Valuation of Environmental Risks to Children's Health*

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1. Introduction

Do parents value improvements in their children's health more than improvements in their own health? This question bears directly on central issues in research on family behavior including resource allocation between family members and the extent of parental altruism toward their children. It also has important implications for public policy in light of the growing worldwide emphasis on protecting children's health from environmental hazards (Scapecchi 2003). Nevertheless, little is known about how parents allocate health-related resources between themselves and their children despite the fact that public policy measures for protecting children operate at least partly through parents or other adult caregivers. Also, the few studies that do examine how parents value their own health relative to their children's health focus more heavily on morbidity (Liu *et al.* 2000 and Dickie and Messman 2003), base estimates on crude health measures (Agee and Crocker 2001), and reach widely differing conclusions. For example, Jenkins, Owens, and Wiggins (2001) find that the value of a statistical life (VSL) of a child (about $3 million year 2000 dollars) is about two-thirds of that for a parent, while Mount *et al.* (2001) find that the VSL for parent and child are about equal ($7.3 million in year 2000 dollars). Additionally, Liu *et al.* (2000), Dickie and Messman (2003), and Agee and Crocker (2001) find that parents are willing to pay about twice as much to reduce morbidity risk for their children than for themselves.

This paper uses unique field data on skin cancer to estimate parents' marginal rates of substitution between morbidity and mortality risks to themselves and to their children. Skin cancer risk, previously considered in related context by Dickie and Gerking (1996, 1997), is a common affliction that can but usually does not result in death. Also, solar radiation exposure during childhood is an important determinant of lifetime skin cancer risk (e.g., Reynolds, et al.

1996, Robinson, Rigel and Amonette 1997, American Academy of Dermatology 1997 and Creech and Mayer 1998) and people accumulate as much as 80% of lifetime exposure before the age of 18.

From a conceptual standpoint, a key advantage of this study is that morbidity and mortality risks are treated together in a consistent theoretical framework. Prior studies of health risks treat either morbidity or mortality, but not both, yet these two health outcomes are obviously related (i.e., death is a possible outcome of illness). Also, the expected utility model developed shows how to make econometric estimates of the desired marginal rates of substitution as risk-risk tradeoffs from an indifference map. Whereas Viscusi, Magat and Huber (1991) used risk-risk tradeoffs to see how people evaluate different sources of risk, this study looks at how parents make interpersonal risk trade offs between themselves and their children, as well as how they make trade offs between morbidity and mortality risks from the same disease.

An important methodological advantage of the study is that data are collected using an experimental design that randomizes health risk changes presented to parents. This feature sidesteps a number of econometric problems because risk changes are exogenous treatments that are orthogonal to individual characteristics. Additionally, although marginal rates of substitution are obtained from parents' stated preference bids, the desired estimates are ratios of bids. Thus, the problem identified by Diamond and Hausman (1994) and Cummings et al. (1997) that stated preference bids overestimate what people actually would pay may be at least partially ameliorated. Additionally, use of stated preference bids may in any case be more appropriate than revealed preference value estimates because tastes do not have to be disentangled from a household production technology (Hanemann 2003).

The paper is divided into four additional sections. Section 2 develops an expected utility model with compound probabilities for a parent-child "family" in which either person might get skin cancer and then might die from this disease. Section 3 describes field data on perceived risk of skin cancer and willingness to pay to avoid the disease collected from 610 parents in Hattiesburg, MS during the summer of 2002. Section 4 presents results indicating that for the full sample, parents' estimated marginal rate of substitution between health risk reductions for their children and health risk reductions for themselves is about 2. This estimate, however, exhibits considerable variation across sub-samples of parents. It is larger for white parents than for black parents, larger for sons than daughters, and larger for younger children than older children. Section 5 concludes.

2. Model

This section presents a one-period expected utility model with state dependent utility functions to guide the experimental design, data collection and empirical analysis. The model consistently treats both morbidity and mortality risk from skin cancer in a "family" composed of one parent and one child. This approach abstracts from several issues considered elsewhere to make application tractable in the field study. For example, the model does not consider divergent interests between family members (see Mount et al. 1991 and Smith and van Houtven 2002) because expenditures to reduce risks of skin cancer represent a small fraction of family budgets. The child is assigned no role in household decision-making; in consequence, the parent is assumed to allocate family resources to maximize his or her own expected utility. Only one child is included in the model to focus on how parents make tradeoffs between their own health and the health of their children, rather than on how parents allocate resources among different children. A one-period model is presented so as to emphasize parent-child tradeoffs and consistent treatment of morbidity and mortality while abstracting from latency periods and time preferences. Extensions of the model to introduce latency periods and two or more children are briefly described at the end of this section.

The parent's expected utility is a probability-weighted sum of utilities in 3^2=9 possible states of the world that depend on whether the parent and child are healthy, sick, or dead. Four probabilities determine which of the nine states of the world actually emerges: (1) the probability that the parent will get skin cancer (S_p), (2) the conditional probability that the parent will die from skin cancer given that the disease is contracted (D_p), (3) the probability that the child will get skin cancer (S_c), and (4) the conditional probability that the child will die from skin cancer given that the disease is contracted (D_c). This approach has at least broad similarities to models previously applied in the literature on environmental risks to health. In their model of health consequences of exposure to hazardous wastes, Smith and Desvousges (1986, 1987) split the unconditional risk of death from exposure into the probability of exposure and the conditional probability of premature death given exposure. Eeckhoudt and Hammitt (2001) examine how a specific risk to an individual's health should be valued when the individual faces independent life-threatening background risks. Both of these models, however, envision only two health states (alive and dead) and thus do not explicitly treat morbidity, and neither model considers the allocation of health resources in a family.

In the model applied in this paper, the four probabilities are determined as shown in equation (1).

$$S_j = S_j(Z_j, \Omega_j, \lambda_j) \qquad D_j = D_j(Z_j, \Omega_j, \delta_j), \qquad j = p, c, \tag{1}$$

In this equation, probabilities of getting skin cancer and of dying from the disease if it is contracted are influenced by predetermined factors ($\Omega_j,\ j = p, c$) such as genetic characteristics like complexion and sensitivity of skin to sunlight. Still, the probabilities are endogenously determined because parents may purchase goods (e.g., hats, sun lotions, medical care) for themselves and their children ($Z_j,\ j = p, c$) to reduce the chances of getting skin cancer and to reduce conditional death risk if the disease is contracted. Because the experimental design applied in the field study manipulates the four probabilities, S_j and D_j also are specified as functions of treatments λ_j and δ_j.

As described in Section 3, the treatments are hypothetical sun lotions that resemble currently marketed products but offer greater skin cancer protection. If purchased, the hypothetical sun lotion would replace any currently used sunscreens, resulting in a savings in expenditure on existing products but no attenuation of the risk reduction offered by the hypothetical sun lotion. Any changes in other protective actions Z_j (e.g., seeking less evaluation of skin damage during medical checkups) are assumed to be negligible. (See Dickie and Gerking 1996 for a model incorporating adjustments in protective behavior.) Also, for ease of exposition, treatment parameters have the property $\partial S_j / \partial \lambda_j = \partial D_j / \partial \delta_j = -1$.

Perceived skin cancer risks are incorporated into the expected utility model as shown in equation (2).

$$\begin{aligned} E(U) &= (1-S_p)(1-S_c)U_0(Y) \\ &+ (1-S_c)S_p[(1-D_p)U_p(Y) + D_pV_p(Y)] + (1-S_p)S_c[(1-D_c)U_c(Y) + D_cV_c(Y)] \\ &+ S_pS_c[(1-D_p)(1-D_c)U_{pc}(Y) + (1-D_c)D_pW_p(Y) + (1-D_p)D_cW_c(Y) + D_pD_cW_{pc}(Y)], \end{aligned} \tag{2}$$

where U_0 denotes utility in the state where both parent and child are healthy, U_j denotes utility in a state in which either the parent or child ($j = p, c$) contracts skin cancer but the other does not and neither dies, V_j denotes utility in a state in which either the parent or child ($j = p,c$) dies from skin cancer but the other does not get it, U_{pc} denotes utility in the state where both parent and child get skin cancer but neither dies, W_j denotes utility in the state in which both parent and child contract skin cancer and one of the two dies ($j = p,c$) but the other does not, and W_{pc} denotes utility in the state in which both parent and child die from skin cancer. In states in which the parent and/or child die, parental utility is not restricted to zero; for example, if the child dies, the parent's life may still go on and if the parent dies utility may be obtained from a bequest. Also, Y denotes the parent's wealth net of: (1) expenditures for self- and child-protection goods (Z_j) and (2) bids for treatments presented in the experimental design (λ_j and δ_j). The parent's gross wealth is denoted as y and for simplicity here is assumed to be the same in all health states. (See Shogren and Crocker (1991) for a model incorporating differences in wealth between health states.)

The model can be manipulated to obtain parents' willingness to pay for reduced morbidity and mortality risks to themselves and their children. Ratios of marginal willingness to pay values provide measures of parents' marginal rates of substitution between: (1) morbidity risk to themselves and to their children, (2) mortality risk to themselves and to their children, (3) morbidity and mortality risk themselves, and (4) morbidity and mortality risk to their children. Assume that the parent already has chosen expected utility maximizing values of self- and child-protection expenditures in each health state, and λ_j and δ_j are initially zero. Then, willingness to pay for reduced risk of skin cancer to the child is obtained by setting $dE(U) = 0$ $= d\lambda_p = d\delta_p = d\delta_c$ and computing

$$-\partial y/\partial\lambda_c = \{(1-S_p)[(U_0-U_c)+D_c(U_c-V_c)] \\ +S_p(1-D_p)[(U_p-U_{pc})+D_c(U_{pc}-W_c)]+S_pD_p[(V_p-W_p)+D_c(W_p-W_{pc})]\}/\Delta. \quad (3)$$

In equation (3), Δ denotes the expected marginal utility of wealth and is positive if the marginal utility of wealth is positive in each state. Also, the numerator of the right hand side of equation (3) is positive if the utility difference in each term of the sum is positive (i.e., healthy is preferred to sick, sick is preferred to dead, one person sick is preferred to two people sick, etc.). Then, $\partial y/\partial\lambda_c < 0$ and gross wealth must fall to hold expected utility constant if the child's morbidity risk is reduced.

Similarly, willingness to pay for a small reduction in perceived conditional death risk faced by the child, holding all other perceived health risks constant, is

$$-\partial y/\partial\delta_c = S_c\{(1-S_p)(U_c-V_c)+S_p[(1-D_p)(U_{pc}-W_c)+D_p(W_p-W_{pc})]\}/\Delta. \quad (4)$$

Thus $\partial y/\partial\delta_c < 0$ if $\partial y/\partial\lambda_c < 0$. Because perceived unconditional risk of death from skin cancer is $R_c = S_cD_c$, equations (3) and (4) can be combined to obtain the parent's willingness to pay to reduce the child's unconditional death risk:

$$-\partial y/\partial R_c = \left(\frac{1-S_c}{1-R_c}\right)\left(-\partial y/\partial\lambda_c\right)+\left(\frac{1-D_c}{1-R_c}\right)(1/S_c)\left(-\partial y/\partial\delta_c\right). \quad (5)$$

Thus $\partial y/\partial R_c < 0$ if $\partial y/\partial\lambda_c < 0$. The parent's marginal rate of substitution, or risk-risk tradeoff, between the child's unconditional risk getting skin cancer and unconditional risk of dying from the disease equals $(\partial y/\partial R_c)/(\partial y/\partial S_c)$. This ratio measures the parent's relative valuation of reducing mortality and morbidity risks for the child. However, if skin cancer is an event that may occur in the future, the absolute magnitudes of $\partial y/\partial R_c$ and $\partial y/\partial S_c$ cannot be used to estimate the value of a statistical life or of a statistical case of skin cancer (i.e., the willingness to pay today to save a life or to avoid a case today).

Key comparative static properties of willingness to pay expressions in equations (3) – (5) are similar those found in the more familiar setting of one individual facing mortality risk only (Jones-Lee 1974). For example, parental willingness to pay to reduce the child's morbidity or mortality risk increases with gross wealth and with the initial levels of risk faced by the child, if the expected marginal utility of wealth is decreasing in wealth and in initial risk levels. Also, for marginal reductions in small risks of morbidity or mortality, willingness to pay is approximately proportional to the size of the risk change.

Similar properties apply to parents' willingness to pay for reduced risks to themselves. These values, which can be obtained by parallel calculations corresponding to equations (3) – (5), are useful in their own right and as benchmarks for assessing the magnitudes of parents' valuations of their children's risks. It will be of interest to test whether parents' marginal rates of substitution between unconditional risks to their children and unconditional risks to themselves equal unity, i.e., whether $(\partial y / \partial \lambda_c) \big/ (\partial y / \partial \lambda_p) = 1$ and whether $(\partial y / \partial R_c) / (\partial y / \partial R_p) = 1$.

The model may be extended to a temporal setting incorporating a latency period before the possible onset of skin cancer and including an arbitrary number of children in the family. The specific extension envisioned features identical children who face a longer latency period than do their parents. In this broader model, willingness to pay for reduced risk for the parent or a child falls as the number of children rises, if the marginal utility of aggregate family consumption is higher when more children are present. Willingness-to-pay values and parent-child marginal rates of substitution depend on weighted sums of utility differences similar to those appearing in the one-period setting, as well as on discount factors determined by latency periods and parents' subjective discount rates. Like the individual utility differences appearing in equations (3)-(5), the discount factors are components of parents' valuations that need not be separately identified to estimate willingness to pay or marginal rates of substitution. While measures of parents' discount factors for latent health risks would be of interest, these measures might be better estimated in a study that focused on latency of one risk to one person, rather than on morbidity and mortality risk for two people.

3. Data Collection

Data on risk beliefs about skin cancer and willingness to pay to avoid this disease were collected during summer of 2002 using a self-paced, interactive, computerized instrument. All respondents were residents of the Hattiesburg, MS metropolitan statistical area. Hattiesburg is located in the southern part of Mississippi, has a mean annual high temperature reading of 77.5 degrees Fahrenheit, a subtropical climate, and a large number of sunshine days each year. Thus, residents have experience with consequences of exposure to ultraviolet radiation from sunlight. The sample was drawn by random digit dialing after removing business, government, and cellular telephone numbers. When the calls reached adults, interviewers described the general purpose of the survey (federally funded research on health risks to parents and their children), asked whether they had at least one biological child between the ages of 3-12 living at home, and asked whether they were willing come to the University of Southern Mississippi to participate in the survey. Biological children were singled out for inclusion in the study because skin cancer risk is partly determined by genetic characteristics inherited from parents (e.g., fairness of skin and sensitivity of skin to sunlight). The age range was chosen to have children old enough to regularly spend time outdoors, but young enough for parents to exert substantial control over their activities. Respondents were paid $25 for completing the 30-minute questionnaire.

The final sample consisted of 610 parents; children did not participate in the survey. The survey obtained information about the parent/respondent and one sample child (chosen at random from among biological children living at home if more than one in the 3-12 year age range was present. Information was obtained about the number of children in the household, but other questions about children pertained only to the sample child in order to limit the length of the interview, to avoid repetitive questioning, and because the model presented in Section 3 assumes that parents treat each child equally. Of sample parents, 75.4% were white, 20.0% were African-American, 4.6% were members of other races, 23.4% were male, 76.9% were under the age of 40, mean household income was $53,000 per year, 75.9% were married, and 59.0% worked full time. Because of random selection, about half (50.5%) of the sample children were male. The average age of sample children was 7.07 years. Also, parents were generally familiar with skin cancer: (1) 95.4% had heard of skin cancer, (2) 83.8% knew of someone (public figures, friends, or relatives) who had been diagnosed with this disease, (3) 22.1% knew of someone who had died from skin cancer, (4) 80.3% had thought about the possibility of getting skin cancer, (5) 3.4% had been diagnosed with this disease themselves, and (6) 71.1% had considered the possibility that one of their children might get skin cancer.

Chances of getting skin cancer were assessed using an interactive risk scale that closely resembled the grid squares used by Krupnick et al. (2002). This approach was used because risk information appears to be better understood using this type of visual aid (Corso, Hammitt, and Graham 2001). As shown in Figure 1, the scale depicted a large square divided into 20 rows and 20 columns showing 400 equal-sized smaller squares. Initially, all 400 of these squares were green. Parents changed green squares to red ones to represent the amounts of risk. By pressing a button at the bottom of each column of squares, they could recolor a column of 20 squares from green to red (or from red back to green) and the color of any individual square could be changed by clicking on it with a mouse. A box beneath the scale showed the percentage of red squares out of 400. This calculation was updated each time one or more squares was re-colored. Before using the scale to estimate skin cancer risk, parents practiced using the risk scale for an unrelated event (a possible auto accident) and were told about the meaning of "chances in 400". Also, they were told to consider only the chances of getting this disease (or of getting it again if they had already had it), rather than how serious the case might be. Parents then used the risk scale to estimate lifetime chances of getting skin cancer, first for themselves and then for their sample children. In making these estimates, they could take as much time as they desired and could make as many changes in the risk scale as desired. Table 1, discussed momentarily, presents the frequency distribution of these risk estimates.

After providing lifetime skin cancer risk estimates for themselves and their children, parents were: (1) provided with information about skin cancer, (2) asked a series of questions about skin cancer risk factors, and (3) given an opportunity to revise these estimates. The idea behind asking respondents to estimate lifetime skin cancer risk a second time was to help them pin down their estimate as well as they could before moving on to the remaining portions of the survey. In particular, they were told that according to the National Cancer Institute, the average person in the United States has a lifetime risk of getting skin cancer of 18% and were questioned about skin color and sensitivity to sunlight, family history of skin cancer, time spent outdoors in direct sunlight, past sunburns, and use of sun protection products and protective clothing. Brief narratives provided information about how these aspects have been related to skin cancer risks in epidemiological studies. To elicit the revised lifetime skin cancer risk perception estimates, parents again were shown the previously described risk scales for themselves and their sample child as they originally were marked, and were given an opportunity to make changes.

After this task was completed, parents were asked about their perceived severity of skin cancer: "Suppose that a doctor tells you that you have skin cancer and you begin treatment. What do you think is the chance that you would die within five years of this diagnosis?" Parents answered for themselves and their sample child using a risk scale like the one shown in Figure 1. Responses are interpreted as estimates of the conditional risk of death from skin cancer given that the disease is contracted.

Table 1 presents frequency distributions of parents' perceived lifetime risk of skin cancer and conditional risk of death from skin cancer both for themselves and for their children. For perceived lifetime risk, the frequency distribution shown pertains to the initial risk estimates. As it turned out, parents made only small revisions in their initial lifetime risk estimates for themselves (the two estimates of mean risk are virtually the same, 23.9%), but revised risk estimates for children were on average about 1.5 percentage points lower than initial risk estimates (19.0 vs. 20.5), a significant difference at the 1% level. Table 1 indicates considerable variation in perceptions about lifetime skin cancer risk, with some parents believing that skin cancer is highly unlikely and a smaller number of other parents believing that skin cancer is virtually inevitable. Regarding the possibility of death from skin cancer, about two-thirds of parents believed that their conditional risk of death given a diagnosis of skin cancer is 10% or less and about three-fourths of parents believed that if similarly diagnosed, their sample child's conditional risk of death is 10% or less. This outcome suggests that parents were aware that skin cancer is seldom fatal.

Table 2 shows estimates of mean lifetime of getting skin cancer and mean conditional risk of dying from this disease for various sub-samples of parents. These sub-samples are further analyzed in Section 4. As shown, white parents estimated that their own lifetime risk of getting skin cancer exceeded that of their sample child (27.6% vs. 22.8%, a statistically significant difference at the 1% level), whereas among blacks, the corresponding difference was not significant at conventional levels (11.8% vs. 12.9%). Parents in both racial groups appear to have overestimated this risk. Ries et al. (1999) found that whites have a lifetime chance of 21% of getting either melanoma or non-melanoma skin cancer and African-Americans have a corresponding risk of less than a 1%. The fact that the survey introduced the possibility of getting skin cancer again if the parent had already had it does not appear to be an important complicating factor in this regard. Sample members are relatively young and few reported having been previously diagnosed with this disease.

Table 2 also shows that parents reported higher mean conditional death risk estimates for themselves (12.2%) than for their sample children (9.4%), a statistically significant difference at 1%. Differences in these estimates between white and black parents are quite small. Thus, it appears that parents generally believe that skin cancer risks for their children are lower than their own. This outcome may reflect parents' beliefs that they take greater precautions to protect their children from skin cancer risk with their own children than their parents did in an earlier period when less was known about the hazards of solar radiation exposure. Also, it may reflect a belief that skin cancer will take longer to develop in children than in parents together with the idea that delayed risks are perceived as smaller. Finally, Table 2 indicates that among whites, who comprise 67% of the sample: (1) mothers believed that their own risks of skin cancer exceeded those for fathers, (2) parents thought that their sons' and daughters' risk was about the same, (3) parents believed that risks faced by younger children exceeded those for older children.

The final section of the survey assessed willingness to pay for a hypothetical sun protection product that would reduce skin cancer risk for both the parent and the child when used as directed. The approach of using a single product to get willingness to pay means that parents do not make separate bids to protect themselves and their children as in Liu *et al.* (2000) and Dickie and Messman (2003). This procedure is aimed at reducing the potential problem that parents might feel that they "should" bid more for child protection than for protection for themselves. Parents became familiar with this product by reading a label that was designed to look like those used on bottles of over-the-counter sun lotions (see Figure 2). The label indicated that the hypothetical sunscreen would be similar in most respects to currently marketed products (available in a variety of SPFs, offer protection against premature aging of skin, non-comedogenic, oil-free, and unscented), but that it would offer greater levels of skin cancer protection.

Eight labels were used in the study. Except for differences in the amount of skin cancer reduction offered, labels were identical in every respect to control for other possible motivations driving the purchase decision such as to prevent or get a suntan and guard against aging or wrinkling of skin (see Dickie and Gerking 1996 who more fully discuss these possibilities). Four labels varied reductions in risk of getting skin cancer, while four other labels varied reductions in conditional death risk of this disease. Table 3 shows the reductions in risk stated on each of label. Labels A, D, E, and H offered equal percentage reductions in skin cancer risk (either 10% or 50%) for both adults and children. Labels B and F offered relatively greater skin cancer protection for children, while Labels C and G offered protection for adults. Each respondent was shown two randomly assigned labels. One of these offered reduced risk of getting skin cancer and the other offered reduced conditional death risk from skin cancer. The order in which these labels were presented was randomized.

After respondents were given time to read the label as if buying a product for the first time, the risk scale was used to show the amount by which the hypothetical sunscreen would reduce skin cancer risks for themselves and their children. Then, parents were asked, "Now please think about whether you would buy the new sun protection lotion for yourself or your child. Please do not consider buying it for anyone else. Suppose that buying enough of the lotion to last you and your child for one year would cost $X. Of course, if you did buy it, you would have less money for all of the other things that your family needs. Would you be willing to pay $X for enough of the sunscreen to last you and your child for one year?" The value of X was varied between $20 and $125. When responses were affirmative, parents were asked if they would pay a higher price; when responses were negative, they were asked whether a lower price would be paid. This procedure was repeated for the second label assigned to the parent.

4. Empirical Estimates

Data described in Section 3 are used to obtain estimates of the marginal rates of substitution described in Section 2. Marginal rates of substitution are inferred from estimates of an equation describing parents' willingness to pay for the hypothetical sunscreen. This equation was obtained from the model presented in Section 2 by totally differentiating equation (2), setting $dE(U) = 0,$ and interpreting the bid for the sunscreen as the change in wealth, $dy.$ The equation estimated is

$$\ln(w_{it}) = d_{it}'\beta + x_i'\gamma + u_i + v_{it}, \tag{6}$$

where i indexes parents and $t = 1, 2$ indexes the two experimental treatments (labels) assigned to parent i. In equation (6), w_{it} denotes willingness to pay for one year's supply of the sun lotion, d_{it} denotes a vector of attributes of the sun lotion including the risk changes for the parent and child as described on the label, and β represents the corresponding vector of coefficients. The β coefficients measure effects of risk changes on (the log of) willingness-to-pay and must be estimated to infer marginal rates of substitution. Also, x_i represents a vector of measured characteristics of the parent, child or family, γ represents the corresponding vector of coefficients, and u_i and v_{it} are uncorrelated mean zero normal random variables with variances σ_u and σ_v, respectively. Thus, v_{it} reflects uncontrolled factors varying over parents and over treatments, while u_i captures the impact of uncontrolled factors specific to the parent (or her child or family) and constant over treatments. Among the many factors that might be reflected in the individual-specific error component are unobserved genetic endowments, current spending on sunscreen lotion, concern for skin cancer risks to herself and her child, and propensity to misstate willingness to pay in response to hypothetical questions. Willingness-to-pay is assumed log-normally distributed in view of its non-negativity and the positive skewness typically characterizing its distribution.

Random assignment of labels to parents implies that risk changes are exogenous experimental treatments that are independent of all measured and unmeasured individual and family characteristics. As a consequence, randomization avoids two potential problems that would otherwise complicate estimation of willingness to pay for reduced risks and marginal rates of substitution. First, variables measuring risk change are orthogonal to characteristics such as initial perceived risks, income, number of children in the household, and race and gender of parent and child, so that the d_{it} is orthogonal to x_i. Thus, the specification of the variables in x_i has no effect on the estimate of β.

Second, random assignment implies that d_{it} is uncorrelated with u_i, so that β may be estimated consistently in a random-effects framework. Without random assignment (e.g., with non-experimental data), the risk changes to be valued are likely to be correlated with unobserved individual characteristics. Previous research indicates that inferences about intra-family allocations may be seriously misleading when heterogeneity of this sort is uncontrolled (Pitt and Rosenzweig 1990, Pitt, Rosenzweig, and Hassan 1990). Fixed-effects methods would remove family-specific heterogeneity but are less efficient that random-effects when heterogeneity is absent, as it is under randomization of experimental treatments. Instrumental-variable methods represent an alternative approach to the heterogeneity problem that are frequently used when repeated observations on individuals are not available. But randomization allows consistent and efficient estimation of β without resorting to use of instrumental variables.

Estimates of equation (6) are obtained by maximum likelihood. Respondents did not directly report their bids for the sunscreen, but the interval in which willingness-to-pay lies may be inferred from responses to the initial and follow-up questions asked about each sun lotion (Hanemann, Loomis and Kanninen 1991). Let w_{it}^{u} and w_{it}^{l} respectively denote the natural logarithms of the upper and lower bounds of willingness-to-pay for parent i, label t. Thus w_{it}^{u} equals the log of the lowest price at which the respondent declined to purchase the sunscreen (or $+\infty$ if she responded "yes" to both initial and follow-up questions), while w_{it}^{l} equals the log of the highest price at which the respondent agreed to purchase the sunscreen (or $-\infty$ if she responded "no" to both initial and follow-up questions). Then the probability that the natural logarithm of willingness-to-pay lies between the upper and lower bounds, conditional on u_i, equals

$$L_{it} = \Phi\left(\frac{w_{it}^{u} - d_{it}'\beta - x_i'\gamma - u_i}{\sigma_v}\right) - \Phi\left(\frac{w_{it}^{l} - d_{it}'\beta - x_i'\gamma - u_i}{\sigma_v}\right), \tag{7}$$

where Φ denotes the standard normal cumulative distribution function. The sample log-likelihood function is

$$\sum_{i=1}^{N} \ln\left[\int_{-\infty}^{+\infty} \prod_{t=1}^{2} L_{it} f(u)du\right], \tag{8}$$

where N equals the number of parents in the sample and f denotes the normal density function. The automated routine included in the econometric package LIMDEP and used to maximize the log-likelihood function computes the integral in equation (8) using Monte Carlo simulation.

Estimates of equation (6) are presented in Table 4. Covariate definitions are in column 1, their sample means are presented in column 2, and results from two regressions using the full sample of 610 parents are in columns 3 and 4. Five covariates are dummy variables that reflect the reductions in skin cancer risk shown on the eight labels (see Table 3). *GET* shows whether the label presented a reduction in the chance of getting skin cancer or a reduction in the conditional risk of dying from it. Thus, *GET=1* for Labels A-D and *GET=0* for Labels E-H. Also, *PARENTCHG=1* if the label offered parents a 50% reduction in risk for themselves and *KIDCHG=1* if the label offered a 50% risk reduction for their children. Interactions of *GET* and (*1-GET)* with *PARENTCHG* and *KIDCHG* show whether the risk reduction pertained to getting skin cancer or the conditional risk of dying from it. Label E, offering a 10% reduction in the conditional risk of dying from skin cancer for both parents and children, is represented by setting all five dummies equal to zero.

The column 3 regression uses only the five label dummies as covariates and column 4 shows the outcome when covariates measuring household income and number of children in the family are added. In both of these regressions, likelihood ratio tests at the 1% level reject the null hypotheses that: (1) the variance of the parent-specific error is zero and (2) all slope parameters are jointly zero. Asymptotic t-statistics, presented in Table 4, show that each coefficient estimated differs significantly from zero at the 5% level or lower under a two-tail test. As expected, coefficients of the label dummies change little when controls for family characteristics are added.

In columns 3 and 4, the positive coefficients of *GET*PARENTCHG, GET*KIDCHG, (1-GET)*PARENTCHG,* and *(1-GET)*KIDCHG* indicate that parents are willing to pay more for larger risk reductions than for smaller risk reductions. Although this outcome is broadly consistent with the conceptual model presented in Section 2, larger risk reductions bring about less than proportional increases in willingness to pay (see Hammitt and Graham 1999 for further discussion of this issue). For example, as shown by the coefficient of *GET*KIDCHG*, a five-fold reduction in risk to children of getting skin cancer (from 10% to 50%) increases willingness to pay by a little more than 40%. Also, likelihood ratio tests at the 1% level reject the null hypothesis that coefficients of *GET*PARENTCHG* and *GET*KIDCHG* are equal as well as the null hypothesis that coefficients of *(1-GET)*PARENTCHG,* and *(1-GET)*KIDCHG* are equal. In fact, the numerically larger coefficients of the risk change treatments for children suggest that parents are willing to pay more for skin cancer risk reduction for their children than they are for risk reduction for themselves. This point is developed more fully below in the context of estimating parents' marginal rates of substitution between skin cancer risk to their children and skin cancer risk to themselves.

In column 4, the positive coefficient of household income indicates that, all else constant, an increase in income by $10,000 increases willingness to pay for the hypothetical sunscreen by 3%. At sample mean household income of $53,000, the estimated income elasticity of willingness to pay for the hypothetical sunscreen is about 0.16. Also, the negative coefficient of the number of children in the household suggests that an additional child (of any age) in the household reduces willingness to pay for the hypothetical sunscreen by about 8%. This outcome is consistent with the discussion in Section 2 that fewer resources are invested in risk reduction per child when more children are present.

Estimates of marginal rates of substitution are computed as ratios of marginal willingness to pay from the column 4 regression. Marginal willingness to pay to reduce the child's risk of getting skin cancer is estimated by dividing the coefficient of (*GET*KIDCHG)* by the sample mean change in the level of unconditional morbidity risk for children. The corresponding estimate of marginal willingness to pay for the parent equals the coefficient of (*GET*PARENTCHG)* divided by the mean change in the level of unconditional morbidity risk for parents. The marginal rate of substitution then is computed as the ratio of the child valuation to the parent valuation. A parallel procedure is used to estimate marginal willingness to pay values to reduce conditional death risks for the parent and child. Marginal willingness to pay to reduce *unconditional* death risk then is computed by combining the marginal valuations of morbidity and conditional mortality risk using equation (5), and the marginal rate of substitution for the unconditional mortality risk equals the ratio of the resulting child valuation to the parent valuation.

The outcomes of these calculations, based on the column 3 in Table 4, are shown in column 2 of Table 5. These results indicate parents are willing to pay about twice as much to reduce the risk of getting skin cancer for their children as they are to reduce it for themselves. Similarly, the child vs. parent unconditional mortality marginal rate of substitution estimate is 2.33 (again see column 2 of Table 5). Standard errors of these estimates, reported in Table 5, indicate rejection of the null hypotheses that these marginal rates of substitution are equal to unity. That parents are willing to pay more to reduce risks to their children's health than they are willing to pay to reduce risks to their own health is of particular interest because age at onset of skin cancer is in the more distant future for children than for parents. Based on the discussion of latency in Section 2, if the time to onset of illness were the same both for parents and children, the marginal rate of substitution values may well be larger.

Column 2 of Table 5 also reports calculations of parents' marginal rates of substitution between the unconditional risk of dying from skin cancer and the unconditional risk of getting skin cancer for themselves and for their children. Whereas the marginal rates of substitution discussed above reflect tradeoffs between the same risk faced by different people, these calculations reflect tradeoffs between different types of risk faced by the same person. As shown in Table 5, parents' marginal rate of substitution between unconditional death risk and unconditional morbidity risk for themselves is 19.16 and the corresponding value for their children is 21.78. These estimates indicate that parents are willing to pay approximately 20 times more to reduce unconditional death risk by one unit than to reduce unconditional morbidity by one unit. Although, this outcome supports the idea that public policies aimed at reducing death risk are much more important to people than policies aimed at reducing morbidity, it may not generalize to related situations. Skin cancer is frequently not life threatening and while treatment may be disfiguring, patients generally expect to resume normal activities. Other illnesses and injuries may exact a greater toll on health if death does not occur and in these cases the marginal rate of substitution between mortality and morbidity may well be lower.

In addition to obtaining point estimates of marginal rates of substitution for a representative parent, it is of interest to examine how health risk tradeoffs may vary with the characteristics of parents or children. To obtain this information, the Table 4, column 4 regression was re-estimated for sub-samples defined by (exogenous) genetic characteristics that may be associated with differences in perceived risks and other initial endowments. A useful starting point in this regard is to compare marginal rates of substitution for whites and blacks. As discussed in Section 3, average perceived risks of skin cancer by white parents are roughly twice as large as those for black parents. Estimates shown in Table 5 indicate that the four marginal rates of substitution for whites are roughly similar to those obtained for the full sample (notice that the 460 white parents represent 67% of 610 parents in the full sample). These estimates, however, differ substantially from those for blacks; in fact, a likelihood ratio test at 1% rejects the null hypothesis that marginal rates of substitution for the two groups are equal. For blacks, two of the marginal rates of substitution could not be computed because the coefficient of *GET*PARENTCHG* was negative and did not differ significantly from zero at conventional levels. Also, the marginal rate of substitution for child vs. parent unconditional mortality is significantly less than unity at the 1% level, suggesting that black parents may be less altruistic toward their children than are white parents. This interpretation, however, should be treated quite cautiously because of the relatively small number of black parents in the sample.

The significant racial differences in valuation estimates suggest that pooling sub-samples of black and white parents to estimate marginal rates of substitution is inappropriate. Thus, in light of the relatively small sample size for blacks, outcomes from additional demographic breakdowns shown in Table 5 are computed only for parents in the white sub-sample. The first of these compares marginal rate of substitution estimates for 351 white mothers and 109 white fathers. Whereas both mothers and fathers similarly evaluate the child vs. parent unconditional mortality tradeoff, the child vs. parent unconditional morbidity tradeoff for fathers is about unity and about half the magnitude of that found for mothers. Thus, in comparison to mothers, fathers appear to be relatively less concerned with morbidity than mortality. This outcome leads fathers' marginal rate of substitution between mortality and morbidity for their child to be larger than that for mothers (50.05 vs. 19.06).

Also, parents appear to place significantly greater weight on reducing both morbidity and mortality risk for sons than for daughters. Estimates of child vs. parent marginal rate of substitution for unconditional morbidity is 2.60 for sons and 1.14 (not significantly different from unity) for daughters. Corresponding estimates of the marginal rate of substitution for unconditional mortality are 5.40 for sons and 2.01 for daughters. The null hypothesis that marginal rates of substitution for sons and daughters are equal is rejected at 1% level. Thus, relative to their own health, parents appear to be willing to invest more in health risk protection for sons than daughters.

Finally, parents are more protective of younger children than older children. The child vs. parent marginal rate of substitution estimates for unconditional morbidity are 1.42 for children aged 3-7 years and 2.22 for children aged 8-12 years; however, these estimates do not differ significantly from zero at the 1% level. On the other hand, corresponding estimates of the marginal rate of substitution for unconditional mortality are significantly larger for young children than for older children (4.38 for children aged 3-7 years vs. 1.73 for children aged 8-12 years). This finding is consistent with recent evidence that health risk protection for young children is valued more highly than that for older children. Nastis and Crocker (2003), find that mothers-to-be value the expected postnatal health of their unborn child as much as six times more than the expected post-partum state of their own health.

5. Conclusions

This paper has presented new empirical estimates aimed at valuing environmental risks affecting parents and children. The application focused on skin cancer, the most common form of cancer in the U.S. Links between environmental exposure to ultraviolet radiation and skin cancer are well established, and chances of getting skin cancer, for a given amount of exposure to solar radiation, depend partly on observable genetic characteristics such as skin type and complexion. The theoretical model is developed from the viewpoint of parents and supports empirical valuation of morbidity and mortality risks faced by both parents and children in a consistent framework. Risk is treated as endogenous and is measured as the risk perceived by survey respondents. The method for estimating willingness to pay rests on directly estimating an indifference relation showing utility-constant trade-offs between morbidity risks, mortality risks, and consumption goods.

The model provides a basis for computing parents' marginal rates of substitution between risk of death from skin cancer faced by both themselves and their children. This calculation shows how parents value children's health relative to their own and may be useful benefits transfer in situations where willingness to pay for reduced risk to adults have been established but corresponding values for children are not available. The model is estimated using data collected by an interactive computerized questionnaire administered on the University of Southern Mississippi campus during summer of 2002. Key aspects of the experimental design were to: (1) determine parents' perceptions of skin cancer risk to themselves and their children, and (2) obtain willingness to pay for skin cancer risk reductions. Risk reductions were presented to parents using randomly assigned labels of a hypothetical sun lotion that offered different amounts of protection to adults and children. Random assignments of risk reductions facilitate estimation of marginal rates of substitution between parent's health and children's health. For example, parents' marginal rate of substitution between their children's unconditional lifetime risk of dying from skin cancer and the corresponding risk for themselves is 2.33. Thus, parents view their children's health as more than twice as valuable than their own. Also, parents see the reductions in mortality risk to be about 20 times more valuable than reductions in morbidity risk both for themselves and their children. This outcome suggests that the morbidity component of benefits for environmental risk reduction may be quite small.

References

Agee, Mark D. and Thomas D. Crocker. 2001. "Smoking Parents' Valuations Of Own And Children's Health." Presented at Association of Environmental and Resource Economists conference, Assessing and Managing Environmental and Public Health Risks, Bar Harbor, Maine, June 13-15, 2001. http://www.aere.org/.

American Academy of Dermatology. 1997. Melanoma Risk Factors Fact Sheet.

American Cancer Society. 1998. Non-Melanoma Skin Cancer Resources. Bethesda, MD.

Corso, Phaedra.S., James K Hammit and John D. Graham. 2001. "Valuing Mortality-Risk Reduction: Using Visual Aids To Improve The Validity Of Contingent Valuation," *Journal of Risk and Uncertainty* 23, 165-84.

Creech, L.L. and J.A. Mayer. 1998. "Ultraviolet Radiation Exposure in Children: A Review of Measurement Strategies," *Annals of Behavioral Medicine*, 19, 399-407.

Cummings, R.D., S. Elliott, G. Harrison and J. Murphy, 1997. Are hypothetical referenda incentive compatible? *Journal of Political Economy* 105: 609-621.

Diamond, Peter A. and Jerry A. Hausman. 1994. "Contingent Valuation: Is Some Number Better than No Number?" *Journal of Economic Perspectives* 8: 45-64.

Dickie, M. and S. Gerking. 1996. "Formation of risk beliefs, joint production and willingness to pay to avoid skin cancer." *The Review of Economics and Statistics*, 78: 451-464.

---, 1997. "Genetic Risk Factors and Offsetting Behavior: The Case of Skin Cancer," *Journal of Risk and Uncertainty*, 15: 81-97.

Dickie, Mark and Victoria L. Messman. 2003. "Valuing Acute Illness In The Household: Are Kids Worth More Than Parents?" Presented at the Association of Environmental and Resource Economists workshop, Assessing and Managing Environmental and Public Health

Risks, Bar Harbor, Maine, June 13-15. http://www.aere.org/.

Eeckhoudt, Louis R. and James. K. Hammitt. 2001. "Background Risks and The Value of A Statistical Life," *Journal of Risk and Uncertainty* 23, 261-279.

Hammitt, James K. and John D. Graham. 1999. "Willingness to Pay for Health Protection: Inadequate Sensitivity to Probability?" *Journal of Risk and Uncertainty*, 18, 33-62.

Hanemann, W. Michael. 2003. "Revealed and Stated Preference Approaches to Valuing Children's Environmental Health," presented at Organization of Economic Cooperation and Development "Workshop on the Valuation of Children's Health," Paris, Sep. 11-12 2003.

Hanemann, W. Michael, John Loomis and Barbara Kanninen. 1991. "Statistical Efficiency of Double-Bounded Dichotomous Choice Contingent Valuation ," *American Journal of Agricultural Economics* 73, 1255-63.

Jenkins, Robin R., Nicole Owens, and Lanelle B. Wiggins. 2001. "Valuing Reduced Risks To Children: The Case Of Bicycle Safety Helmets," *Contemporary Economic Policy*, 19, 397-408.

Jones-Lee, Michael. 1974 "The Value of Changes in the Probability of Death or Injury," *Journal of Political Economy* 82, 835-49.

Krupnick, Alan, Anna Alberini, Maureen Cropper, Nathalie Simon, Bernie O'Brien, Ron Goeree, and Martin Heintzelman. 2002. Age, Health, and the Willingness to Pay for Mortality Risk Reductions: A Contingent Valuation Study of Ontario Residents. *Journal of Risk and Uncertainty* 24: 161–86.

Liu, Jin-Tan, James K. Hammitt, Jung-Der Wang and Jin-Long Liu. 2000. "Mother's Willingness to Pay for Own and Her Child's Health: A Contingent Valuation Study in Taiwan," *Health Economics* 9, 319-26.

Mount, Timothy, Weifun Weng, William Schulze, and Laurie Chestnut. "Automobile Safety and the Value of Statistical Life in the Family: Valuing Reduced Risk for Children, Adults and the Elderly," presented at the Association of Environmental and Resource Economists Workshop on "Assessing and Managing Environmental and Public Health Risks," Bar Harbor, Maine, June 13-15, 2001. http://www.aere.org/.

Nastis, Stefanos and Thomas D. Crocker. 2003. "Mothers Valuation of Own and Unborn Child Health," working paper, Dept. of Economics and Finance, University of Wyoming.

Pitt, Mark M., Mark R. Rosenzweig, and Md. N., Hassan. 1990. "Productivity, Health, and Inequality in the Intrahousehold Distribution of Food in Low-Income Countries," *American Economic Review*, 80, 1139-58.

Pitt, Mark M. and Mark R. Rosenzweig. 1990. "Estimating the Intrahousehold Incidence of Illness: Child Health and Gender-Inequality in the Allocation of Time," *International Economic Review* 31, 969-89.

Reynolds, K.D., J.M. Blaum, P.M. Jester, H. Weiss, S.J. Soong, R.J. Diclemente, "Predictors of Sun Exposure in Adolescents in a Southeastern U.S. Population," Journal of Adolescent Health, 19 (1996), 409-15.

Ries, L.A.G., M.P. Eisner, C.L. Kosary, B.F. Hankey, B.A. Miller, L. Clegg, A. Mariotto, M.P. Fay, E.J. Feuer, B.K. Edwards (eds). *SEER Cancer Statistics Review, 1975-2000*, National Cancer Institute. Bethesda, MD, http://seer.cancer.gov/csr/1975_2000 (2003).

Robinson, J.K., D.S. Rigel, and R.A. Amonette. 1997. "Trends in Sun Exposure, Attitudes, and Behaviors: 1986 to 1996," *Journal of the American Academy of Dermatology*, 37, 179-86.

Scapecchi, Pascale. 2003. "Valuation Differences between Adults and Children," presented at Organization of Economic Cooperation and Development "Workshop on the Valuation of

Children's Health," Paris, Sep. 11-12 2003.

Shogren, Jason F. and Thomas D. Crocker. 1991. "Risk, Self-Protection, and Ex Ante Economic Value," *Journal of Environmental Economics and Management* 20:1-15.

Smith, V. Kerry and William H. Desvousges. 1986. "Asymmetries in the Valuation of Risk and the Siting of Hazardous Waste Disposal Facilities," *American Economic Review* 76, 291-294.

Smith, V. Kerry and William. H. Desvousges. 1987. An Empirical Analysis of the Economic Value of Risk Changes," *Journal of Political Economy* 95, 89-114.

Smith, V. Kerry and George Van Houtven, "Recovering Hicksian Consumer Surplus within a Collective Model: Hausman's Model for the Household," working paper, North Carolina State University (2002).

Viscusi, W. Kip, Wesley Magat, and Joel Huber, "Pricing Environmental Health Risks: Survey Assessments of Risk-Risk and Risk-Dollar Trade-offs for Chronic Bronchitis," *Journal of Environmental Economics and Management* 21, 32-51 (1991).

Table 1. Frequency Distribution of Parents' Perceived Risks.
N=610.

	Risk of Getting Skin Cancer[a]		**Conditional Risk of Dying from Skin Cancer**	
Risk Range (%)	**Parents**	**Children**	**Parents**	**Children**
0 - 4.75	85	75	103	142
5 - 9.75	57	79	163	194
10 - 14.75	70	94	122	111
15 - 19.75	65	69	67	44
20 - 24.75	65	74	42	31
25 - 29.75	66	73	26	23
30 - 34.75	45	35	13	8
35 - 39.75	23	19	8	8
40 - 44.75	36	25	7	7
45 - 49.75	6	5	5	2
50 - 54.75	53	32	19	11
55 - 59.75	4	2	2	1
60 - 64.75	5	7	3	0
65 - 69.75	0	1	0	0
70 - 74.75	5	2	2	0
75 - 79.75	6	5	0	0
80 - 84.75	2	3	0	0
85 - 89.75	3	2	0	0
90 - 94.75	8	5	0	0
95 – 100	6	3	0	0

[a]Initial risk assessment.

Table 2. Parents' Mean Risk Perceptions (%).

Sample	Risk of Getting Skin Cancer[a]	Conditional Risk of Dying from Skin Cancer	Sample Size
All Parents	23.90	12.24	610
All Children	20.54	9.44	610
Black Parents	11.79	12.98	122
Black Children	12.88	9.77	122
Whites: All Parents	27.61	12.15	460
All Children	22.76	9.44	460
Mothers	29.79	12.54	351
Fathers	20.59	10.90	109
Daughters	22.76	9.39	230
Sons	22.76	9.49	230
Children aged 3 to 7 years	24.47	10.35	258
Children aged 8 to 12 years	20.57	8.28	202

[a]Initial risk assessment.

Table 3

Hypothetical Sun Protection Product Labels

Label	Percent Change in Morbidity Risk		Percent Change in Mortality Risk	
	Parent	Child	Parent	Child
A	10	10	0	0
B	10	50	0	0
C	50	10	0	0
D	50	50	0	0
E	0	0	10	10
F	0	0	10	50
G	0	0	50	10
H	0	0	50	50

Table 4
Willingness to Pay for Reduced Risk of Skin Cancer

	Full Sample		
Variable	**Mean**	**Estimate (t-ratio)**	**Estimate (t-ratio)**
Constant	---	4.028 (130.32)	4.023 (86.63)
GET=1 if label changes risk of getting skin cancer; *=0* if label changes conditional risk of dying from skin cancer	0.500	-0.089 (-1.992)	-0.093 (-2.079)
PARENTCHG=1 if parent risk change = 50%; *=0* if risk change = 10%	0.498	---[a]	---[a]
KIDCHG=1 if child risk change = 50%; *=0* if parent risk change = 10%.	0.496	---[a]	---[a]
*GET*PARENTCHG*	0.249	0.251 (6.82)	0.252 (6.86)
*GET*KIDCHG*	0.251	0.436 (11.84)	0.417 (11.85)
*(1-GET)*PARENTCHG*	0.248	0.309 (8.38)	0.306 (8.30)
*(1-GET)*KIDCHG*	0.245	0.340 (9.23)	0.339 (9.22)
FAMILY INCOME ($10,000 per year)	5.325	---	0.031 (7.66)
NUMBER OF CHILDREN IN HOUSEHOLD	2.075	---	-0.076 (-5.23)
σ_u	---	1.029 (53.79)	1.023 (53.65)
σ_v	---	0.548 (57.78)	0.548 (57.80)
Number of Parents	610	610	610

[a] Denotes omitted dummy variable.

Table 5

Estimated Marginal Rates of Substitution
(Asymptotic Standard Errors in Parentheses)

			White Parents						
Marginal Rate of Substitution	**Full Sample**	**Black Parents**	**All**	**Mothers**	**Fathers**	**Child is Daughter**	**Child is Son**	**Child Age 3-7 yrs**	**Child Age 8-12 yrs**
Child vs. Parent Unconditional Morbidity	2.05 (0.35)	---[a]	1.61 (0.27)	1.83 (0.35)	0.96 (0.38)	1.14 (0.24)	2.60 (0.88)	1.42 (0.29)	2.22 (0.74)
Child vs. Parent Unconditional Mortality	2.33 (0.32)	3.28 (0.51)	3.28 (0.51)	3.24 (0.58)	3.35 (1.02)	2.01 (0.40)	5.40 (1.46)	4.38 (0.90)	1.73 (0.46)
Unconditional Mortality vs. Unconditional Morbidity (Parent)	19.16 (3.15)	---[a]	11.35 (1.83)	10.76 (2.08)	14.36 (4.09)	10.42 (1.78)	14.17 (4.93)	7.86 (1.55)	24.60 (7.73)
Unconditional Mortality vs. Unconditional Morbidity (Child)	21.78 (2.59)	22.48 (8.98)	23.19 (2.84)	19.06 (2.57)	50.05 (15.74)	18.42 (3.55)	29.38 (4.84)	24.25 (3.58)	19.18 (4.71)
Number of Parents	610	122	460	351	109	230	230	258	202

[a] Estimate is negative but not significantly different from zero at the ten percent level.

Figure 1. Risk Scale.

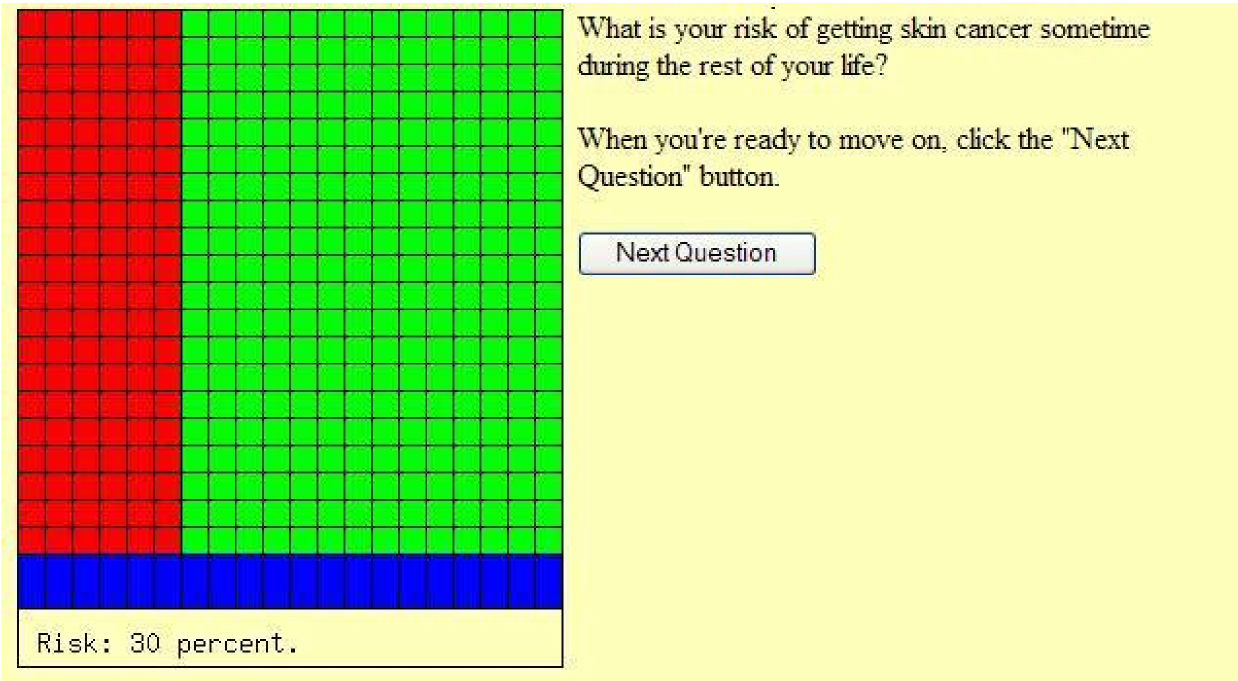
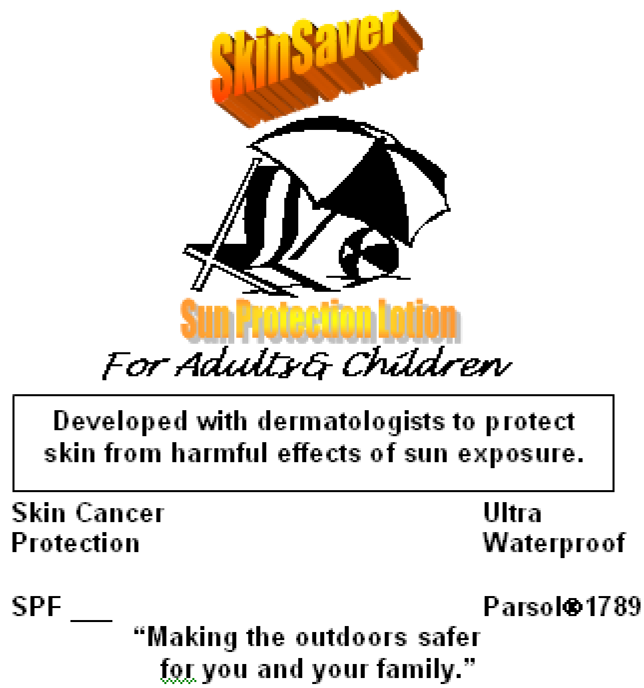


Figure 2. One of Eight Sun Lotion Labels.



(Back of bottle)

New SkinSaver® sun protection lotion.

Skin Cancer Protection		
✓ Used as directed in clinical trials, SkinSaver reduced risk of skin cancer by:		
10% for Adults		10% for Children
✓ Used as directed in clinical trials, SkinSaver had no effect on the risk of dying if skin cancer occurred.		
More Skin Protection		
Parsol®1789		SPF_____
Protects against premature skin aging		Protects against sunburn

More Added Features

* Ultra long-lasting waterproof formula – One application lasts all day *
* Non-comedogenic–Won't block pores * Oil-free–Won't feel greasy *
* Hypoallergenic * PABA-free * Unscented *

DIRECTIONS: Apply generously and evenly to all exposed areas of skin at least 15 minutes before sun or water exposure.

ACTIVE INGREDIENTS: Oxybenzone, octocrylene, 2-ethylhexyl salicate, homosalate, avobenzone.