estimates should be based on an appropriate measure of value that is based on economic theory. This paper examines what economic theory has to say about what sorts of elements should be counted in that value, and how that value should then be used in decision-making.

The paper begins with a discussion of the various reasons why children's own willingness to pay (WTP) is unacceptable as a measure of value. I first ignore altruism by parents and other adults. I present short discussions of young children's psychological inability to imagine death, their generally high discount rates, the high degree of risk-taking behavior in adolescents, and the short time horizons of both children and adolescents. I argue that these preference related issues mean that own WTP for health and safety improvements are poor measures of the true benefits of these goods to children. I show that an additional difficulty arises from children's inability to borrow against future income.

I argue that these aspects of children's preferences and budget constraints can lead them to make decisions which can be Pareto improved on by a social planner. That is, even if parents and non-related adults are not altruistic, it may be possible for government to adopt policies that alter the voluntary decisions of children in ways that make some of the children, parents, and other adults better off and none worse off. I show how own WTP should be altered in order to provide the information necessary for such decisions.

I then focus on what I believe is a more significant question: how to account for the altruistic feelings that parents and other members of society have for the health and safety of children. It is commonly argued that parents and to a lesser extent society in general have a legitimate interest in children's welfare. In practice, parents almost universally provide their children with far more health and safety than they would voluntarily consume. While the effect is usually less extreme, society also tends to provide children with more of these goods than their families would voluntarily provide, and in "dysfunctional" cases this effect can also be very large. It is much rarer (though not unheard of - adults often believe that some degree of risk taking is part of growing up) for parents to insist that children are being too safe, or for society to take the opinion that parents are being overprotective.

While I have argued above that part of this protective behavior may be explained by a model where decisions are made by benevolent planners, rather than by altruism in the usual sense, altruism is also an important, and potentially more important factor. How altruistic preferences should be correctly incorporated into policy decisions is not obvious.

For the purposes of this paper two kinds of distinctions in altruistic preferences are relevant. The first is that between non-paternalistic and paternalistic altruism. In the former the utility of one person (the child) is an argument in the utility of another (the adult.) In the latter it is the level of consumption of a particular good by the child, say safety, that enters the preferences of the adult. This distinction is potentially important. Others have shown that, under certain circumstances, if parents care about the utility of children, then incorporating adults WTP for children's safety can result in more safety than is socially optimal. I examine the reasonableness of the assumptions on which this result is based and how sensitive this conclusion is to those assumptions. For example, I assume that there is some constraint on cash transfers to children, and look at second best solutions. There are obvious reasons why in multi-period models parents may prefer not to make cash transfers to children, even if they really care about the utility of their children.

The second distinction is between pure and impure altruism. Pure altruism is where the level of utility or consumption of the child enters the adult's utility. Both the non-paternalistic and the non-paternalistic cases above would be examples of pure altruism. Impure altruism is where the amount of the adult's contribution to the child's utility or consumption enters the donor's utility. This might be either because the donor feels good when he donates, or because he gets some benefit when other people notice he has donated.

It is well established that impure altruism is an important explanation for donations to charities and contributions to small groups in experimental settings. It seems likely that this is also true for contributions by adults to charities that help children. It is an open question as to whether parent's support of their own children is an example of pure or impure altruism.
I address the question of how preferences that incorporate impure altruism will affect WTP for the well-being of another, and how measures of WTP that include impure altruism should be used in making policy decisions.

2: Some Simple Problems with Own Willingness to Pay:

Although there is no ideal measure, economists generally agree that for the purposes of conducting benefit-cost analysis and making policy decisions the amount that a person is willing to pay to acquire a good is a useful measure of the good's value. In later sections of this paper I will discuss what happens to the validity of this measure if people other than the purchaser care about how much of it the purchaser consumes. The purpose of this section is to argue that - even ignoring externalities and altruism - this measure should not be applied to reductions in children's mortality and morbidity rates.

Different conceptions of what death means.

One argument is that young children simply lack the ability to imagine death. Carey (1985, pp. 13-40 and 60-65) reviews the psychological literature and finds a consensus that there are three stages in children's understanding of death. Until age 5 or so, children typically see death as a form of sleep, and while they see it as painful, because it involves separation from parents, they do not understand that it involves an final end to the body's biological processes. For example, they ask questions such as "How do dead people go to the bathroom?" and they speak of the need to whisper when talking at funerals to avoid waking up the deceased. Elementary age children do understand that death is terminal, but not that it is an inevitable biological fact. They often attribute the death of a person described as bad to that person's bad deeds or bad nature. However, elementary age children do understand that things such as poisons and falls and cancer can kill a person, and that once dead they aren't coming back. By about age 9 or 10, children seem to understand death as adults do.

It seems likely that children not only do not understand death as adults do, but that they do not understand that their conception of death is going to change in a way that makes death more unacceptable. Since death is irreversible, this means that we can argue that a child's WTP for a given reduction in the probability of death will be a downward biased measure of the true benefits to them of that reduction.

Changes in Discounting and Risk Aversion

A similar problem arises because children and adolescents discount the future at high rates (Krause and Harbaugh, 1998). Again, it seems likely that children do not understand that their discount rates will decline as they grow older, though the evidence on this is less conclusive. If they are faced with giving up current consumption for future increases in health or decreases in the risk of death, and if they fail to realize that their discount rate will decline, they will discount these improvements at the current rate instead of at a rate that declines with age. Again, this will mean that own WTP for safety improvements will undervalue the true benefits of the improvements.

On the other hand, if given a chance to trade off their current (but not future) health for increased future consumption, children will *underestimate* the value of future consumption, and presumably choose too much current health. Unfortunately, children seem to have relatively more opportunities of the first sort.

While risk aversion also seems to increase with age, and adolescents are well know for their willingness to take far greater risks to health than adults will accept, changes in risk aversion are probably not the source of problems of the above sort. This is because risks are typically one shot affairs. Adults are not forced to repeat the sorts of risks that they take as children. One exception might be addictions. Adolescents might be willing to take the chances that, say, cigarette smoking entails, while adults are not. However, once addicted, the adult may essentially be stuck continuing to accept repeated risks of heath damage that he would be unwilling to agree to with his current preferences. Note that this could happen even if the adolescent had made a rational forward looking decision to become addicted, as in Becker (1989).

Restricted Access to Credit

Even if there were no problems of the sorts described above, and children were able to make fully rational choices, another difficulty arises because children's current incomes are very low relative to their permanent incomes. Legal prohibitions on their rights to sign contracts make it essentially impossible for them to borrow against their future earnings. This means that, in the common situation where the cost must be paid now and the health benefits or risk reduction come later, children would be unable to borrow to make optimal choices, given their preferences. The simple solution to this problem would be to remove the borrowing constraint, but the costs of doing this will be large, if the sorts of problems described above *do* exist.

3. Should Social Planners Try to Improve on the Decisions of Children?

The above issues suggest the possibility of Pareto improving changes in children's own choices regarding health and safety, even if we ignore the possibility that adults are actually altruistic towards children. This is slightly different from the usual situation where the social planner's approach is used. The typical setup is the case where one person's actions affect another's. While these children are making bad decisions, those decisions are only affecting themselves (again ignoring altruism).

Still, it seems clear that in every case considered in section 2 above, it is possible at least in theory to construct a Pareto improvement. For example, consider the under-investment in activities that increase future health, caused by temporarily high discount rates. The social planner needs only to borrow and make the investments for the child, then have the child pay pack the loans when older.

In short, I am arguing that it's possible to give plausible normative and positive explanations, that have nothing to do with altruism, for interfering in children's own decision's. This is important because it suggests that the interference in children's decisions we *do* observe may not solely be the result of altruism, where that is defined as an adult's willingness to sacrifice his own consumption for that of a child's. As we will see below the question of how to include WTP that is derived from altruistic preferences is complicated. I believe this adds another layer of complication, requiring that empirical efforts to measure WTP for children's safety must also determine the motives behind that WTP.

4. Altruism.

In this section I address the question of how to account for the altruistic feelings that parents and other members of society have for the health and safety of children. For expositional purposes I will often take the (hopefully) oversimplified point of view that these altruistic feelings all run in one direction, from adults to children. I will also often assume that adults are more altruistic toward their own children than to other children. These conventions will make it more obvious as to how the theory, which was often developed for more general purposes, applies to the question at hand. I should note that there are models of the evolutionary development of altruism, described in Bergstrom 1996 and Sober and Wilson 1998, that predict these sorts of preferences.

For the purposes of this paper two kinds of distinctions in altruistic preferences are relevant. First is the distinction between non-paternalistic and paternalistic altruism. Non-paternalistic altruism means that the altruist cares about the well-being of other people *as those other people define their well-being*. In other words the utility of the other person is an argument in the altruists utility function. Paternalistic altruism means that the altruist cares about some particular aspect of a person's well being, not their utility. For our purposes that something will generally be safety.

It has been shown that, under certain circumstances, if people are non-paternalistically altruistic, then incorporating their WTP for the safety of others will result in more safety than is socially optimal. I examine the reasonableness of the assumptions on which this result is based, how sensitive this conclusion is to those assumptions, and how applicable this result is to the question of children's health and safety.

The second distinction is that between pure and impure altruism. Impure altruism is an important explanation for donations to charities and for contributions to small groups in experimental settings. It seems almost certain that this motive is also an important one for contributions by adults to charities that help children. It is an open question as to whether parent's support of their own children is an example of pure or impure altruism. I address the question of how preferences that incorporate impure altruism will affect WTP for the well-being of another, and how measures of WTP that include impure altruism should be used in making policy decisions.

4.1 Non-paternalistic and paternalistic altruism.

In this subsection I review work by others on the appropriate way to include WTP for reductions in the mortality and morbidity rates of others. I show that in general it is not sufficient to just look at revealed or reported WTP, and that instead it is necessary to understand both the motives behind the willingness to pay, and the constraints on the altruist and the recipient.

Non-Paternalistic Altruism

Bergstrom (1982) proved what at first glance seems to be a rather astonishing result about how non-paternalistic altruism affects the socially optimal level of safety. With a few relatively innocuous assumptions he shows that the conditions for the Pareto optimal level of public safety are the same whether people care about others or not.

The intuition is very simple if we view safety as a private good. Safety is expensive and providing it means someone must consume less of some other good. If that someone is the recipient, he gets less consumption and more safety than he would have voluntarily consumed, and so is worse off than before. Since the altruist cares about the recipient’s utility, he is also worse off. This is obviously not a Pareto improvement, much less Pareto optimal.

So suppose the altruist pays for the safety. The recipient is better off because he has more safety, a good he cares about. The altruist is better off because of the increase in the well-being of someone he cares about, but worse off because of the decrease in his own consumption. It’s not clear if this is a Pareto improvement, but it can be shown that it’s not Pareto optimal.

Suppose that the altruist gives the recipient cash equal to the cost of the safety, instead of safety. The recipient would then buy the amount of safety that maximizes his utility. This would leave the recipient with no less utility than before, and assuming the marginal utility of consumption was positive, with more utility. Since the altruist cares about the recipient’s utility he'd be better off with this larger utility increase than he would be with the smaller increase he got by giving safety. So there's a way to make everybody better off: redistribute money and let people by the amount of safety they find optimal, that is where there WTP equals the marginal cost of provision. This is just the standard argument for transfers of money rather than goods.

Bergstrom extends it to the situation where safety is a non-rival good. The argument is essentially the same: if we provide more safety than is optimal by the usual Samuelson rule, people must be consuming less of others goods than is optimal. So increasing a person's safety beyond the amount people would voluntarily buy cannot be Pareto optimal. This is not to say it's bad, just that we can do better.

In the context of the question of how to account for parental and social valuations of children's safety, this result says that society should not provide children with anymore safety than children would voluntarily buy themselves, since we could always do better by redistributing income instead. In the context of this paper, which is concerned with the question of how to value improvements in children's health, the implication is that, if we are trying to achieve the efficient amount of safety, we should use the child's own value *and not add a term for their parents willingness to pay for safety*.

Note that this is not quite the same as saying that the socially optimal quantity of children's safety, with parental or societal altruism, is the same as the level that would be optimal without that altruism. Instead, we are saying that the marginal conditions for optimality are the same. If benevolent altruists transfer money to children, then so long as safety is a normal good, the amount needed to satisfy the children's own condition for optimality will increase.

But what if the altruists are paternalistic?

There are several difficulties with using this result as a prescription for what should and should not count in benefit cost analysis. First, there is abundant evidence, beginning with the very origin of the word paternalistic, that parents, and society in general, are concerned with children's safety, and not their utility. In such a situation Jones-Lee (1991) shows that it is correct to consider *all* the altruist's WTP for the recipient's safety when determining the socially optimal level of safety.

Some intuition for this result is as follows. First, suppose we ignore the altruist's WTP in setting the recipient's safety. Now consider a slight increase in safety. This makes the recipient better off, since his safety goes up, and it also makes the altruist better off, for the same reason. Continue this process until the altruist's WTP is fully incorporated into the decision to buy safety, that is so he is no longer willing to pay for more safety.

Can we find a Pareto improvement to this situation? Obviously we can't make the altruist better off unless we can somehow induce the recipient to increase his consumption of safety even more. But we are already providing the recipient with more safety than he was willing to buy voluntarily. Again, this logic is developed for the case where safety is a private good, but the conclusion also holds if it is rival.

<u>An explanation for why WTP from non-paternalistic altruists should count too.</u>

In this part of the paper I argue that an important assumption of the Bergstrom model is unlikely to apply to the case of parents and children. As a result I will argue that, *even when parents are non-paternalistic altruists,* it is appropriate to include some portion of their WTP for safety into the calculation of the socially optimal amount of safety.

Bergstrom assumes that transfers of money to children and transfers of goods are equally expensive. However, if it is cheaper to transfer a particular good, say safety, to a recipient than it is to transfer cash, the Bergstrom result no longer holds. For example, suppose that it costs \$3 to transfer \$2 of cash (or of the consumption good), but only \$1 to transfer \$2 of safety. Then clearly it is no longer always possible to create a Pareto improvement to a safety transfer by making a cash transfer instead.

Arguably, the most important reason why it is expensive to transfer cash to children is the distortions that the prospect of these transfers create. While at first glance it might seem obvious that cash transfers to children will distort their behavior, the issue is actually rather subtle. Becker's (1981) well known rotten-kid theorem showed that there are plausible circumstances where, rather than cause children to distort their behavior in *inefficient* ways, cash transfers can actually cause them to act *efficiently*.

Suppose that the parent is an altruist who is going to make a cash transfer to the child.

The child knows this, and knows that this transfer is going to be an increasing function of the parent's wealth. By choosing actions that maximize that wealth, the child will maximize the transfer. So in this situation the prospect of a cash transfer from the altruistic parent actually serves to *reduce* inefficient distortions in the child's behavior.

The problems with this argument are both empirical and theoretical. Peters et al. (1997) in an ingenious experiment with family members show that children simply do not behave this way towards their parents. Either they don't understand the game, or they don't believe their parents are altruists. The second problem is that under more realistic assumptions the theoretical prediction no longer holds.

Bergstrom (1989) shows the rotten-kid theorem only holds in restrictive circumstances. One of several ways that cash transfers can produce distortions is if the child can commit to actions before the adult, as Bergstrom shows in a two-period model. Suppose that in period 1 the child has a choice between consuming \$1 and investing it in a way that will increase the family's period 2 earnings by \$1(1 + r). The child knows that his altruistic parent will divide the second parent income up between the parent and the child, so the child has a choice of \$1 now or a *portion* of the \$1(1 + r), later. Suppose that r is greater than the child's and the parent's discount rates, so that it is efficient to make the investment. If the portion of family income that the parent intends to share is small enough, it is quite possible the child will prefer *not* to make this investment, even though doing so would be efficient.

Bruce and Waldman (1990 and 1991) further develop this idea in a way that is relevant to the question of safety. They develop a two-period model like Bergstrom's, and use it to show that it may be optimal for even non-paternalistic altruists to give gifts in kind rather than cash. Their explanation is similar to Bergstrom's argument above and is explicitly based on Buchanan's (1975) "Samaritan's Dilemma," which was concerned with the adverse incentives of welfare programs. The dilemma for the parents is that if they promise their children a future cash transfer that is inversely related to the child's future wealth, they will induce children to work less than is optimal, and also to under invest in activities that increase their productivity. The intuition they give is that by spending more now and less in the future, children increase the marginal utility of future consumption, and this higher marginal utility will induce altruistic parents to increase their transfer. This distortion is inefficient.

Bruce and Waldman argue that parents can avoid this inefficiency by giving their children an in-kind transfer instead. They argue that the ideal good is one that forces the children to increase their savings, and they use education and down payments on a home as good examples. Children would like to convert these gifts to cash, spend the cash on current consumption, and then collect higher last period transfers from their parents, but the nature of these particular sorts of gifts makes this very difficult.

A similar and perhaps even stronger story could be told about morbidity. Children naturally, and generally correctly, believe that their parents will take care of them if they are injured or get sick. Suppose that a child with these beliefs is given the opportunity to sacrifice $1 of consumption now, in order to get a reduction in morbidity with a present value of $2 to the parent and the child. Obviously , it would be optimal to make the sacrifice. But, suppose the child knows that if they consume the $1 now, their parents will increase their future bequest, since they will be poorer in the future, *and* that if after not buying the safety they do get injured, their parents will take care of them. In such a situation children will obviously have an incentive to consume rather than invest that is even stronger than that which occurs with regular investments.

Note that the situation with risks to life is somewhat different than that of risks to health. Parents cannot make second period transfers to their children that can compensate them for death, as they can for injury and illness. Because of his, children will have no particular incentive to consume too little of forms of safety that specifically reduce death. Since in practice risks of morbidity and of mortality are correlated, this means that the problem of children under-investing in safety is somewhat mitigated.

Applying Bruce and Waldman's results to the case of safety has shown that children will tend to under-invest in safety to an even greater extent than in other things. This provides a justification for policies that increase safety above the amount that children will purchase voluntarily. The question is how far to go. Since both parents and society in general may be making second period cash transfers to children, both will be in a situation where their transfers are distorting behavior, and both will conceivable be in a situation to implement policies to increase children's safety.

For simplicity, I will assume that there is only one altruist, the parent. The analysis will be similar with more than one. We want to know how we should use the child's and the parent's WTP for safety in determining the optimal level of safety. First, recall that the fact that the altruists are making second period cash transfers causes the recipient to choose less safety than would otherwise be optimal, even if the altruist's preferences are ignored. So it is clear that there is scope for the altruist to do as Bruce and Waldman recommend and increase the provision of safety. The question is how far, and in particular should the quantity decision also incorporate the parent's WTP?

As argued above, for Bergstrom's result that we should ignore the altruist's WTP for safety to hold it must be possible to transfer money at the same cost as safety. Is that possible here? We already know that, because he cannot pre-commit to a transfer, the cash transfers from the parent will be distortionary. The question is, can the government do any better? In practice, we would have to say no. For example, neither SSI payments, Medicare, or Medicaid benefits discriminate against those whose conditions are the result of their own decisions, such as smoking or riding a motorcycle without a helmet.

Interestingly, if the government *could* pre-commit to a transfer, this would still not necessarily eliminate the distortionary effects. Parents still might undo the governments commitment by adjusting their own transfer to reflect the recipient's marginal utility of second period income.

So, I argue that in the two period model, the WTP for safety of parent's and other altruists, generally *should* be considered when making decisions about how much public safety to provide children, even if the altruists have entirely non-paternalistic motives. This is contrary to Bergstrom's conclusion. Note that it does not matter whether we measure WTP by observing parent's purchases of private safety or use CV questions about public safety. In either case, the estimated WTP should be used in government decision-making.

While the Bergstrom / Jones-Lee results are interesting, they do not apply under what I believe are the most realistic conditions. The Bruce and Waldman (1990) assumptions are more realistic, and the give a contradictory result. The conclusion for pure altruism is that, when determining the socially optimal level of safety, we should include even non-paternalistic altruist's

WTP for increases in children's safety.

4.2 Impure altruism:

Now I consider the situation where parents derive a benefit that depends on the amount of contribution they make towards their child's utility or safety. There are numerous reasons why this may be the case. Suppose that parents derive utility not from how safe their kids are, but from the actions they take to make them safer. Any parent who has found themselves worrying not only about whether their child is safe, but about whether they have taken the right steps to insure their safety knows what I mean here. Having your child suffer from an accident feels bad, but knowing that you could have done something to prevent that suffering, and failed to do it, feels even worse. Or, suppose that parents get utility when other people see that they have taken "proper" steps to ensure the safety of their children, or disutility when others see they have neglected something.

These sorts of feelings may not be uncommon. Andreoni (1988) shows that giving to charities cannot be explained without this "warm glow" motive, and work by Palfrey and Prisbrey (1997) show in an experimental setting that it is a far more important motivation than pure altruism is for giving to strangers. Harbaugh (1998) argues that *public* recognition of these gifts are important motivations as well. Our question is how, if at all, WTP for safety that is motivated by warm glow should be used for government decision making.

There are two very different possible issues here. The first is Kahneman and Knetsch's (1992) argument that the warm glow motive may explain people's responses to contingent valuation (CV) studies. That is, when people are asked if they would be WTP $20 to reduce a child's risk of death they respond yes, not because they value the reduction, but because they know they get a warm glow from contributing. Kahneman and Knetsch give a convincing argument that if this motive is in fact behind CV responses, these responses do not represent WTP in the usual sense.

But, that is not to say that impure altruism should be ignored. Suppose that the experimental results on strangers also apply to adult's altruistic feelings toward children: it's their contribution to children's safety, not the overall amount of safety the children have, that matters to the adults. Now consider a program that would solicit donations from adults and use the money to improve child safety. The "warm glow" motive would obviously lead to an additional benefit of such a program, beyond the safety improvement itself, and ignoring this additional benefit could lead policy makers to incorrect decisions.

The difficulty arises when trying to take measures of WTP from an altruist that are in part based on warm glow and then using those measures the determine the benefits of policies that do not provide the same warm glow. For example, suppose we estimate WTP by looking at contributions to a charity that promotes children's safety, and then use these estimates to determine the benefit of adopting a policy that will provide similar amounts of safety but be funded by taxation. Since taxes are involuntary, there presumably is no warm glow associated with paying them, and we will have overestimated the benefits of the policy. On the other hand, voting for such a policy, and the associated tax increase, is a voluntary act that presumably does create some warm glow benefits. In fact, it's quite possible that people might get some benefit from paying a tax to provide a benefit to others even if that tax is involuntary.

These sorts of possibilities obviously raise many questions. To my knowledge there is virtually no work on their theoretical implications for how WTP should be used. Similarly, there is little empirical understanding of how warm glow type benefits change with the method of payment.

5. Conclusion:

While I have argued that theory does *not* say that the appropriate level of safety is obtained simply by equating the sum of own, parental and societal WTP for a child's safety to the marginal cost of provision, I have provided numerous reasons why children should be provided a level of safety that exceeds the amount that would be optimal if we looked only at their own WTP.

My first arguments were made from the position of a social planner, and ignored the possibility of altruistic preferences. Instead I relied on the argument that children's safety choices suffer from failures that must be corrected, in order to achieve the efficient level of safety. I began with the evidence that very young children do not take death as seriously as adults do. Since death is permanent and they do not realize that their preferences will change, children will under-invest in safety. Second, even once children reach an adult understanding of death, they cannot borrow against future earnings. This market imperfection leads them to under-invest in safety. Third, adolescents are notorious for taking extraordinary risks with their health and safety, by the standards of adults. If they do not understand that their risk aversion will drop substantially as they get older, they may commit to patterns of behavior now that are not optimal. Along similar lines, even if children could borrow, their discount rates are higher than the rates they will have as adults. If they take their current discount rates as permanent, they will again under-invest in safety.

All these problems can be seen as market failures which lead children to purchase too little safety, and which should be corrected by government policies that provide additional amounts. Similarly, they lead to children's own reported or observed WTP for safety to be lower than what is optimal. When considering optimal levels of such publicly provided forms of safety as a clean environment, this means that the usual rule, to provide the public good in a quantity that sets the sum of WTP equal to marginal cost, will lead to too little provision of children's safety. I believe that one empirical approach that might produce more useful estimates of the correct WTP would be to use estimates of own WTP for safety from adults, and apply them to children.

I then turned to the question of altruism. It is obvious that parents, and to a presumably lesser extent non-related adults are willing to pay money to reduce children's morbidity and mortality. However, it is not so obvious how this WTP should be counted when determining whether a given policy should be adopted. The reason for this is that if we count altruist's WTP for safety, while ignoring their WTP for other things (for example, education), society will provide children with more safety and less of the other goods than is optimal. I argued that despite this theoretical result, there were some good reasons to include the WTP of parents and other adults for safety in a measure of the benefits of children's safety. First, if the altruism is *paternalistic*, in the sense that the altruist cares about, say, only the recipient's, WTP for safety should be counted. It would seem relatively simple to design CV studies that would determine to what extent the altruistic preferences of parent's and non-related adults toward children are specifically directed toward safety.

A second reason for why altruist's WTP matters is that, even with non-paternalistic or benevolent altruism, safety transfers may be cheaper than cash transfers, and that for this reason it may be optimal, in a second best sense, to consider altruist's WTP for safety. I argue that the informational requirements necessary to do this correctly are likely to be quite high, but of course that does not mean this should be ignored.

Another complication is impure altruism. I argue that there is substantial evidence that this is an important reason for charitable contributions to public goods, and that this suggests it is almost certainly an important part of the WTP by non-related adults for children's safety, if not for parents. Properly accounting for this sort of WTP in policy considerations requires a good understanding not only of WTP, but of how that WTP differs for different payment vehicles such as voluntary contributions and mandatory taxation. Again, this sort of information will require substantial empirical work of a new sort in order to correctly incorporate this motive.

To conclude, it is clear that there are many convincing reasons, well grounded in economic theory and common sense, for why a child's own WTP for safety improvements that reduce mortality and morbidity will be an underestimate of the social WTP for safety. The preferences of altruistic parents and other relatives, and of unrelated but still concerned adults, surely matter for determining what portion of it's resources society should devote to children. However, there are good reasons why the optimal amount to spend on children's safety cannot be found simply by adding up the WTP for safety of the various interested parties. Accurate measures of the social benefits of policies that increase children's health will require more than just measures of children's own preferences for safety and the altruistic preferences of their parents and of society at large. In this paper I have argued that we will also need measures of such things as the severity of the distortions that transfers create, and of the effect of payment methods on altruism.

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Contingent Valuation and Children's Health
Commissioned Paper*

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CONTINGENT VALUATION AND VALUING CHILDREN'S HEALTH

George Tolley* and Robert Fabian**

The special problems in valuing child health--including mortality, acute morbidity, and especially chronic and latent illness effects--all call for estimation by contingent valuation (CV) as a matter of default, since CV alone can elicit values when other evidence is lacking. The problem becomes how to extend the large amount of work on adult mortality and morbidity to estimation for children. With regard to mortality, the major evidence on values connected with adult mortality is from wage hedonics and is not applicable to children, who have yet to enter the labor force. With regard to morbidity, CV has emerged as one of the only ways to estimate values connected with adult morbidity, in view of the conceptual inadequacy and bias in the cost of illness approach and the inability of wage and land value hedonic approaches to yield useable estimates of illness values. Studies of averting behavior or household behavior in the face of risk can also throw light on how health risks are valued, and in some cases the approaches can be used complimentarily.

Contingent valuation has been recognized as an important and valid source of value estimates since its acceptance by the 1993 NOAA panel, which pointed out several needs for

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quality assurance in CV. Since that time, improved ways to meet these needs have been developed, and consideration of other needs and issues has further advanced the state of the art. The resulting best available methods can and should be used in child health CV estimation as we will discuss. The more fundamental challenge is to incorporate into CV the very special health valuation issues that arise for children. These include: questions of how to view the utility of children who are not yet responsible for their own decisions and who do not have the capacity to reason fully in terms of what is in their best own long run interests; how to discount future developmental and mortality effects on children from chronic exposure sometimes with latency; and how to take account of distinctions in value of health to the child as an individual human being, value placed on child health by parents and others acquainted with the child, and values of people at large for whom child well-being is cared about altruistically as well as with self interest in view of the importance of children to the future of society. In this paper, we deal with the implications of such issues for CV, suggesting approaches indicating that CV is promising and feasible for estimating child health values.

In Part I, we consider the prerequisite theory of child health values needed to guide contingent valuation estimation. We develop the theory of the own value of life over life with emphasis on child ages. We then distinguish three additive components of child health value: 1) own value to the child taking account of effects over life discounting back to the child's present age but using valuations the child will have as an adult with more rational decision-making powers than the child has at present, 2) value to persons acquainted with the child, and 3) value to society at large. The discussion brings out what is to be measured and provides guidance to questionnaire construction and evaluation of responses. In Part II, we consider implications of the existence of many different types of child health effects. These suggest the need for not one, but several, types of CV investigation. In Part III, we stress, as prerequisites to CV field work, attention to child dose-response relations, need to distinguish between those who have experience with the child health effects asked about and those who do not, and need for focus groups in view of paucity of previous efforts to estimate child values. In Part IV, we consider major issues in the design of CV instruments as they pertain to child health. Topics include discounting, risk, bid anchoring bias from named bids and assumed payment vehicles, and response elicitation problems caused by embedding, scope, seriousness with which respondent feels answers will be taken known as the decisiveness issue, and decoupling. Alternative means of dealing with the problems, and the strengths and pitfalls of alternatives are considered. In the Appendix, we offer suggestive examples of CV interview modules.

I. The Components of Child Health Values

A. A Primer on the Own Value of Life Over Life

a. Need for Economic Theory

That sound theory is indispensable to contingent valuation work is axiomatic. If we are interested in the welfare of the child, then the child's well being over life is a first component of child value to be considered. Important previous CV work has estimated how values attached to survival to remaining years vary according to age of adult, as for example in Johanneson and Johansson (1997a), which questioned how young and old adults would value an extra year of life at the end of life. This type of work establishes the feasibility and usefulness of using CV to estimate health values for individuals at different ages. A need is to extend this work based on development of theory that evaluates investments affecting longevity. Child values rather than only adult values need to be considered, which raises a number of additional valuation issues that either do not arise or arise to a lesser extent with adults, and the work needs to be extended to morbidity.

The usefulness of economic theory in contingent valuation is at least four-fold. *First*, it structures the whole inquiry, indicating what questions should be asked and how they should be formulated. *Second*, answers of respondents can be checked for consistency with qualitative implications of theory. *Third*, attempts can be made to infer numerical values of parameters implied by respondents to check their reasonableness in relation to non-CV estimates of the parameters. *Fourth*, theory brings out the logic of the value of life which can be used to help the respondent think about answers before giving bids.

b. Mortality

i. Collapsing the Future to a Single Period

A certain amount of insight about the value of life over life can be gained from the one period formulation where expected utility is the probability of survival times utility that will be experienced if a person survives the period or

$$EU = P_s U(W,Z) \tag{1}$$

where P_s is the probability of survival and utility U stands in for utility that will be experienced in the rest of life. U is a function wealth W and shifters Z of the utility of wealth that may vary with age. To find how much wealth W would be given up to increase the probability of survival P_s, set the differential of expected utility to zero letting W and P_s change incrementally

$$dEU = P_s U'(W,Z)dW + U(W,Z)dP_s = 0 \tag{2}$$

The first right-hand side term is the change in utility resulting from a change in wealth and is the probability of survival times the marginal utility of wealth, or the expected marginal utility of wealth, multiplied by the incremental change in wealth. The second right-hand side term is the change in utility from a change in the probability of survival and is the utility of wealth multiplied by the incremental change in probability. Setting the sum of the two changes equal to zero shows what the change in wealth must be to leave the individual indifferent to the change in the probability of survival. Re-arrange (2) as a solution for dW/dP_s recognizing that it is negative since wealth is being diminished. The wealth change dW/dP_s is negative since a subtraction from wealth keeps the person as well off as before in face of an increase in probability of survival. To express as wealth that would be given up V, take the negative of the change in wealth, so that $V=-dW/dP_s$, giving

$$V = -dW/dP_s = U(W,Z)/P_s U'(W,Z) \tag{3}$$

which is the wealth the person is willing to pay to just compensate for a change in the probability of survival. The right most term of (3) is often referred to as the value of a statistical life. It is the expected utility gain from a one unit increase in the probability of survival divided by the expected utility loss from a one dollar decrease in wealth. The gain is the utility of life U(W,Z) times one for the one unit change in probability, and the loss is the probability that the loss will be realized P_s times the marginal utility of wealth -U'(W,Z)). While the units of measurement of survival probabilities in the expression imply that a one unit change in probability of survival is from zero to one, or from certain death to certain survival, the expression is applicable to incremental or strictly speaking infinitesimal changes in survival probability. (3) is appropriate for evaluating the actual small changes in probabilities taken by people in everyday life and by most policies taken to reduce risks of loss of life. Policies of concern are not from certain death to certain life but rather from a probability of survival which is usually quite high to a very slightly higher probability of survival. The monetary equivalent of lives saved by most policies is dW/dP_s as given by (3) times the small change in survival probability brought about by the program.

Multiplying and dividing by wealth W, (3) can be rewritten

(4) $$dW/dP_s = W/P_s\varepsilon$$

where ε=U'(W)W/U(W) is the elasticity of utility with respect to wealth, i.e. wealth or percentage increase in utility from a one percent increase in wealth. (4) says that the value of a statistical life is proportional to W and inversely proportional to the probability of survival times the elasticity of utility $P_s\varepsilon$. If a person's earnings are $30,000 per year, an approximation to W as the present value of earnings capitalized at a 5% interest rate is $600,000. Given the high probability of survival of most persons, P_s may be approximated as unity in this example. Then from substitution into (4), an elasticity of utility ε of 10 gives a value of a statistical life of $6 million, which is on the order obtained from hedonic wage studies of earnings differentials people require to bear increased risk.

Using τ to denote age and V to denote dW/dP_s, (4) gives $V_\tau=W_\tau/P_s\varepsilon_\tau$ as the value of a statistical life at age τ, which may be differentiated with respect to τ and divided by V_τ to obtain

(5) $$(dV/d\tau)/V\tau = (dW_\tau/d\tau)/d\tau - (dP_s/d\tau))/P_s - d\varepsilon/d\tau)/\varepsilon$$

The percentage change in the value of life as age advances by one year is the percentage change in wealth minus the percentage change in probability of survival minus the elasticity of utility of wealth.

If ε is constant, $(d\varepsilon/d\tau)/\varepsilon$ drops out. Whether the value of life increases or decreases with age then depends on whether the percentage change in wealth exceeds or falls short of the percentage change in probability of survival. For adults, each year of advancing age reduces future earnings by the amount of earnings of the current year, while earnings in all future years become one year closer and are discounted less heavily. The latter effect may well outweigh the former in early years, especially when due to earnings rising with age the future earnings less heavily discounted are larger than present earnings. The effect may be reinforced due to other influences on utility Z noted in (1) whereby the child raising period increases the value attached to one's life because of feeling of responsibility toward dependents, consistent with the Johanssen and Johannasen (1997a) findings. Considering the entire life span, wealth might generally go up through working life and then decline during retirement when the dependent effect would also be lessened. Probability of survival declines, but only slightly so until very late in life. A likely course is for value of life to rise up to, say, middle age as retirement is approached due to increasing wealth. Wealth decreases after retirement, but eventually the decreasing probability of survival comes in as a significant positive influence on the value of life since it appears in the denominator of (4) and consequently has the negative effect in (5). The decreasing probability of survival could continue to increase the value of life until very advanced ages, when diminishing wealth could finally overtake its influence, leading to possible falls in the value of life in terminal years, especially for people bequeathing little wealth.

With regard to childhood, the wealth of the child consists primarily of the present value of earnings less education and rearing expenses. As the child grows older the present value of earnings grows because the adult earnings are discounted less heavily as they get closer in time. Assuming earnings during childhood are negligible, they are not a consideration. The increase in value of life with age noted above that is expected to occur at younger adult ages extends back to childhood.

Distinctions Between Value of Life, Utility of Life and Expected Utility of Life. From the multiplicative relation (3) giving the value of life $U(W,Z)/P_sU'(W,Z)$, the percent change in the value of a statistical life when age increases by one year is the sum of: the percent change in utility if one survives **minus** percent change in probability of survival **minus** percent change marginal utility of wealth. The percent changes in utility and marginal utility are in turn functions of percent change in wealth and percent changes that occur with age independent of wealth. If the utility function is separable in wealth and non-wealth influences, the percent changes in utility and marginal utility independent of wealth are identical and will cancel since they enter with opposite sign. For example, if the utility function is $U=aC^{1-\alpha}f(\tau)$, the percent changes $(dU/d\tau)/U$ and $(dU'/d\tau)/U'$ both equal $f'(\tau)/f(\tau)$ and cancel in the condition for percent change in value of life since one enters with positive and the other with negative sign. Combining the wealth effects on utility and marginal utility, the percent change in the value of life becomes the difference between the elasticity of utility and elasticity of marginal utility with respect to wealth **minus** the percent change in probability of survival. As shown by (5) if the elasticity of utility with respect to wealth is constant, the result reduces to the percent change in wealth **minus** the percent change in probability of survival.

The percent change in utility given survival as age advances by a year is the elasticity of utility with respect to wealth times the percent change in wealth **plus** the percent change in utility due to aging by one year at a given wealth level. The percent change in wealth is multiplied by the elasticity of utility with respect to wealth, which is likely to be a much smaller number than percent change in wealth multiplied by unity in the case of the value of life. Meanwhile, neither the elasticity of marginal utility with respect to wealth nor change in probability of survival enter.

The percent change in expected utility, which is the percent change in utility given survival **plus** the percent change in probability of survival, has the differences from percent change in value of life just noted for expected utility given survival, in addition to which the percent change in probability is added rather than subtracted as it is for the value of life.

Among the lessons from these distinctions are that one will have to be very careful in making statements about how value of life changes over life, so as not to be confused with changes in utility or expected utility, both in the framing of CV questions and interpreting results.

ii. Multi-period Models

Expected Utility in the Multi-Period Case. In extending work on how the value of life varies with age, one needs to go from the above model that collapses the future into one single period to an explicit multi-period model. Let the utility from a life year at future age t be $U(C_t,Z_t)$, where C_t is consumption of goods and services to which income is devoted and Z_t is a vector of other influences on utility varying with age t. $U(C_t,Z_t)$ here distinguishes utility in each future year in place of the single expression U(W,Z) used in (1) where the effect of all future years is collapsed into one term. In (1) wealth W is spread over consumption in all future years. The expected utility of remaining life at age τ is the sum of future utilities from τ onward as evaluated at τ giving as expected utility at time t

(6) $$EU_\tau = {}_\tau\!\int U(C_t,Z_t)g(t-\tau)dt$$

where $g(t-\tau)$ diminishes the utility attached to future outcomes because of time preference. For a Ramsey rational individual who perfectly foresees future utility, the only reason for time preference is the possibility of not being alive in future periods. Future utilities are weighted by the probability of survival from t to τ. If the individual faces a time-constant instantaneous probability of death ρ, $g(t-\tau)$ becomes $e^{-\rho(t-\tau)}$. While reasons other than survival probability can contribute to time preference, the effect on utility of a health improvement that increases survival probability is to reduce time preference. Survival probability remains one of the contributors to ρ or to a more general form of $g(t-\tau)$, which provides the path through which increases in survival probability become translated into dollar values.

To consider what happens to the utility from remaining years of life with advancing age, differentiate (6) with respect to τ obtaining

(7) $$dEU_\tau/d\tau=-U(C_t,Z_t)+\rho EU_t$$

derived assuming $g(t-\tau)=e^{-\rho(t-\tau)}$. The first term comes from the loss of the lower increment in the integration and represents the diminution in expected utility from having one less year of life to enjoy. The second term results from differentiating under the integral which moves utility from every future year one year closer. Each future year becomes more certain because one year of hazard that has to be endured to survive has been eliminated, acting to increase expected utility. Dividing (7) by EU_τ gives the percentage change in expected utility from remaining years of life from a one year increase in age

(8) $$[dEU_\tau/d\tau]/EU_\tau=-U(C_t,Z_t)/EU_\tau+\rho$$

showing that whether expected utility decreases or increases with advancing age depends on whether the negative impact of loss of this year's utility as a percent of utility from remaining life exceeds or falls short of the rate of time preference which in the Ramsey case would be the instantaneous probability of death.

Value of Life in Multi-Period Case. While expected utility of remaining years of life or total utils considered in (6), (7) and (8) is interesting, our central concern is the dollars that will be paid for a change in probability of survival, just as in the single period model. Setting to zero the differential of (6) letting wealth W_τ and ρ change gives

$$\text{(9)} \qquad dEU_\tau = {}_\tau\!\int U'(C_t,Z_t)e^{\rho(T-\tau)}(dC_t/dW_\tau)dt \cdot dW_\tau$$

$$- {}_\tau\!\int U(C_t,Z_t)(t-\tau)e^{-\rho(t-\tau}dt \cdot d\rho = 0$$

where $U'(C_t,Z_t)$ is the partial of utility with respect to C_t and we have again assumed a constant rate of time preference $g(t-\tau)=e^{-\rho(t-\tau)}$. The effect on expected utility of the change in wealth in the first right-hand side term just offsets the effect of the change in survival probability in the second term. The change in wealth in this equation is the WTP for a change in survival probability and is the change in wealth necessary to compensate for an increase in the instantaneous probability of death leaving the individual at the same utility level. The negative sign for the second term arises because the increase in ρ decreases utility as reflected in the minus obtained when differentiating with respect to ρ since $de^{-\rho(t-\tau)}/d\rho=-(t-\tau)e^{-\rho(t-\tau)}$. The re-arrangement of the equation giving the ratio of the change in wealth to the change in probability of survival, or WTP expressed as the change in wealth needed to compensate for an increase in survival probability, is

$$\text{(10)} \quad dW_\tau/dP_s = -dW_\tau/d\rho = {}_\tau\!\int U(C_t,Z_t)(t-\tau)e^{-\rho(t-\tau)}dt \;\Big/\; {}_\tau\!\int U'(C_t,Z_t)e^{-\rho(T-\tau)}(dC_t/dW_\tau)dt$$

Comparing value of life in the multi-period case (10) with that in the one period case (3), the numerator in (3) is the utility of living for the one period is seen to stand in for the sum of utilities of all future periods weighted by probability of survival in the multi-period case and is not really free of uncertainty at all. The denominator in (3) is expected marginal utility of wealth $P_s U'(W,Z)$ as compared to the denominator in the multi-period case (10) which is an expected marginal utility of wealth again weighting the future marginal utilities by probability of survival and further allocating a change in wealth at τ over the changes in consumption that are allocated over all future periods, as reflected in the dC/dt terms. For some purposes, it will be worth dealing with the extra complexities of the multi-period case to obtain further detailed insights.

To consider the multi-period case further, in the right-hand side numerator of (7), the τ in the lower limit of integration means that a year of utility is lost when age advances, acting to lower WTP. Within the integral the increase in τ in the $(t-\tau)$ term also lowers the numerator. However, the τ in $e^{-\rho(t-\tau)}$ has a positive effect due to drawing each survived year closer. Except for the $(t-\tau)$ term, the effect in the numerator is the same as the effect of age on expected utility. Thus the numerator should have a less rapid increase if increasing, or a more rapid decrease if decreasing.

In the right-hand side denominator, τ again appears in the lower limit of integration acting to decrease the denominator as age advances. Under the integral sign are effects that do not appear in expected utility of remaining years, namely the marginal utilities and the responses of consumption in different time periods to the change in wealth the individual gives up. The marginal utilities depend on the shape of the utility function. The changes in consumption depend on inter-temporal consumption allocation decisions. If one assumes rationality and a constant borrowing-lending interest rate, maximization of expected utility (6) with respect to C_t adding the

Lagrangian constraint $\lambda(W_\tau - {}_\tau\!\int C_t e^{-r(t-\tau)}dt)$ gives the well-known result $U'(C_t)=U'(C_\tau)e^{-r(t-\tau)}$ since λ is found to equal $U'(C_\tau)$. Consumption must increase continually to make the marginal utility of consumption fall at the rate of interest minus the rate of time preference, retarding the fall in the denominator with age. The results suggest the feasibility of further exploration of changes in the numerator and denominator of the multi-period value of life expression (10).

Predecessor literature using the life cycle model as it bears on the value of life includes Ng (1992) who presented numerical results for the value of life over life using a CRR utility function and other simplifying assumptions, in which the value of life peaked at a very advanced age, much later than the peak in expected utility. The analysis above provides a basis for further detailed exploration under a number of assumptions and for extending the analysis to child ages which Ng did not do.

In further life cycle work on mortality, the stringent inter-temporal assumptions of the Ramsey model could be relaxed, for instance, letting consumption more closely track income because of departures from a constant borrowing=lending interest rate. Defensive measures could be introduced and would be affected by changes in the probability of survival brought about by a program. If risks and effects of defensive measures are perceived accurately, the defensive measures in fact provide estimates of the value of life. Challenging cases to be investigated are those where perceptions are imperfect. Other possible complications include time varying ρ, changes in capacity for enjoyment over life and reciprocal altruism whereby at ages where children are dependent on the individual, the individual's valuation of his own life goes up because of support given to the child whose utility is of concern. Simple analytic solutions to these more extended formulations may not to be possible. However, qualitative insights emerge from them, and they are quite amenable to simulation.

c. Morbidity

A complication with morbidity models as compared to mortality models is that expected utility if a morbidity hazard is realized is not zero, as in the mortality case. Expected utility becomes a weighted average of probability of being healthy and probability of contracting a symptom, and the theory becomes accordingly more complex but remains tractable. The theory for the one period case was laid out in Berger et al. (1994) for use in CV estimation of morbidity values for adults. In the same volume Rosen (1994) developed elegant life cycle models encompassing both mortality and morbidity concerned primarily with the value of life extension. While specific expressions for the value of morbidity reductions by age were not presented, he emphasized heavily that the value of life and health are age dependent. His work provides a basis for extension to explicit expressions for value of morbidity by age and, from there, application to children.

d. Discount Rate

The discount rate is a separate issue from the value of life and health over life considered so far. The discount rate r figures in the above valuation expressions and is assumed to be known. Cropper and Sussman (1990) suggested that present WTP can be estimated as future WTP discounted by the consumption rate of interest defined as the marginal rate of substitution between present and future consumption $U'(C_t)/U'(C_{t+1})$. This result suggests that value of child mortality risk reduction could be estimated by finding the parent's surrogate valuation as an adult and using a possibly time varying $r-\rho$ to discount to the child's age. The major focus of the

Cropper and Sussman work, which also included inter-generational discounting not of concern here, was on the discount rate and not on the magnitude of the value of life as such though an algebraic expression for it was presented.

Regarding future work, we have already suggested that differences between borrowing and lending rate need to be distinguished. A person can ordinarily lend, when income exceeds consumption, at market rates of interest available on financial securities ranging from time deposits to equities. However, a parent making investments in a child's education and health may in effect lend to the child at the rate determined by the rate of return on investment in the child which ideally might be driven down to the market lending rate as the opportunity cost. The borrowing rate, when consumption exceeds income, may be determined by collateral such as real estate at low levels of borrowing, but the rate may rise rapidly if borrowing exceeds equity in financial collateral because the repayment depends on the borrowers return to human capital which is risky because of survival and health uncertainty and the difficulty of garnishing earnings. Empirically, household production studies may throw light on discount rates, the results of which could be used in or combined with contingent valuation studies.

B. Own Value and Parent Role Taking

We have so far considered conceptual issues in placing a value to oneself on one's own life and health, which is a first component of value to consider. We now begin to consider how to use the theory in the design of contingent valuation studies as applied to children's well-being. In estimating the first or own component of child value, the point immediately arises that children themselves are incapable of speaking adequately for themselves about their welfare over their lives. As we see it, the most practical approach is to have parents speak for them. For this component of value, one must ask a parent to undertake the challenging task of taking on the role of the adult that the child will become, giving opinions about what the adult who was the child will say was the wisest course that should have been taken when he or she was a child. As far as we know, this requirement for role taking is unique to child health valuation. Considerable experimentation is likely to be necessary to help respondents take on this role. In a survey instrument, needs for new types of warm up and explanation will certainly arise in addition to more than usual care in devising bid questions.

In addition to the problem of role taking, a reason the task is challenging is that discounting is involved. The parent may answer conjecturing what the child's willingness to pay (WTP) to avoid a symptom will be as an adult, which must then be discounted back to the child's age at present, either by the parent respondent or the researcher who must then find an alternative source of information about appropriate discount rate.

The task is further challenging because the parent must later in the interview be asked about the parent's valuation of child health for altruistic reasons, which is a separate source of value to be considered in the next section.

C. Value of Child Health to Family and Friends

A second component of child health value, to be added to the increase in the child's own welfare considered so far, is value of the child's health to other family members, principally parents. A major CV challenge is to induce parents to distinguish carefully between the values they express for a child's own value of health acting as a surrogate for the child as considered in the previous section and the value over and above this amount that they attach to the child's health. A desirable procedure would appear to give up front explicit instruction about the matter, with carefully constructed sequential questions that further make the distinction clear.

Value to parents includes several subcomponents, which should be called to the attention of respondents and possibly separated out for individual bids. The subcomponents include altruism due to appearance of child utility in parent utility function, warm glow due to the appearance of utility attached intrinsically to acts of giving and nurturing in parent utility function, and joy of parenting due to consumption utility of parenting appearing in parent utility function. The task of disentangling these subcomponents in bid elicitation would be daunting. The best hope may be to obtain a single bid for all of them, accepting them all as legitimate components of child health value.

From the foregoing positive subcomponents are to be subtracted costs to parents as bearers of uncovered medical expense and care giving. In the case of mortality, death of a child while still dependent brings a reduction in education, child consumption and other rearing expenses borne by parents.

While values to parents are surely the most important part of value of child health to family member, values to siblings, relatives and friends are also involved. An implication is that bid elicitation about sibling and relative values should be provided for in CV instruments. Since parents will be the primary interviewees, a feasible though not entirely satisfactory procedure is to ask parents to make conjectures about values that siblings, relatives and friends would express if asked.

D. Value of Child Health to Society at Large

The third component of child health value, to be added to the value to the child and value to family members, is value to those other than family members. Without knowing all children individually, people are concerned with the state of health of children generally in the population. After obtaining bids for the first two components, bids can be obtained for the third component making sure to carefully educate respondents about the distinctions between the three components.

II. Types of Child Health Effects

A. Symptom Distinctions: Acute versus Developmental, and Constant Risk versus Latency

One part of child health is everyday acute or short term symptoms ranging from colds to measles, many of which may be only tenuously caused by environmental pollutants. Exceptions are respiratory symptoms such as coughing, tearing and, of particular importance, asthma. A single CV questionnaire eliciting bids to avoid sick days, doctor visits or school days lost will at best throw partial light on WTP for avoidance of acute symptoms, inevitably being inadequate because of the variety of differences in pain and suffering associated with different symptoms. Even for acute symptoms, symptom-specific bids are needed.

Acute symptoms however are only a part, and perhaps not the most important part, of child health effects. Child cancer though much rarer clearly may have some roots in the environment, with smaller risks but far more serious consequences when contracted. Developmental effects such as stunted growth, brain damage and other sources of learning disabilities are further examples of long term effects during childhood. The symptoms differ greatly from more ordinary childhood symptoms, and much more attention is needed to helping respondents evaluate small risks. A different CV instrument could be needed for each disease.

Perhaps the most important child health effects of all occur when children become adults, either because a constant risk leads to a diminishing survival rate free of death or a debilitating disease with effects occurring into adulthood, or because of latency whereby there is relatively low risk during childhood with increasing risk from earlier exposure occurring during adulthood.

Inter-disciplinary effort including input from the medical profession will be required to specifically structure a meaningful differentiated CV approach. The major point is clear, however, that a series of different CV studies will be needed.

B. Mortality Versus Morbidity

As a review by Viscusi (1992, pp.45-68) brings out, the most prevalent value of life estimates are labor market studies. Some contingent valuation studies of the value of life have been carried out, with variable results. One approach to mortality effects, that tentatively seems appealing to us, is to estimate the value of life from labor market studies and use inferences from contingent valuation studies about discount rate to infer value appropriate to a child's welfare. Another approach is to frontally assault value of life in CV studies. Indeed if this is done asking about a reduction in child risk of a death from childhood disease that will occur in adulthood, the value of life and discount rate are rolled into one bid that the researcher in principle does not need to disentangle. Against this advantage is the burden placed on the respondent's mental calculation abilities which will undoubtedly be largely intuitive and thus more suspect in terms of accuracy.

Too sharp a distinction is sometimes drawn between mortality and morbidity, in that there is a tendency to consider the subjects separately. Death from disease is ordinarily accompanied by significant pain and suffering, as is clearest with cancer. The health costs include premature death and pain and suffering prior to death, both of which must be estimated. A significant part of a CV effort on child health therefore needs to be devoted to morbidity effects, even when fatal diseases are involved. The pain and suffering from the disease increases its costs, with the cost due to life shortening being at least a little reduced by the fact that the quality of life of final periods is not as great as if the individual were healthy.

C. Age of Child

Far more important than deciding the cut-off age at which a person is considered to be a child, sometimes put at 18, are distinctions between children of different ages, including negative age while still in the womb. Since children of different ages are affected differently by environmental exposures, different CV questions and perhaps even different CV studies, may be needed for children of different ages.

D. Environmental Versus Non-Environmental Health Effects

The fact that child health is affected by far more than environmental effects is one of the few considerations that helps to narrow studies focusing on the environment. For example, air pollution exposure will be of concern, but effects of nutrition may not be.

E. Direct Versus Indirect Environmental Effects

The effect of air pollution on child health is an example of a direct effect. The effect of air pollution on health of parent caring for the child, that diminishes the quality of care given, is an indirect effect. Systematization of indirect effects is needed, with provision for queries about indirect effects in CV instruments.

F. Lesson

CV estimation of child health appears eminently feasible and has marked advantages over other methods as brought out by Agee and Crocker (1998). At the same time, this section has indicated the need for an entire series of studies with careful investigation of how they should be structured in view of the variety of distinctions among health effects.

III. Prerequisites to an Adequate CV Investigation of a Disease

A. Dose Response Relations

Incorporation into the CV instrument of knowledge about dose response relations is particularly important in the case of risk reduction. Risk reduction queries need to be in terms of realistic risk reductions that would be brought about by a policy action. It is widely recognized that knowledge is particularly poor about the magnitude of most child health risks. In view of the difference in stage of biological development of children as compared to adults, damage from pollution differs. While children can throw off some common symptoms and diseases with less long lasting or ill effects than adults, they may be more susceptible to long term effects.

Non-CV attention is sorely needed to child dose response relations. While awaiting better knowledge, CV will need to assume general orders of magnitude being as realistic as possible. Ignoring the magnitude of risks, treating them cavalierly, or asking respondent to bid on risks that are out of the ball park, can importantly endanger the validity of CV estimates.

B. Recognizing the Importance of Respondent Experience

Because of the difficulty of visualizing and empathizing with symptoms with which a respondent has no experience, a case can be made that CV questionnaires be administered only to those who have experienced the symptoms or who intimately know people who have. To do so reduces the burden of defining the health commodity for which a bid is obtained. As a minimum, in a broader sample, experience with symptoms needs to be recorded in the interview process, followed by an analysis of how answers differ as between those who have experience with the symptom and those who do not.

C. Focus Groups

Continuation of the practice of having extended focus group experimentation prior to full field sampling is needed a fortiori in the case of child health. Focus group sessions ordinarily lead to substantial revisions of proposed questionnaires. In view of the new issues raised, revisions are likely to be even more substantial for child health.

IV. Issues in the Design of Child Health CV Instruments

A. Discounting

A typical way of estimating a discount rate in CV studies is to study differences in expressed values for a given commodity as affected by differences in future distance in time that the commodity will be consumed. The commodity considered is often lives saved. For example, intra-generationally, Johannesson and Johansson (1997a) compared values of people in their mid-thirties and in their mid-sixties for a mortality reduction in their mid-seventies, finding an implicit discount rate at 1.3%. Moore and Viscusi (1990) estimated discount rate based on labor market data, which is a source of discount rate outside a CV study that could be used to discount a parent's current valuation of a health risk back to age of child. CV studies of inter-generational discount rates include Cropper (1991), Johannesson and Johansson (1996) and Johannesson and Johansson (1997b). The techniques used in these various studies give ample precedent for inferring discount rates.

Questions arise as to how to use these techniques in child health CV work. Discount rates are needed for the three components of health value delineated in Part I. For discounting the first component, the child's own health value, the procedure of letting the parent speak for the child raises the question of what the rational discount rate for a child is. The child's observed behavior is likely to imply a very high discount rate but following our recommended approach is not to be used. A contender for an approach is to use adult discount rates either as inferred from questions to parents as part of the CV questionnaire using received techniques or simply using estimates from other studies.

For discounting the other two components of child health value, value to family and value to society, an inter-generational discount rate might be applied, since inter-generational distributional considerations enter.

B. Risk

The same problems of risk perception that confront CV studies of health risks to adults will confront child health studies. Viscusi (1992, chapters 6, 7 and 8) catalogs the many problems. We have already referred to the lack of scientific knowledge about child risk magnitudes. It goes without saying that extreme care regarding risk in the questionnaire is essential. We do not systematically review the possibilities here. As one example, Sloan, Viscusi, et al. (1997) applied the usual risk-money or direct payment of money for risk reduction to value multiple sclerosis, and they also applied risk-risk comparisons asking about mortality probability that would be accepted to cure a health condition, followed by use of value of life estimates from the wage literature to monetize the probability. The study also used a Bayesian formula and assumed a utility function form, combining the risk-money and risk-risk information, to correct for risk perception bias. A more elaborate chained approach combining responses to contingent valuation standard gamble questions is suggested in Carthy, et al. (1999) to break down response logic into manageable steps. Great care in providing heuristically appealing visuals for thinking about risk, requiring little mental effort, is to be recommended.

The literature on adult health effects thus supplies much precedent for handling risks that should be applicable to child health. One of our suggestions for possible CV questions in Part V offers a life path approach for eliciting bids where risk is important.

C. Bid Simplification and Avoidance of Anchoring

A tendency is often observed for respondents to value a symptom as what they believe the cost of a medicine is to treat the symptom. This is in fact correct if there is such a medicine and it will completely cure the symptom. On reflection, we believe it is simplest to remove dollar medical cost completely, obtaining bids for avoidance of symptom over and above medical costs. A simple procedure that is often true and in any case can be easily grasped is to tell the respondent that medical costs will be covered by pre-paid medical insurance with the premiums unaffected by the program. Viscusi follows a similar approach in asking respondents to bid on relief of pain and suffering only. We would add that bids on lost earnings also be obtained, as this can be an important part of value and in fact is seldom fully covered.

The literature on bid mechanisms in contingent valuation is long and still in flux. Some of our own hypotheses distilled out of bid mechanism experience in several studies in which we have been involved are as follows. First, iterative bidding which the interviewer initiates with a first bid suffers from respondent tendency to anchor to that bid. Second, the referendum approach whereby the interviewer asks yes-no questions about whether an amount named by the interviewer would be accepted encounters the same problem. Third, questions that convert payment into a vehicle such as a tax payment suffer from vehicle bias wherein the respondent is influenced by pre-conceived biases about the desirability or undesirability of the vehicle.

Fourth, asking the respondent to call out a bid on his or her own suffers from none of these problems and in our opinion deserves serious consideration.

Fifth, as another bid mechanism, we have had good results with a card game where, say, a dozen different bids ranging from ridiculously low to ridiculously high amounts are printed on playing card size pieces of cardboard. As the respondent watches, the interviewer shuffles the cards and picks them up with the values facing him that the interviewer cannot see, as in a game of fish. The respondent choose one of the cards from the interviewer's hand and either accepts it or discards it, proceeding until the value the respondent will pay is bracketed. The procedure convinces the respondent that the interviewer has no preconceived bid thought to be correct, and the involvement in the game seems to help get the respondent's mind off of thoughts that might lead to bias.

C. Embedding

Problems of embedding, where respondents value more than the researcher intends, extend to CV study of child health. Jointly produced goods appear most susceptible to embedding. If a CV questions asks about WTP for child health benefits resulting from environmental improvement, many respondents are likely to give an answer that includes benefits to adults; some may include aesthetic benefits and perhaps benefits of other public programs in their bids. Schulze et al. (1998) have considered several possibilities for dealing with embedding that should be applicable to child health. Mental models of joint products are of particular relevance to child health values. For example, if the respondent is asked "How much would you be willing to pay in extra taxes for an air pollution control program that will save your own four children 10 restricted activity days per year?", the respondent might reason that any such program will help all other children, and would also improve adult health, and would improve atmospheric visibility too; and because extra taxes mean more public goods in general, the children will benefit from improved school facilities. The example suggests that people will have different mental models; they will mix and match joint products and bid accordingly. If components of health values are asked sequentially--how much extra would you be willing to pay to extend the health benefits from your own children to include all children?--then embedding respondents will bid zero for the extra children because they have already been embedded in the initial response. Meanwhile, some respondents will accept the researcher's mental model and bid correctly. The problem is to disembed respondent answers where necessary and adjust the bids. Schulze et al. examine considerable evidence that the problem of mental models can not be completely overcome no matter how zealous the efforts are to increase context and convince the respondent to accept the researcher's point of view, though to do so to the maximum extent possible is indeed needed.

Crocker et al. (1998) argue that exchange institutions must be selected so as to elicit the respondent's underlying beliefs. Presenting a contingent market product in the language of the researcher's utility maximizing paradigm and expecting respondents to accept it will not work in many an perhaps most cases. In their examination of referendum contingent valuation, Green et al. (1998) find evidence of psychometric anchoring effects that can not be eradicated by questionnaire construction, leading them to a skepticism we agree with as to the usefulness of the referendum approach--will you pay some amount of dollars pre-specified by the interviewer for the commodity in question? We are thus not convinced of the arguments favoring using the referendum approach in the NOAA report.

D. Scope

The scope test proposed by the NOAA panel, wherein separate groups are offered programs of different scale as a check to see if the larger program receive large bids, is relevant to child health. Closely related to embedding, the scope problem is explained by Schulze et al. in terms of rapidly diminishing moral satisfaction, goods that are close substitutes, and mental models of joint products. Schulze et al. point out that the NOAA scope test is a between-group test and does not discriminate among individual respondents. Work by Schulze et al. employed a split sample and used follow up questions to detect embedding. They found that respondents who report little or no embedding tend to pass a scope test, while those who report substantial embedding tend to fail a scope test. By focusing on individual respondents, embedding problems can be identified and adjusted even when groups as a whole pass a scope test.

E. Decisiveness and Decoupling

Decisiveness means that the respondent's bids have a positive probability of influencing the adoption of a program. Decoupling means that if a program is adopted, its cost will be determined in a way the does not depend on the CV response. See Green et al. (1998, p.88), who argue that decisiveness and decoupling are necessary. The NOAA panel was less concerned, saying that "the respondent in a CV survey understands that the referendum is hypothetical; there is no implication that the tax will eventually be levied and the damage actually repaired or avoided. This suggests that considerable efforts should be made to take the question seriously..." (Arrow et al., 1993, p. 606). The panel does not give specific guidance on how to do this and does not include it in their guidelines or recommendations. We attempt to apply the analysis of Green et al. to child health valuation in our suggestive CV questions in the Appendix and include attention to the NOAA concern that respondents will have difficulty viewing the program being bid upon as isolated from other programs.

APPENDIX. ILLUSTRATIONS OF POSSIBLE CV QUESTIONS

A. Purpose of This Appendix

The number of issues discussed above is too voluminous to permit suggesting CV material covering all of them. In any case beyond, to develop a complete and refined CV instrument is too large an undertaking for the present paper. What we do in this part is to present illustrations of some possible modules of a CV instrument that attempt to grapple with some of the issues we have discussed. The material is offered tentatively to help make the issues real and to help in stimulating discussion.

We have started from the top down with the family, taking total value and breaking it down to various family members including the child. In retrospect, we might have started with the child whose heath is of concern and then built up adding on value to family members as was done in the theoretical discussion of Part I. We have not done as much with discounting or risk as we might and do not contend in any part of the material that these are the only approaches deserving consideration.

We first present set of questions that are independent of any specific environmental plan. It is the most abstract and hence simplest CV approach. Second, we develop a program-linked questionnaire that contains a good deal of descriptive realism that would be present in an actual EPA program under evaluation. Third, we briefly sketch a hybrid approach that combines elements of the first two versions. It may be most useful to evaluate programs in their earlier, formative stages.

Abstract Survey Format -- Introduction

The abstract survey version is similar to that in Tolley et al. (1994). It differs in being adapted to needs estimating child-health values, incorporating disembedding questions and using a card-game elicitation format to avoid anchoring instead of an iterative bid with starting point. Modules on budget consciousness, health evaluation, health status, defensive measures, and ranking of symptoms precede the CV questions, some of which are illustrated here.

In the abstract survey format to be considered first, there is no mention of environmental pollution, no mention of increased tax payments, utility bills or the like, and no mention of USEPA or other agency. These questions avoid a great deal of real-world institutional complexity. An advantage of this approach is that people are not prompted to think about taxes or utility bills, which may be too high already in their estimation, thus clouding the issue of health values. The questions do not allude to pollution, which can prompt respondents to vote on how they value the environment in general or to protest (with zero bids) what they see as bad behavior which should be paid for out of profits. An already complex and taxing questionnaire can thus be framed exclusively in terms of personal (and family) experience and behavior, and corresponding personal values.

We include some acute symptoms frequently associated with environmental pollution. We do not name diseases, only symptoms. We also include cancer as a long term health effect to be valued. We treat acute symptoms in a certainty context, though we cold have introduced a probability of symptom particularly for asthma. Risk in central in our consideration of cancer. Our approach to risk presentation is to face the respondent with the base-case probability of contracting cancer during an average lifetime. Thus the first probability the respondent faces is one of comfortable size, say 0.3. We then ask willingness to pay for a change in lifetime cancer risk commensurate with that associated with the pollutant. The pollutant, of course, is not mentioned in the abstract format. If the change in probability associated with environmental programs to be evaluated is too small for people to react to comfortably, the change can be magnified somewhat to induce comfort. Since no program is involved, no untruth has been conveyed to the respondent. Because several probability changes will presumably be presented to respondents, probably in a split sample, the curvature of the resulting bid curve should permit some reasonable interpolation to realistic probabilities. See Tolley et al. (1988) for an application of this approach to atmospheric visibility.

For cancer, life-path scenarios are used to define the contingent product. One scenario is the base case, where the respondent lives to an actuarially expected age. This is compared with column 1, the cancer path, to define the product. The respondent is told “You have say a 0.7 chance of getting column 3, the base case, and a 0.3 chance of getting column 1, the cancer case. Probabilities could be conveyed, for example, by a page with a thousand dots. Three-tenths are colored black, indicating base-case cancer probability, and seven-tenths red. A number of green dots could be added to convey the added cancer risk, prevention of which the respondent is asked to value. In a split sample, different groups of respondents are given different numbers of green dots, corresponding to different risks that generate a bid curve.

A "wheel of death" is used to help the respondent think about risk. It consists of a pie chart with areas corresponding to probabilities of different health outcomes and a spinner that will land on one of the areas when spun. The spinner is spun several times by the respondent, after which life path scenarios like those given on the second and third accompanying pages are presented to the respondent. The scenarios describe three age-specific health histories including asthma, cancer, and good health resulting in longer life.

Other approaches to risk could include dealing with hazard rates for cancer, which would affect the time at which cancer is contracted. If the probability that a pollutant causes cancer is constant through time, then the effect of a reduction in the constant probability on expected time to contraction of disease is a straight expectancy calculation akin to expected length of life in usual demographic work. If the hazard is more complex, with a latency period, then the probability of contracting cancer in near years may be affected little if at all but may rise sharply in later years. This is a uniform change in probability of contracting the disease through time and would require a still more complicated approach.

Focus-group work should include determining comfortable probability levels for this CV exercise. Larger-than-realistic probabilities introduce inaccuracy, but if a well-fitted bid curve can be derived, interpolation may warrant the tradeoff. Focus groups could also be used to experiment with questions based on hazard rate approaches to cancer, which we do not illustrate here.

Careful use of disembedding questions is important to getting a realistic scale of bids within programs. This in turn maximizes our chances of passing the external scope test advocated by NOAA (Schulze et al. 1998). As a way of dealing with the particularly severe potential for embedding in eliciting child-health values, we choose to start the bidding with health benefits to the family as a whole, and then ask what proportion of the bid pertains to the children, and then others. Disembedding questions are greatly simplified thereby. Another advantage of this approach is that if we view the parent-respondent as an agent for the children, then respondent's own health values, suitably discounted, serve as proxy for benefit values that will accrue to the children during their adult years. This may be a controversial interpretation, but it provides a benchmark against which other approaches can be compared.

A major tradeoff involved in using the abstract format centers mainly around the much-discussed issue of incentive compatibility. Green et al. (1988, p.88) state that there are three distinct aspects of an incentive-compatible CV protocol. They are elicitation frame, implementation frame and payment vehicle. The abstract or program-free approach makes use of only one of these aspects -- the elicitation frame. Our elicitation frame combines a symptom-ranking card game with the simple calling out of WTP bids. Frequent opportunities to revise rankings and bids gives our elicitation format the flavor of an iterative bid without a starting point. The anchoring problem associated with the iterative bid and referendum formats is thus to some extent avoided, while maximizing respondents' opportunity to research their own preferences. The other two aspects of the protocol are not appropriate to the abstract format.

Questionnaire Material -- Abstract Version

Hello. I'm _________________________ from the University of ______________. We are visiting with people in your area as part of a research project about risks to health. We have scientifically selected a sample of households to represent your area and your household has been chosen as part of the sample.

Are you the [male/female] head of the household?

[If not, ask to speak to the head and start over.]

Your opinions are very important and we hope you will help us. Please be assured that this is purely a research project and we do not represent any business or product. No sales call will result by your participation in this study. The information you provide us will remain confidential. The questionnaire will take about 30 minutes.

First I'd like to ask you some background question about your household.

How many members are present in your household?

Adults _____ Children _____

_____ _____

[Fill in age and sex on blank. Eg. 7, F]

How do you see your childrens' future income prospects?

____ Not as good as yours
____ About the same as yours
____ Better than yours

[Ask this question for kids as a group. Note any differentiation that respondent offers.]

The next few questions are about your general health. As you answer them, though, I would like you to think about the health of other members of your household, particularly your children.

A. Health Evaluation

[Interviewer: circle numbers.]

A-1. Would you describe your overall health as being
1. Excellent
2. Good
3. Fair
4. Poor

A-2. Please look at this card and tell me which statement best describes the control you have over your health.
[Interviewer: hand out card on ABILITY TO CONTROL HEALTH.]
1. There is little I can do because it is beyond my control.
2. I can do some things, but they have little effect.
3. My actions have moderate effect.
4. My actions have a great effect.

[Interviewer: take card from respondent.]

A-3. How often were you bothered by any illness, bodily disorders, aches, or pains during the last month?

Every day	1
Almost every day	2
About half of the time	3
Now and then, but less than half of the time	4
Rarely	5
None of the time	6

H. Health Status

Now we are going to talk about whether you have certain health problems and how they have occurred. Most people have difficulty remembering how many times they have experienced these problems, but it is important that you try to remember about how often you have had them. The health problems are listed on this card.

[Hand respondent Health Problem card.]

H-1. Which of the health problems on the card have you experienced in the last 12 months?

[For any health problem named, circle the number at the top of the column corresponding to the symptom. Remember to turn the page to complete each question.]

	Coughing Spells	Stuffed up Sinuses	Asthma

H-2. About how many days have

	you had this in the last 12 months?	___ days	___ days	___ days
H-3.	Which of these bothered you the most? 1 = most, 3 = least	_______	_______	______
H-4.	During the last year did this health problem cause you to miss 1 or more days of usual activity such as work, school, or work at home? Write H for housework, N for no activity missed, S for school, W for work away from home.	_______	_______	______
H-5.	About how many days of work or other usual activity did you lose because of this?	_______	_______	______
H-6.	Were there 1 or more days during the last year when this health problem caused you to greatly reduce your normal activities? Enter number of days.	_______	_______	______
H-7.	During the last year did you purchase any medicine for this health problem, either over the counter or with a prescription? Check for yes.	_______	_______	______
H-8.	About how much did you spend for this medicine?	$ _____	$ _____	$ _____
H-10.	During the last year did you visit a doctor, clinic, hospital, or other source of professional medical care for this problem? Enter number of visits.	_______	_______	______

H-12. About how much of this cost did you pay out of pocket? $ _____ $ _____ $ _____

H-13. [If workdays were lost in H-5] About how much earnings were lost because of workdays missed? $ _____ $ _____ $ _____

R. Ranking of Symptoms

In this next set of questions, I'm going to describe several symptoms of discomfort that are common to many people. The symptoms will not necessarily describe what you experience. I would like you to put yourself in the position of having these symptoms, however. Later on we're going to talk about a risk of cancer many years from now. But right now let's concentrate on the 3 symptoms.

I want you to suppose that your health in the next 12 months is going to be like it was in the past 12 months, except that you will experience 7 additional days of a given symptom.

First, we're going to talk about which of the symptoms you consider to be worst, and which you would be bothered by the least.

Everyone has experienced coughing. Please look at this card, which describes a particular coughing experience.

[Hand respondent coughing days card]

The card describes a day on which coughing occurs. You will cough about twice an hour in spells that last 10 to 20 seconds. You will feel the cough in your chest, but it is not severe enough to make you red in the face.

I am going to pause briefly to let you think about how much you would mind the 7 days of coughing.

Now suppose that, *instead of* having 7 additional days of coughing, you will have 7 additional days of sinus problems in the next 12 months. In other respects, your health will be exactly as it has been in the last 12 months.

A day of sinus problems is described on this card.

[Interviewer: hand respondent Days of Sinus Problems card]

You will have congestion and pain in your sinuses and forehead all day. You will be bothered by a feeling of stuffiness in your head, accompanied by sinus drainage in your throat. You will need to blow your nose every few minutes. You will have to breathe through your mouth most of the time.

Please think over how much you would be bothered by the 7 additional days of sinus problems and compare it to the 7 days of coughing. Think about which symptom you mind the least and which the most.

When you have decided, please tell me which bothers you more.

[Check one]

___ a coughing day
___ a day of sinus problems

Place that card under the other card.
[Wait for respondent to arrange cards]

Another problem that bothers people is asthma. Here is a card describing a day of asthma.
[Hand respondent card on Day of Asthma]

On this day, you will feel tightness in your throat and chest. You will begin to notice difficulty breathing. You will gasp and attempt to inhale more forcefully than is normal, attempting to get more air into your lungs. The harder you try, the worse your condition becomes. You wheeze, softly at first and then loudly. You inhale and exhale ever more rapidly. You feel panic, being afraid you will not get enough air. The attack last three hours, during which time you become physically exhausted. Finally you are so exhausted that you have to relax. You doze o sleep to recover.

Suppose that instead of either the coughing or the sinus problems, you will have 7 additional days of asthma, as described on the card.

Please rank the three symptoms. The question is which day bothers you the least, which the next least, and which bothers you the most. Place the three cards in the order you have decided on, the least serious on top.
[Interviewer: check to see cards are in proper order. If respondent has difficulty in ranking the days, read the following three indented paragraphs. If respondent has difficulty in ranking later on in the questionnaire, return and read these paragraphs. Otherwise, do not read the indented paragraphs to the respondent.]

> If there are symptoms that bother you the same, cards for those days should be next to each other in the deck. It does not matter which comes before the other.
>
> For example, if you don't care whether you have coughing or sinus problems, either of the two cards may be on top.

[Resume text if indented paragraphs were not read]

Thank you. I'm going to record your answers for use later. Let's keep the deck sitting there. We'll use it in a minute.
[Interviewer: record rankings on Tally Sheet.]

CV. Contingent Valuation -- Abstract Format

Now I want to ask you how much it would be worth to you to avoid the symptoms we've just talked about. In addition to the symptoms, we are also going to ask you to value the avoidance of a small risk of cancer many years from now. Notice our Tally Sheet, which we will use to record all your bids. **[Show respondent Tally Sheet]**

<u>Tally Sheet</u>

	Asthma	Cancer Risk
1.	$ _______, for entire family per year	
2.	$ _______, for children in family per year	$ ______ (one payment)
3.	$ _______, for self per year	$ ______ (one payment)
4.	$ _______, residual, if any, for other family members per year	
	[Check 1 = 2 + 3 + 4. Adjust if necessary.]	
5.	$ _______, children close to your family	$ ______ (one payment)

6. $ _______, all other children in U.S. $ ______ (one payment)
7. $ _______, TOTAL BID for asthma symptom reduction. $ ______ TOTAL (one payment) for cancer-risk reduction

[Check 7 = Σ 1-6.
Check to see if total is satisfactory.
Check to see if 1-6 are in desired relationship.
Revise as necessary.]

It shows you all the kinds of questions I will ask you about the three symptoms. Keep in mind as you answer individual questions that the total value you express will include all these parts. As we go along, you will be able to revise your bids to keep the total where you want it and to keep the parts in the right relationship to one another.

I have a deck of cards here where each card has a money amount written on it that you might or might not be willing to pay for the symptom reductions that we are asking about. Some of the numbers are really large, others quite small. We will shuffle the deck and deal the cards one by one. Please say yes if you would pay that amount for symptom reduction; say no if you wouldn't.

The first question pertains to your entire family, and refers to asthma. Would you be willing to pay the amount on this first card I've drawn at random from the deck to prevent 7 extra days of asthma? [If appropriate] And remember your expenses for these symptoms were H-8 + H-12 + H-13 for _____ symptom days. So you would be saving about $ _____ in out-of-pocket expenses. You should take account of this in your answer.]
[Deal cards repeatedly from deck. Record highest "yes" $ _____ .]
[If zero bid, probe for protesting.]

Your highest "yes" card is $ _____. Should we record that number as your bid, or would some other number be better?

Yes ____ . Value $ _____. per year.
No ____ .

Some people tell us it is difficult to think about paying to reduce just one health problem. Would you say that the dollar amount you stated your household would be willing to pay is: (Circle number)

1. Just for the Stated Health Program
2. Only for Yourself Instead of the Entire Family
3. Somewhat for People Outside Family
4. Somewhat for the Better Health and Somewhat a General Contribution to Environmental Causes
5. Basically a Contribution to All Environmental or Other Worthwhile Public Causes
6. Other (Please specify) ________________________________

About what percent of your dollar amount is just for the better health we just described? (Circle percent)

NONE SOME HALF MOST ALL

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Adapted from Schulze et al. (1998)

Next, lets focus on the value of preventing the 7 days of asthma <u>for your children</u>. Let's deal the deck again.

[Shuffle and repeat the card gam approach as long as it is meaningful to respondent. At some point, respondent may get the idea and be willing just to call out his bids. Record highest "yes". $ _______ .]

[If zero bid, probe for protesting, if necessary.]

Your highest "yes" card is $ ______. Should we record that number as your bid, or would some other number be better?

Yes ______. Value $ _______. per year.

No ______.

Next, I want you to think about the portion of your family bid pertains to <u>yourself</u>. Now let's recall your family bid and what's left over. Tell me how much of what remains pertains to yourself, leaving as much as you want for [your husband, wife, other adult household member].

Value for self $ _______ per year.

As you think about this, you might want to consider altering the family bid, or rearrange the amounts apportioned among your kids, yourself, and others.

[Changed values, if any]

Family $ _______. per year.

Children$ _______. per year.

This takes care of your family. We now move to values outside your immediate household. Here we're going to focus exclusively on kids. Are there any children outside your immediate household that you feel especially close to?

Yes ______. How many? ______.

No ______. Move to next section

How much would be willing to pay to reduce the symptoms (three symptoms, 7 days for each child) for these children?

WTP $ _______. per year.

[Elicit bid again. Card game may have spent its usefulness by now. This is a focus group question.]

A last question on the symptoms. Let's consider all children in the U.S. How much would you be willing to add to your bid to prevent extra symptoms for all these extra children?

WTP: $ _______. per year.

Let's look at the Tally Sheet. Do you wish to change any of the bids you've made so far?

[Record change, if any]

Now lets look at the cancer risk to your children during their lifetime. Here I have an illustration of some typical life paths.

[Show respondent life-path sheet]

Column 3 shows a person living out an average life span. Column 1 shows a typical life path of a person who contracts cancer. Suppose there are three chances in 10 that a person will contract cancer over the course of life and 7 chances in 10 that the person will live a normal life span. Imagine that your children face these prospects, but that there is an extra 0.05 probability -- an extra 5 chances in 100 that they might contract cancer at age 50. Let's look at this diagram to help get a better idea of the risk we're talking about.

[Hand respondent cancer-risk sheet.]

There are 70 black dots, representing normal life span and 30 red dots representing chances of contracting cancer. [Interviewer point to cancer path on life-path sheet.] The cancer risk we're talking about is represented by the 5 extra green dots shown in this diagram.

[Interviewer show second sheet of dots.]

Do you have any questions about this?

What would you be willing to pay <u>now</u> to prevent this extra risk of cancer to your children at age 50? Suppose that your children, when adults, will have adequate health insurance. Assume that they will also have adequate sick leave or workers' compensation to cover lost earnings. So, what we're asking you is how much would be willing to pay to spare your adult children the extra risk of pain and suffering from cancer.

I have a second set of bid cards here. Let's deal the cards.

[Shuffle and deal as before, unless respondent objects that it's not necessary.]

Record highest "yes" $ ______. (one payment.)

[If zero, probe for protesting.]

Again, I'd like to note that people sometimes find it difficult to think about paying to reduce just one health problem. Would you say that the dollar amount you stated your household would be willing to pay is:

(Circle number)

1. Just for the Stated Health Program
2. Somewhat for Pecuniary Expenses
3. Somewhat for Other Members of Your Family
4. Somewhat for People Outside Family
5. Somewhat for the Better Health and Somewhat a General Contribution to Environmental Causes
6. Basically a Contribution to All Environmental or Other Worthwhile Public Causes
7. Other (Please specify) ____

About what percent of your dollar amount is just for the better health we just described? (Circle percent)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Adapted from Schulze et al. (1998)

Now I'd like to repeat the cancer-risk question to you. But now we're talking about your own risk. What would you be willing to pay to prevent the additional 5 chances in 100 of contracting cancer?

10 years from now? ___ [whichever is greater. check.]

At age 50? ___

[Interviewer show the two sheets of dots again.]

WTP: $ ______ . (one payment)

Let's keep our eye on the Tally Sheet as values are completed. Feel free to make changes any time you want to.

Next, what would you be willing to add to your bid to get cancer-risk reduction for children who are close to you and your family?

WTP $ _____ .(one payment)

Lastly, let's consider all the rest of the kids in the U.S. What would you be willing to add to get the cancer-risk reduction for them?

WTP $ _____ .(one payment)

Total WTP to remove cancer risk

WTP $ _____ .(one payment)

Cancer -- Quality Adjusted Life Year Approach

Let's look at the cancer-risk question from a somewhat different point of view. Here is a card with a line drawn on it that is scaled from 0 to 1. [Interviewer hand card to respondent.] The number 1 corresponds to our column 3 situation -- long life with good health. The 0 number stands for sudden death in the immediate future. Now let's take another look at our cancer-risk life path in column 1. [Interviewer hand first life-path sheet to respondent.] I'd like you to mark the line between 0 and 1, where you think the cancer-risk life path would put a person on the quality-of-life scale. Let's look again at the sheet that illustrates the increased probability of cancer in the future. [Interviewer hand respondent second page of dots.]

Do you have any questions about this?

[Discuss, as necessary]

Please mark the line on the quality-of-life scale where you feel the cancer risk falls.

[Respondent mark line]

Now lets consider the lower level of cancer risk that we discussed earlier.

[Interviewer hand first life-path sheet to respondent.]

Please mark the line to show how much the prevention of increased cancer risk improves the quality of life. The improvement will be reflected in the size of the interval between the two marks.

Any questions?

[Respondent marks the scale.]

Here's a second quality-of-life line to rate the three symptoms we discussed earlier, thinking about your children's quality of life. Recall our discussion of 7 days per year of the three symptoms. Let's use the marker labeled "1" to compare. How much below "1" would 7 days of the three symptoms place your children?

[Respondent mark the line]

Now, if we put the two lines together, we can compare the effects on quality of life from the cancer risk and asthma. We can also see how big the relative improvements are in the before and after situations.

Looking at them together, do your responses reflect your judgment about the relative importance of the illnesses and the before and after situations? Feel free to change them in any way you like. Respondents often use their erasers a lot in this part of the survey.

[Record changes.]

We have now almost come to the end of this long exercise. Before we leave it, though, I would like to take another look at your bid card and quality-of-life lines to see if there are any values you would like to change. You could adjust the total amount, or adjust the relative size of the individual entries.

[New bids go here, if any]

Thank you. Do you have any questions about the questionnaire? If so, we can go over any part of it you like. If you'd like to think about it some more, we could meet again in a day or two to repeat any or all of the questionnaire so that it really reflects the way you feel about the program. The importance of the program and the fact that you are one of a small number of citizens in our representative sample made it important to do as good a job as we can.

Program-Linked Survey Format -- Introduction

The second narrative develops a program-linked CV for child-health values. In reality, a real program would be described. The program we describe here, however, is a purely hypothetical one, made up to illustrate some of the main features of this type of questionnaire construction. The material from the first narrative, prior to the CV questions, is partly interchangeable with the second narrative. As with the abstract questionnaire format, embedding is stressed as perhaps the main challenge to the valuation of child health. Incentive compatibility is the reason for introducing the program. Program-linked questionnaires utilize all three aspects of the Green et al. CV protocol. In addition to the elicitation frame, they provide a program to be decisive about, and they raise the real possibility that payment will be required. Implementation frames should be decisive, according to Green et al., which means that respondents should know that their bids have a positive probability of determining whether a program will be implemented. The authors recommend that the payment vehicle be decoupled, which means that respondents' bids be dissociated with amounts they would actually have to pay if the program is implemented.

If the researcher decides to stress the incentive-compatibility potential of contingent valuation, then it is necessary to describe in some detail the actual program, the agent responsible for abatement, and the method by which payment will be made. Some idea of program cost is often conveyed in program-linked surveys, but it can be wondered whether this practice would produce anchoring. We elect not to include any program-cost detail. There may be uncertainties, on both the benefit and cost sides, concerning the program. These should be conveyed, as succinctly as possible. The CV product itself, however, should be made quite precise, so that everyone is encouraged to bid on the same thing. (Clear definition of the CV product is, of course, essential to any CV approach.)

All of this requires a good deal of descriptive realism and interview time, much of which will no doubt be evocative in a variety of ways to many respondents. Zero protest bids are one common result of CV program characteristics that respondents object to. These must be probed. Tax-financed government programs offer fertile grounds in which embedding problems can grow. Considerable care must be given to disembedding questions. Of course, protest and embedding are problems for abstract questionnaires as well, but abstract questionnaires would appear to offer fewer promptings in those directions.

We believe that program-linked CV has some serious additional shortcomings for the elicitation of child-health values compared to the abstract approach. A program description could state that children on average would experience say 5 fewer symptom days per year and that the average severity is such and such, according to best available knowledge. With sufficient knowledge about program effects, it could describe the extent of variability and elicit values in the tails of the distributions. But in the absence of this degree of detailed knowledge, only point estimates of average symptom-reduction values could be elicited.

The abstract format, by contrast, could simply postulate say 1-day, 7-day, and 30-day symptom reductions, and elicit their values. Responses would provide the basis for an estimated bid curve, relating willingness to pay to a range of symptom reductions and background explanatory variables.

Another disadvantage of this program-linked approach is that CV probably must be focused on population aggregates rather eliciting values at the household level. It would be different to tell a respondents that the child's symptoms could be reduced from 15 days per year (information already acquired) to an expected 8 days per year, or even to give the respondent a reasonable probability distribution. Using the abstract format and knowledge of household symptom endowments, one could ask "What would 5 days relief be worth?" In the case of relatively light symptoms, certainty-oriented questions are useful, and there's no problem of a lack of knowledge about program effects at the household level.

Questionnaire Material -- Program-Linked Version

Several of the modules in the Abstract and Program Linked Version are very similar. These include Health Evaluation, Health status; Ranking of Symptoms. The only modification to these parts in the program-linked version are that the P-reduction program is mentioned in the Health Status section and a day of symptoms is used rather than 7 additional days, because the program-linked version asks for values of symptom <u>reduction</u> in the CV section.]. The description of the contingent product and the bid questions differs in the program-linked version and are as follows:

Description of Program

A program is currently being planned to reduce pollutant P concentrations in the air. The plan is required to meet standards that USEPA is establishing in order to achieve health benefits that scientific research has determined will result from better air quality. These benefits are the symptom reductions we have just discussed. Benefits also include reduced risk of cancer which might occur after many years of exposure to P cancer. All citizens stand to benefit from the program. Children and other sensitive groups are likely to receive greater benefits.

We are seeking to find how much value citizens place on the value of health improvements that result from better air quality. You're household is one of 800 in several areas of the country being interviewed. Your views, therefore, will be an important part of the sample that represents the values of the U.S. population. Because of the small number of households being interviewed the importance of your views will be similar to the vote of a representative or senator in the U.S. Congress, rather than, say, your vote in a presidential election. P reduction is costly, and our concern is whether the citizens believe it to be worth the cost. The basic atmospheric science of P reduction has largely been put in place during the last half dozen years of so. The technology needed to make the science work is not as well developed, however. Also, the management practices that will be used to reduce program cost are still developing. Consequently, we don't have precise knowledge of the cost of P reduction at present. Sources that produce P include electric utilities, automobile drivers, and people who cut their lawns with gasoline-powered lawn mowers, among others. If the P-program is enacted, it will be paid for by increased prices of heating fuel, gasoline, and some other price increases.

We would like to know what your household would be willing to pay each year for the program. Your bid is important to the overall result. The higher your bid the more likely the program will be enacted, because a higher bid increases the average bid for the 800 people in our sample. The higher average bid makes it more likely that the value people place on the program will justify the cost. If, of course, you don't see that much value to the program, then a low bid for your household reduces the likelihood that the program will be enacted.

Before you state your valuation of this program, there is one additional point we would to make. It is that all households are not equally able to pay for an environmental program. Some are a lot wealthier than others, and in reality they will actually pay more for the program than households that are less well off. In short, it is unlikely that your household will end up paying the amount you give as your stated value.

Do you have any questions about what we've just talked about?

CV. Contingent Valuation

Notice our Tally Sheet, which we will use to record all your bids.

[Show respondent Tally Sheet]

Tally Sheet

	3 Light Symptoms	Cancer Risk
1.	$ ______. for all children in U.S., per year.	$ ______ to reduce cancer risk to all children. One payment.
2.	$ ______. Own children per year	$ ______ to reduce cancer risk to own children. One payment.
3.	$ ______. Other children who are close to you, per year.	$ ______ to reduce cancer risk to other children who are close to you. One payment.

[Check 3 = 1 + 2 in both columns. Is total satisfactory? Check to see if 1-3 are in desired relationship. Revise as necessary.]

It shows you all the kinds of questions I will ask you about the three symptoms and the cancer risk. They are all parts of the benefits the EPA program is expected to produce. Keep in mind as you answer individual questions that the value you express for the program will include all these parts. As we go along, you will be able to revise you bids to keep the total where you want it and to keep the parts in the right relationship to one another.

Now I want to ask you how much you would be willing to pay to get the benefits of the pollution-control program. Our focus is on the benefits that children in the U.S. would get from the program, immediately and throughout their lives.

Right now there are about n children in the U.S., 18 years old or less. On average, each child could be expected to experience (5) fewer days each year of the symptoms we have just looked at, according to best available knowledge. Some children will get less benefit. These would be kids who get less than average exposure to pollutant P, and those kids who resist its effects because they are in very good health. Others will get more that average benefit because they live in areas of high exposure to P, or because poorer health makes them more sensitive to P exposure.

If people are exposed to P for many years, they are at a higher risk of cancer than they would be if P were removed from the air. I will describe the illness with you in a moment, and also the increased chances of getting it if P is not removed from the air. We will also discuss the value to you of reducing this risk. [Interviewer point to cancer column on Tally sheet.]

How much would you be willing to pay to reduce all three symptoms by an average of 5 days per child for all children in the U.S.?

I have a deck of cards here where each card has a money amount written on it that you might or might not be willing to pay for the program. Some of the numbers are really large, others quite small. We will shuffle the deck and deal the cards one by one. Please say yes if you would pay that amount for the program; say no if you wouldn't. Think about the children in your own household, other children you feel close to, as well as all kids in the U.S. Your bid is for all children in the U.S.

[Shuffle deck and deal cards. Record highest "yes." $ _______ .]

[If zero bid, probe for protesting.]

Your highest "yes" card is $ _______ per year. Should we record that number as your bid, or would some other number be better?

Yes _____. Value $_______ per year.

No _____.

Some people tell us it is difficult to think about paying to reduce just one environmental problem. Would you say that the dollar amount you stated your household would be willing to pay for child-health improvement is: (Circle number)

1. Just for child-health improvement
2. For adult-health benefits of the program
3. For health benefits not related to the program
4. Somewhat for the child-health program and somewhat a general contribution to all environmental causes
5. Basically contribution to all environmental or other worthwhile public causes
6. Other (Please specify) ____

Q13 About what percent of your dollar amount is <u>just</u> for the stated child-health improvement program? (Circle percent)

NONE		SOME			HALF			MOST		ALL
0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%

Source: Based on Schulze et al. 1998

We realize it's difficult to guess how much the program might benefit your own family and those close to you. But could you tell us about how much of your willingness to pay is for your own children and those that are close to you?

Own children $ or % _____ .
Other children who are close $ or % _____ .

Let's look at the Tally Sheet that summarizes your bids. Are there any you'd like to change?

[Enter changes]

[The cancer-risk CV questions are almost the same as in the abstract format from here to the end of the CV section. The only differences is that the green dots on the cancer-risk sheet show a <u>reduction</u> in cancer risk.

Hybrid Survey Format -- Introduction

A conclusion that can be drawn from the comparison of abstract vs. program-linked CV surveys is that there are tradeoffs in the choice between the two methods. Program-linked contingent valuation is feasible when environmental programs are fully formulated or at least in a fairly advanced state of preparation. But is contingent valuation useful to health policy only when specific programs are in an advanced stage of development? We argue that CV can be profitably employed in the early stages of policy making, before programs have begun to take shape. For example EPA might wish to employ CV to help make a decision on policy priorities. A full-blown policy-linked survey is then not possible; one can't lie to respondents about programs. But because program thinking is already part of the policy process, it should be possible to exploit some of the incentive-compatibility features of the program-linked survey while taking advantage of the stronger points of the abstract format. We propose some language to help direct the development of a hybrid form of CV survey that could be useful in this context.

Hybrid Survey Format -- CV Narrative

There are concerns about cancer risk arising from years of exposure to pollutant P. A group of researchers from the University of __________________ is exploring the desirability of reducing the air pollutant P. One of the health benefits expected from reduced P pollution is reductions in the risks of cancer that can occur after many years of exposure.

We have chosen a random sample of households . . . .

It isn't known yet how much it will cost to reduce P pollution. We have at this time only an approximate knowledge of the extent of cancer-risk reduction as more and more P is taken out of the air. What we plan to do in this interview is ask you how much you would value various amounts of cancer-risk reduction. These risk reductions are expected to be in the range of actual risk reductions as P pollution is reduced.

The higher you value these risk reductions the more likely it is that a P reduction program will be enacted. [Continue to establish decisiveness.]

Also I want you to understand that wealthier households will pay more for P reduction than less wealthy households . . . . [Continue to establish decoupling.]

Proceeding to the bids:

Now consider what it would be worth to you to get the benefits from the pollutant P reduction program, focusing first on values to the entire family. We want to get a combined value for all the symptoms and diseases together.

Note that a disease like cancer involves medical expenses, loss of earnings and pain and suffering. In your answers, suppose that medical insurance is good enough to cover all the medical expenses. Suppose also that sick leave and disability and unemployment insurance provided by employer are generous enough so that no lost earnings occur. If the idea of having no lost earnings makes things too unrealistic for you, please give me a separate estimate of how much you think lost earnings would be. What we want to get down to is how much you would be willing to pay solely to avoid pain and suffering from the disease.

What is the most you would be willing to pay to reduce the risk of pain and suffering associated with the cancer scenario from X to Y (probabilities to be specified by the interviewer based on best available information about dose response relations):

WTP 1: $____

How much of this amount pertains to you and your wife and not to other family members?

WTP 2: $____

Next consider the cancer risk your child will face as an adult because of pollutant exposure early in life. Suppose that cancer sets in at age 50, a long time from now. Again suppose that there will be full coverage of medical expenses and that there will be no lost earnings (or state amount if you believe there be lost earnings). We could ask your child what the benefit to him would be now for the prospect of better health as an adult, but he is unlikely to have the judgment to answer accurately, especially since children under 18 tend to be impatient and may discount the future benefits more heavily than if they were able to reason with more maturity. Therefore, we are asking that you answer for the child. Please try to put yourself in the place of your child when grown, and imagine what he would say it should have been worth to him when he was a child to reduce the risk. What is this amount?

WTP 3: $____

Finally, we wish to consider how much of the bid for your entire family is for other family members who may feel bad about the child's illness or who may suffer from lack of attention due to parents caring for a sick brother or sister, and the like. Extend your bid to include what you think would be paid by relatives who know the child, as well as friends whose feelings would be affected by the child's sickness.

WTP 4: $____

A benefit that may be worth something to you that we have not yet considered is making children outside your family, everywhere in the United States, better off. How much would you be willing to add to your bid because children everywhere are made better off?

WTP 5: $____

A follow-up question as adapted from Schulze et al. (1998) deals with embedding:

Some people find it difficult to think about paying to reduce just one problem. Would you say that the dollar amount you stated your household would be willing to pay for reduced cancer risk is (circle number)

1. Just for the cancer risk reduction from the program
2. Somewhat for other causes of cancer
3. Somewhat for other illnesses
4. Somewhat for medical expenses
5. Somewhat for lost earnings
6. Somewhat for other worthwhile programs
7. Other (Please specify)______________

If you answered that your bid was not just for the cancer risk reduction from the program, about what percent of your original bid was for the other effects?

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Question and Answer Period for Session III

Jenkins, Owens and Wiggins Paper

Kerry Smith, Duke University, asked whether the life of a bike helmet shouldn't be shorter than that assumed in the study. There is a difference between adult behavior and children's behavior here, in that adults don't replace bike helmets, whereas children outgrow helmets. Mr. Smith asked if Ms. Jenkins's assumption that adult helmets were replaced every four years (as recommended by manufacturers) was supported by any evidence. Ms. Jenkins replied that there are no data on actual replacement rates. Bill Harbaugh, University of Oregon, added that there is also an issue as to longevity because of misplacing helmets. His own experience is that his daughter often loses her bike helmet, and that he has to replace hers every six months.

Alan Krupnick, Resources for the Future, commented that the estimate of the value of a statistical life might be biased downward because there is not only a safety factor but a regulatory factor. In several states now, wearing bicycle helmets are mandatory for children of certain ages. The willingness to pay for safety may thus be less than the price of the helmet, but the desire to comply with the law might play a significant part in the decision to buy a helmet. Possibly a two-bid model would be appropriate for identifying the separate values.

Ellen Post, Abt Associates, wondered if the sample population used was a representative one. Bicycle helmets are often not purchased from poorer sectors of the population. Also, Ms. Post suggested that perhaps the best way to establish a baseline was to look at what the probability of buying a helmet would be in the first place (with respect to a respondent), and then measure how that person deviated from the predicted probability.

Ann Watkins, US EPA Office of Air and Radiation, commented that the costs may be an under-estimate of willingness to pay because like bikes, some helmets have to be replaced more frequently than others.

Richard Belzer, Washington University, commented that parents typically do not buy helmet with the expectation that their kids will wear the helmets all of the time.

Tim Bushnell, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, was concerned that helmet-wearing habits change over time, and that this may cause the value of a statistical life to change dramatically over a five-year period, for example.

Nick Bouwes, US EPA Office of Pollution Prevention and Toxics, pointed out that being a long-time bicyclist and bike commuter, and a long-time subscriber to Bicycling magazine, he considered himself an informed bicyclist but had no idea what the probability of an accident was, or what the reduction in probability is from his wearing a helmet. This suggests that the decision-making process is much cruder than that modeled in the paper.

Al McGartland, US EPA Office of Policy, pointed out that there are significant enforcement costs as well, with respect to both parents monitoring their children's behavior and authorities monitoring compliance with legal requirements of helmet safety.

Mr. Smith noted that the recently-begun National Recreation Survey, which queries respondents as to numerous recreational transportation patterns, presents an excellent opportunity to supplement studies similar to the present one, in that extensive data have been collected on leisure bicycling trips.

Harbaugh and Tolley and Fabian Papers:

Bryan Hubble, US EPA Office of Air Quality Planning and Standards, queried if there was a middle ground between the extremes of benevolent preferences, where parents wish to truly maximize their childrens' utility, and paternalistic preferences, where parents may be imposing their utility functions upon their children. Mr. Harbaugh replied that this was a reasonable possibility, but that the important thing about being a parent is having the advantage of knowing that their childrens' utility functions for safety will change over time. George Tolley, University of Chicago, wondered whether we, as adults, are able to put ourselves in the place of children.

Laurie Chestnut, Stratus Consulting, followed up on Mr. Hubble's question, citing the example of making kids do homework as parental altruism. This is not necessarily "paternalism." This is simply because parents have more information. Mr. Harbaugh agreed, likening the role of a parent to that of a social planner.

Mr. Krupnick asked if they were aware of studies of how parents give allowances to children. He cited as an example parents who give their kids $500 at the beginning of the year, and allow them the freedom to make their own spending decisions. Is this considered paternalistic or benevolent?

Sandy Hoffman, University of Wisconsin, cited Mr. Harbaugh's assertion that children are rational economic actors, and asked if the economic literature has looked at how children make economic decisions. Mr. Harbaugh replied that there has been very little work done by economists, but a significant body of work done by psychologists, although Mr. Harbaugh did not cite specific examples.

Clay Ogg, US EPA Office of Policy, commented that there are too many differences between children and adults, such that comparisons are difficult. The key is to find a good that is comparable between adults and children, so that relatively simple adjustments can be made. Mr. Tolley responded that children do indeed have some concepts of valuation that are similar to those of adults.

Ellen Post, Abt Associates, raised the issue of the appropriate sector of the population to be used for asking for valuations. Should we use the valuation of a crack addict parent? The model of a paternalistic parent may break down in such cases. Mr. Harbaugh responded that this is a sampling issue, and although other parents may not be paternalistic clearly Ms. Post was, and that these preferences are easily identified ex post. Ms. Post then added that this poses a moral problem, in that valuations are being made by third parties.

Mr. Chu raised the "trained seals" point raised by Reed Johnson the previous day – can we train children sufficiently so that they can respond to economic valuation exercises more rationally? And if we can, does that really help us measure the willingness to pay on the part of the larger population? Mr. Harbaugh agreed that this was a problem and noted that it still seems better to get adults to look backward than to get kids to look forward.