Valuation of Non-Market Goods Using Computer-Assisted Surveys: A Comparison of Data Quality from Internet and RDD Samples[*]

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1. Introduction

Valuation of non-market environmental goods relies heavily on surveys. With rising out-of-pocket costs and logistical issues associated with face-to-face, mail, and telephone surveys, investigators conducting stated preference studies have recently turned to firms that maintain a national panel of potential respondents that can be accessed via the Internet (Alberini *et al.* 2004, Cameron and De Shazo 2004, Viscusi and Huber 2006, von Stackelberg and Hammitt 2006, Hammitt and Haininger 2006). While quality of data obtained in mail and telephone surveys has been evaluated in prior valuation studies (Mannesto and Loomis 1991, Loomis and King 1994, Whittaker *et al.* 1998, Ethier *et al.* 2000, Champ 2003), only one such study (Berrens *et al.* 2003) has compared valuation outcomes from a survey of commercially available Internet panelists with outcomes from a similar instrument administered using a different mode, in this case a telephone survey.[1] Although this study concluded that samples from Internet panels are reasonable alternatives in many applications to samples gathered through random digit dialing (RDD) telephone surveys, more research would be useful to compare the efficacy of Internet surveys to alternative modes of collecting valuation data.[2]

Additionally, all modes currently are under review in light of the controversy over Office of Management and Budget (OMB 2006) guidelines for approval of surveys to be conducted by the federal government or as part of federal research contracts. Whereas OMB guidelines stress the collection of representative samples, other aspects such as differences in respondent engagement, effort, and attention across modes may be equally important to consider. Little is known about the level of respondent engagement in valuation surveys even though these studies

[1] In a closely related study, Berrens *et al.* (2004) compare valuation outcomes from different instruments presented to three Internet panels.

[2] Social scientists from disciplines such as political science, communications, and psychology also have found that results from Internet surveys are similar to those obtained using other survey modes (e.g., Krosnick and Chang (2004), Horreroa and Meneses (2006), Epstein *et al.* (2001), Herschel and Kirk (2003).

often require respondents to focus on relatively difficult questions about risk concepts, hypothetical goods and situations, and willingness to pay to reduce hazards. Krosnick and Chang (2004), who studied voting in the year 2000 Presidential election, concluded that their RDD telephone survey manifested more random measurement error, survey satisficing, and social desirability response bias than their Internet survey; but this result may or may not carry over to the more complex set of questions that respondents must confront in valuation studies.

This paper compares results from an Internet survey of parents' stated preference values for avoiding skin cancer risks to themselves and their children to results from a virtually identical instrument administered by computer on a university campus. The Internet survey used randomly selected respondents from the national web-enabled panel maintained by Knowledge Networks, Inc. (KN). Respondents received the survey electronically, completed it at a location of their choosing (usually at home), and returned it electronically to KN. In the comparison survey, respondents recruited by RDD telephone methods from the Hattiesburg, MS area completed the instrument in a computer laboratory on the University of Southern Mississippi campus. Results presented indicate that in comparison to the Hattiesburg respondents, relatively more KN respondents: (1) failed to answer key questions, (2) either rushed through the survey or took long breaks between completing different segments of it, (3) indicated little awareness of skin cancer, (4) took perhaps unwarranted short-cuts in estimating skin cancer risk, and (5) provided stated preference values indicating no greater willingness to pay for large risk reductions than for small risk reductions, thus failing an important external scope test. Together, these findings are consistent with the notion that the KN respondents experienced more distractions, had fewer incentives to give the survey their full attention, and motivate a discussion of steps that might be taken to correct these problems.

2. The Two Surveys

Each of the two surveys obtained stated preference values to estimate parents' marginal rates of substitution between skin cancer risk reductions for themselves and for their young children aged 3-12 years.[3] Estimated marginal rates of substitution were used to test an equilibrium condition from a household production model in which parents behave altruistically toward their young children (Dickie and Gerking 2006a). The equilibrium condition is similar to the transfer-income derivative restriction analyzed by Becker (1981) and tested by Cox and Rank (1992), Altonji, Hayashi, and Kotlikoff (1992, 1997), Laitner and Juster (1996), and Pabilonia (2001). The test outcome is important because it indicates whether special governmental efforts to protect children from environmental hazards will be at least partially offset as parents redistribute family resources.

The Hattiesburg survey, conducted during summer of 2002, was administered to 635 parents; children did not participate. Responses from 25 parents (3.9%) were excluded either because they did not answer all questions (21 parents) or because they did not follow instructions given by the survey administrator (4 parents). Responses from 122 African-American parents also were excluded because, as explained in Dickie and Gerking (2006b), these parents perceived little risk of skin cancer and therefore had little incentive to think about precautions that might be taken to avoid this disease or about how their own risk might differ from that of their children. In any case, observations on 488 non-black parents are analyzed below.

An early version of the survey instrument was used in a pilot study of parents' willingness to pay to reduce perceived skin cancer risks (Dickie and Gerking 2003). Two subsequent versions of the instrument were pre-tested and de-briefing sessions with pre-test

[3] In approving support for the proposal to conduct the Hattiesburg survey, USEPA provided additional funding for a parallel national survey to ascertain the extent to which results from the local sample mirror results from a nationally representative sample.

participants guided development of the final version of the survey. Participating parents from the Hattiesburg, MS metropolitan statistical area were identified by RDD, after screening out commercial and cellular telephone numbers. When telephone calls reached adults, interviewers asked whether they had at least one biological child between the ages of 3-12 living at home, and whether they were willing come to the University of Southern Mississippi to participate in a federally funded study of health risks to parents and their children. Skin cancer was not mentioned in the initial telephone call. Biological children were the focus of attention in this 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). Parents were offered a $25 payment for participating in the study. Partly because of the narrow sampling frame (parents of at least one biological child between the ages of 3-12 years, living at home), interviewers placed approximately 100 telephone calls to generate each completed response.[4]

In 2005, Knowledge Networks (KN) used a similar survey instrument to collect parallel data on parents with at least one biological child between the ages of 3-12 years, living at home. KN's core resource is a nationally representative panel of web-enabled U.S. households. Panel members are given inducements such as free Internet access in return for agreeing to regularly complete short surveys on subjects of academic or commercial interest. Surveys are administered by computer access to the Internet (if the respondent has access to a computer) or via WebTV©, a technology that involves attaching a device resembling a cable box to a television so that panel members can use remote-control devices or keyboards to complete surveys using the television as a monitor.

[4] Approximately 30% of calls to presumed working residential numbers yielded no contact with an adult after three attempts at different times of the day and days of the week. In 64% of cases in which a call reached an adult, the adult stated that the household did not meet eligibility requirements. Parents agreeing to participate in the study constituted 3.5% of working residential numbers, 5% of contacts with adults, and 14.3% of contacts with adults who did not declare the household ineligible. Finally, 68% of persons agreeing to participate completed the instrument.

The KN survey was pre-tested with 40 panelists and 7 panelists participated in 15-minute cognitive interviews.[5] KN then transmitted the survey to 1199 panelists of whom 644 eligible panelists returned it. To maintain comparability with the Hattiesburg sample, analysis below focuses on 592 non-black parents. Twenty-eight percent of these parents completed the survey by WebTV©.

The Hattiesburg and KN surveys had four important common features. First, at an early stage one biological child aged 3-12 of each parent was randomly selected (if there was more than one in this age range) and designated as the sample child. Parents then responded to questions about themselves and about this sample child.

Second, parents estimated lifetime skin cancer risk using an interactive scale similar to that used by Krupnick *et al.* (2002) and Corso, Hammitt, and Graham (2001). The scale depicted 400 squares in 20 rows and 20 columns. All 400 squares were initially colored green. Parents changed squares from green to red to represent amounts of risk. Beneath the scale, a box indicated the level of risk numerically by displaying the number of red squares selected as a percentage of 400. An important feature of the risk scale is that parents either could change the color of one grid square or recolor an entire column of 20 grid squares with one mouse-click. This feature made it possible for a parent to recolor, for example, 83 grid squares to do so in 7 mouse-clicks ((4 x 20) + 3 = 83). Before estimating 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". They also were told to consider only the chances of getting skin cancer (or of getting it again if they had already had it), rather than how serious the case might be. Parents

[5] Six of cognitive interviews provided useful information. One of the interviews was quickly terminated after establishing that someone other than the intended panelist had completed the draft survey.

first estimated lifetime chances of getting skin cancer for themselves and then did so for their sample child.

Third, parents were given an opportunity to revise their beliefs about the chances of getting skin cancer after receiving information about this disease. They were told that: (1) according to the National Cancer Institute, the average person in the United States has a lifetime risk of getting skin cancer of 18% and (2) a person's risk may differ from this average because of skin color and sensitivity to sunlight, family history of skin cancer, amount of time spent in direct sunlight, experience with sunburns, use of sun protection products, and other factors. Parents were questioned about observable skin characteristics, sun exposure history, and use of sun protection products both for themselves and their sample children. Afterwards, they were given an opportunity to revise their initial risk estimates.

Fourth, parents valued risk reductions by expressing willingness to pay for a hypothetical sun lotion.[6] The product was described using labels (see Figure 2 for an example) designed to look like those on bottles of over-the-counter sun lotions. Except for differences in the type and amount of skin cancer protection offered, the labels were identical in all respects to control for other possible motivations for purchasing sun lotion, such as to prevent or to get a suntan and to guard against aging or wrinkling of skin (see Dickie and Gerking 1996). In each of the two studies, four labels varied reductions in risk of getting skin cancer (10%/50% for parent/child). Each parent was randomly assigned one of the four labels; Figure 2 shows the label for a 10% risk reduction for both parent and sample child. After reading the label as if to consider buying the product for the first time, parents were shown risk scales both for themselves and their children depicting the level of perceived risk the parent originally estimated together with the risk reduction the sun lotion would offer.

[6] This approach also was used in a recent cross-country study of skin cancer risks (see Brouwer and Bateman 2005).

Parents were then 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?" In each survey the value of X was randomly selected, from among nine values ranging from $20 to $125 in the Hattiesburg survey and from among five values ranging from $40 to $200 in the KN survey. The narrative also reminded parents that lifetime use of the sun lotion is necessary to obtain the stated skin cancer protection benefits.

Although most questions and visual materials were virtually identical, the two surveys concluded with different questions. In the Hattiesburg survey, after eliciting perceived risk of getting skin cancer, parents were asked for their perceived risk of dying from skin cancer given that they had been diagnosed with this disease. When estimating the chance of getting skin cancer, parents were unaware that this second aspect of risk would be addressed. Willingness to pay to reduce conditional mortality risk then was elicited using labels for a hypothetical sun lotion. The labels were identical to the unconditional morbidity labels just described except that they depicted conditional mortality reductions for the parent/child by 10%/50%. An unconditional morbidity label and a conditional mortality label were presented in random order to each respondent.

Willingness to pay for a reduction in conditional mortality risk was not elicited in the KN survey. Instead, parents were asked for willingness to pay for a delay in the onset of this disease. Parents estimated age at onset of skin cancer in both surveys, but only the KN parents were asked for their willingness to pay to delay it. Delay in onset of skin cancer was randomly varied

using labels similar to the one shown in Figure 2. A label for unconditional morbidity and a label for delay of onset of skin cancer were presented to each respondent in random order.

3. Characteristics of Respondents

Before comparing results from the two surveys, it is useful to briefly compare socio-economic and demographic characteristics of respondents. As shown in Table 1, 93% of the 488 non-black Hattiesburg parents were white and 7% were members of other races. Their mean age was 35 years, 75% were female, 83% were married, 58% were college graduates, mean household income (in 2005 dollars) was $59,000 per year, and the mean number of persons per household was 4.02. Among the 592 non-black KN parents, 77% were white, 23% were members of other races, the mean age was 37 years, 61% were female, 82% were married, 30% were college graduates, mean household income was $58,100 per year (in 2005 dollars) and the mean number of persons per household was 4.18.

At the 1% level, a significantly greater percentage of males participated in the KN survey than in the Hattiesburg survey. A possible explanation for this outcome is that men are more time-constrained than women and in the KN survey, respondents could complete the survey at home and did not need to travel to a central location. Additionally, at the 1% level, Hattiesburg respondents were more likely to be college graduates. As discussed by Krosnick and Chang (2004), respondents with greater levels of education tend to be over-represented in RDD telephone samples. Local graduates of the University of Southern Mississippi may also have been more likely to respond positively to a request from their alma mater to return to the campus and participate in a research project. Effects of gender and education differences between the two samples are explored below. For the remaining respondent characteristics, the null hypothesis of equal means in the two samples is not rejected at the 5% level.

The two surveys exhibited few differences between characteristics of the sample children. In the KN survey, 48% of sample children were female, whereas the corresponding percentage in the Hattiesburg survey was 49%. The average age of sample children was 7 years in both surveys.

4. Comparison of Results

This section is organized into six subsections that compare the following aspects of responses from the two surveys: (1) item non-response, (2) awareness of skin cancer risks, (3) completion time, (4) frequency distributions of perceived risk estimates, (5) determinants of perceived risk, and (6) estimates of willingness to pay for reduced skin cancer risk.

a. Item non-response

As mentioned previously, 21 Hattiesburg parents (3% of 635 respondents) failed to answer one or more survey questions. Incomplete data were obtained for 12 questions and questions about income were left unanswered most frequently. In the KN survey, 83 parents (13% of 644 respondents) failed to answer one or more questions, and incomplete data were obtained for 33 questions. KN provided previously collected socio-economic and demographic information from their records, so respondents were not queried about income. Gender and schooling would not appear to explain the extent of item non-response in the KN sample.[7]

b. Awareness of skin cancer

Table 1 indicates that parents in both surveys generally were knowledgeable about skin cancer, although Hattiesburg parents were better able to recall people who had contracted this disease. Among the respondents in the Hattiesburg sample 51% knew of a public figure, such as

[7] In the KN sample, 12% of males and 13.5% of females failed to answer at least one question; these proportions do not differ significantly at the 1% level. With respect to schooling, 10% of college-educated respondents skipped one or more questions compared to 14.4% of respondents with less schooling; these proportions do not differ significantly at 1%.

former President Reagan, who had been diagnosed with skin cancer, 82% knew someone personally (a friend or relative) who had been diagnosed with this disease, and 25% knew of someone that had died from this disease. Among KN respondents, 26% indicated that they knew of a public figure that had been diagnosed with this disease, 55% knew someone personally who had been diagnosed with skin cancer, and 11% knew of someone who had died from skin cancer. Between the two samples, each of the three corresponding proportions differs significantly at the 1% level. These outcomes suggest that Hattiesburg respondents were better able to recall people who have experienced skin cancer than were KN respondents. Although the incidence of skin cancer varies somewhat between U.S. regions (U.S. Cancer Statistics Working Group 2005), differences in region of residence between the two samples do not appear to explain these results and the main differences in respondent characteristics between the two samples, gender and education, play only a minor role in these results.[8]

c. Survey completion time

Figure 1 shows the distribution of completion times for each of the two surveys. The two surveys were approximately the same length and pre-test data suggested that participants would complete them in about 25 minutes. Although median completion time lies between 20 and 25 minutes for both surveys, mean completion time among Hattiesburg respondents was 26 minutes, compared to 1178 minutes (about 19.6 hours) for KN respondents. Of the 592 KN respondents,

[8]Probit regressions reported in Appendix Table A-2, for example, indicate that college graduates in the KN sample were more likely to recall a public figure with skin cancer than non-college graduates. Nonetheless, the difference in education between the two samples account for only 4 (16%) of the 25 percentage point difference in the ability of respondents to recall such a person. The difference in the proportion of males in the two samples was unimportant in accounting for this difference. The probit regression for the KN sample also indicates that there is no significant difference in ability to recall a public figure with skin cancer between Census regions. Also, the limited data available on regional differences in skin cancer incidence do not indicate that incidence is higher in Mississippi than in the rest of the U.S. Incidence rates for melanoma skin cancer are reported by state and region (U.S. Cancer Statistics Working Group 2005), but not for the South because data are missing for several states including Mississippi. In the two states bordering Mississippi for which data are reported, age-adjusted incidence per 100,000 whites is 16.5 in Alabama and 13.2 in Louisiana. Both of these rates are lower than the corresponding national figure of 18.3.

99 (17%) took longer than 100 minutes to complete the survey. KN classifies such interviews as "resumed" or interrupted interviews. In other words, while Hattiesburg respondents had no realistic option but to complete the survey in one sitting, KN respondents could have begun the survey, put it aside to engage in other activities, and resumed it later, perhaps repeating this process multiple times. [9]

Figure 1 also shows that a greater fraction of KN respondents completed the survey relatively quickly. Among KN respondents, 39% completed the survey within 20 minutes and 18% completed it within 15 minutes. Among Hattiesburg respondents, 22% completed the survey within 20 minutes and 7% completed it within 15 minutes. Both of the corresponding differences in proportions between the two samples differ significantly at the 1% level. Among the group of KN respondents who completed the survey in less than 100 minutes, college graduates completed it significantly (at the 1% level) more quickly (by 3.2 minutes) than non-college graduates.[10] College graduates in the Hattiesburg sample also completed the survey significantly (at the 5% level) more quickly (by 2.1 minutes) than non-college graduates.[11]

These results indicate that the main differences in respondent characteristics between the two surveys, gender and education level, do not account for the observed differences in time to completion. Among KN respondents, men were more likely to take more than 100 minutes to complete the survey. But among respondents taking less than 100 minutes to complete both

[9]Appendix Table A-1 presents a probit regression in which the dependent variable distinguishes whether respondents in the KN survey took longer than 100 minutes to complete it. Covariates measured respondents' gender, age, marital status, education, and household size. Males were significantly more likely to have completion times longer than 100 minutes; coefficients of other covariates did not differ significantly from zero at conventional levels.

[10]These results were obtained from an OLS regression (n=493) of completion time (in minutes) on respondents' gender, years of age, marital status, number of persons living in the household, and whether the respondent is a college graduate. At the 1% level, younger and married respondents also completed the survey more quickly than their older and unmarried counterparts. See Appendix Table A-1.

[11]These results were obtained from an OLS regression (n=488) specified similarly to the KN regression described in footnote 9. Coefficients of variables other than education level did not differ significantly from zero at the 5% level. See Appendix Table A-1.

surveys: (1) men and women took about the same amount of time and (2) college graduates took less time than non-college graduates. Thus, while the proportion of college graduates in the Hattiesburg survey was nearly twice that in the KN survey, the average completion time among KN respondents who completed the survey in less than 100 minutes was lower than for respondents in the Hattiesburg sample. This outcome suggests that the more rapid completion time of KN respondents was due to factors other than respondent gender and education level.

d. Frequency distributions of perceived skin cancer risk

Frequency distributions of initial estimates of perceived risk of getting skin cancer are presented in Table 2 for both parents and children in both surveys. These estimates exhibit considerable variation with some parents believing that skin cancer is highly unlikely and a smaller number of parents believing that skin cancer is inevitable. In both surveys, risk estimates tend to pile up on values that could be selected using only a few mouse-clicks. To estimate perceived risk for themselves in the Hattiesburg survey, 59% of parents chose perceived risk values of 0.05, 0.10, 0.15, 0.20, 0.25, 0.50, 0.75, or 1.00, whereas in the KN survey, 69% of parents selected these values.[12] These two proportions are significantly different from zero at the 1% level.

To estimate perceived risk for their sample children, parents also chose these same easily selected values in 65% of cases in the KN survey and 68% of cases in the Hattiesburg survey. These two proportions do not differ significantly from zero at the 5% level. Nonetheless, in the KN survey, 32% of parents chose their children's risk to be the same as their own, whereas in the Hattiesburg survey, 20% of parents chose their children's risk to be the same as their own. This difference is significant at 1%. Additionally, in the Hattiesburg survey, 14% of respondents

[12] Selecting these values could be accomplished by changing entire columns of grid squares from green to red using one mouse-click per column.

chose one of the above easily selected values to represent their own risk *and* estimated their children's risk to be the same as their own, while the corresponding fraction in the KN survey was 26%. These two proportions also differ significantly at the 1% level.

Regarding revision of perceived risk estimates, in the Hattiesburg survey, 42% of parents revised their own lifetime skin cancer risk estimate, while 39% of parents revised their child's lifetime risk estimate. In the KN survey, the corresponding percentages were 34% and 35%, respectively. At the 1% level, the proportion of parents that revised their own risk estimates is significantly greater in the Hattiesburg survey, but at this significance level, the null hypothesis that an equal proportion of parents revised their child's risk estimate is not rejected.

Overall, therefore, relatively more KN parents than Hattiesburg parents: (1) selected easily chosen values to represent risk, (2) anchored on their own risk in estimating their children's risk, and (3) declined to revise their initial risk estimate. Differences in gender and education do not appear to explain these results.[13] These outcomes suggest that KN respondents were more likely to have taken short-cuts in estimating both their own and their children's perceived risk of getting skin cancer and are consistent with the smaller amount of time (apart from the "resumed interviews") they spent to complete the survey.

e. Determinants of perceived risk

Table 3 presents ordinary least squares estimates of four equations to determine the extent to which parents' initial perceived risk values for themselves and their children are predictably related to skin cancer risk factors. Parents provided initial risk assessments before

[13] Probit regressions using the specification in the middle column of Table A-2 were estimated to examine determinants of (1) selecting easily chosen values to represent parent risk, (2) selecting easily chosen values for parent risk *and* estimating child risk to be the same as parent risk, and (3) revising the initial risk estimate for the parent. In the Hattiesburg sample, no coefficient of any covariate differed significantly from zero at 5% in any of these regressions. In the KN sample, the only variable with a significant coefficient at 5% indicated that females were more likely than males to select easily chosen values to represent their own risks. Because the proportion of females is smaller in the KN sample than in the Hattiesburg sample, this factor cannot explain why more KN respondents provided easily chosen risk values.

being asked about skin cancer risk factors. Thus, results in Table 3 show how parents implicitly weight these risk factors in arriving at their initial perceived risk estimates. Columns 2 and 3 present estimates based on the Hattiesburg sample and Columns 4 and 5 present estimates based on the KN sample. In the regressions for parent's perceived skin cancer risk, values R^2 are 0.183 and 0.178 for Hattiesburg and KN, respectively. In the regressions for parents' perceptions of their children's risk, values of R^2 are 0.117 and 0.053 in the Hattiesburg and KN samples, respectively.

In the Hattiesburg sample (see Column 2), parents' perceived risk for themselves was significantly higher at the 5% level among females as well as those with: (1) very fair skin, (2) a prior diagnosis of skin cancer, (3) knowledge of public figures, family members, or acquaintances with skin cancer, and (4) a history of three or more bad sunburns. Other covariates were not important determinants of perceived risk. This outcome is broadly consistent with determinants of perceived skin cancer risk obtained in a prior face-to-face survey (Dickie and Gerking 1996). In the KN regression for parents' own perceived risk (see Column 3), fairness of skin was unimportant, while coefficients of variables for a prior diagnosis of skin cancer, knowledge of others that have had skin cancer, and a personal history of bad sunburns differed significantly from zero at the 5% level. Additionally, the null hypothesis of equal slopes between Hattiesburg and KN parents is not rejected at the 10% level ($F(10,1030)=1.44$). Thus, it appears that Hattiesburg and KN parents made similar evaluations of their own risk of getting skin cancer.[14]

[14]To further check this aspect, the parent perceived risk regressions were re-run for split samples for parent gender, and parent education. In the KN sample, the null hypotheses of equal slopes between college graduates and non-college graduates and between fathers and mothers are not rejected at 10%. In the Hattiesburg sample, the null hypotheses of equal slopes in both split sample regressions are not rejected at 10%.

Additionally, significant (at 5%) determinants of Hattiesburg parents' perceptions of their children's skin cancer risk (see column 4) were: (1) whether the child had very fair skin, (2) the child's age, and (3) the parents' prior diagnosis of skin cancer and (4) knowledge of others with this disease (see Column 4). In the corresponding estimates from the KN sample, only variables measuring parents' prior diagnosis of skin cancer and knowledge of others with this disease had significant coefficients (see Column 5). The null hypothesis of equal slope coefficients in these two regressions is not rejected at the 10% level ($F(9,1049)=1.68$). Nonetheless, in the KN regression only parent characteristic variables have significant coefficients, whereas child age and skin type had significant coefficients in the Hattiesburg regression, suggesting again that KN parents anchored on their own perceived risk estimate more frequently than did Hattiesburg parents in estimating skin cancer risk for their children. This finding does not appear to be related to the main differences in respondent characteristics between the two samples: For both KN and Hattiesburg, the null hypothesis of equal slopes is not rejected in split sample regressions for parent gender and education level (college graduate/non-college graduate).

f. Willingness to pay and scope tests

This subsection compares external scope tests of stated preferences for the hypothetical sun lotion that would reduce unconditional risk of skin cancer (i.e., the type of sun lotion for which the labels were identical in each study). The scope tests examine whether parents' proclivities to purchase the sun lotion are higher for lower prices and for greater percentage risk reductions. The tests are based on binomial probit equations to distinguish the parents' (yes/no) purchase decision for the hypothetical sun lotion. One equation is estimated using the Hattiesburg data and a second equation is estimated using the KN data. Covariates are the experimental design points used in the survey (sun lotion price, the percentage risk reductions for

the parent and the child that were stated on the label, whether the label was the first or second seen by the parent), and controls for household income and number of children. An important aspect of estimation is that random assignment ensures that the experimental design point variables are orthogonal both to observed and unobserved parent characteristics. As explained more fully in Dickie and Gerking (2006a), this feature also means that coefficients of the experimental design point variables are robust to the choice of included controls.

Results of estimation are presented in Table 4. Consider first the results from the Hattiesburg equation. The coefficient of price is negative and significantly different from zero at 1%, suggesting that parents were more reluctant to purchase the sun lotion at higher prices than at lower prices. Coefficients of variables measuring the extent of reductions in skin cancer risk are positive and significantly different from zero at the 5% level or lower for both parent and child. This outcome suggests that parents are willing to pay more for 50% risk reductions than for 10% risk reductions. Estimates also show that an increase in the total number of children in the family is associated with a reduction in willingness to pay. Household income and the order in which the morbidity and conditional mortality labels were presented are unimportant.

In the KN survey, parents again were less likely to say they would purchase the hypothetical sun lotion at higher prices than at lower prices, however, estimates suggest that these parents were unwilling to pay more for a 50% risk reduction than for a 10% risk reduction. Coefficients of both child and parent risk reduction variables in this equation were not significantly different from zero and the coefficient of parent risk reduction was negative. Thus, the external scope test for risk reduction is not satisfied.[15] Additionally, in contrast to the

[15]In previous valuation surveys using survey data from the KN panel, Dickie and Gerking (2004) and von Stakelberg and Hammitt (2006) also found that the external scope test was not satisfied in the context of workplace risks and developmental health risks to children, respectively. Viscusi and Huber (2006), on the other hand, in their valuation study using the KN panel, found that respondents were willing to pay significantly more for a large

Hattiesburg results, the coefficient of household income was positive and significantly different from zero and the coefficient of number of children in the household was not significant. The order of label presentation again did not matter.

At least five factors may explain the contrasting results from the external scope tests for risk reduction from the two studies. First, the equations estimated in Table 4 ignore the possibility that coefficients estimated may not be constant between socio-economic and demographic groups including those that represent the main differences between the Hattiesburg and KN samples (parent gender and college graduation status). To investigate this possibility, regressions specified like those in Table 4 were re-estimated for seven pairs of subgroups defined by (1) parent gender, (2) child gender, (3) parent age (younger/older than 35 years), (4) child age (younger/older than 8 years), (5) parent schooling (college graduate or not), (6) annual household income (less/greater than $50,000 in 2005 dollars), and (7) number of children in the household (one/more than one). This makes a total of 14 additional regressions in for both the Hattiesburg and KN samples.[16]

In these regressions, the coefficient of sun lotion cost remains negative and significant at the 1% level in 13 of 14 subgroups for the Hattiesburg survey and in all subgroups for the KN survey. For the Hattiesburg survey, coefficients of variables measuring parent and child risk reductions remain positive in all subgroups, although significance levels deteriorate relative to the full sample regression in Table 4. At the 10% level, the coefficient of parent risk reduction is significant in 7 of 14 subgroups and the coefficient of the child risk reduction is significant in 11 of 14. In the KN survey, on the other hand, the parent risk reduction coefficient is positive in

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improvement in water quality as compared with a small improvement. Alberini et al. (2004) found that KN respondents were willing to pay significantly more for larger than for smaller reductions in mortality risk.

[16] The variable measuring household income or the number of children in the household was excluded when sub-samples were defined by income or the number of children, respectively.

only 4 of 14 subgroups and is never significant at the 10% level. The child risk reduction coefficient is positive in 12 of 14 KN subgroups but is significant at 10 percent in only 3 of 14 (younger parents, mothers, and parents having only one child). With few exceptions, then, Hattiesburg parents in all of these demographic groups appear to have considered the magnitude of risk changes as well as the cost in making hypothetical sun lotion purchase decisions, whereas KN parents appear to have considered only the cost.

Second, parents who are more knowledgeable about skin cancer or perceive greater risk for themselves or their children may be more inclined to thoughtfully consider risk changes posed in valuation questions, and these individuals are more heavily represented in the Hattiesburg sample. To look at the impact of prior knowledge about skin cancer on scope tests, Table 4 regressions was re-estimated three times for each sample using three alternative indicators for familiarity with skin cancer, based on whether the respondent knew (1) of a public figure who had been diagnosed with skin cancer, (2) someone personally with the disease, and (3) of anyone who had died from it. These indicators were included as dummy variables along with all original covariates and a full set of interactions. In the three additional Hattiesburg regressions, only one of six risk change coefficients differs significantly at the 10% level between parents with more or less familiarity with skin cancer (the coefficient of the child risk reduction is larger for those who have known someone personally with the disease). Similarly in the three additional KN regressions, only one of six risk change coefficients differs significantly by skin cancer knowledge (the coefficient of the child risk change is larger for parents who can recall a public figure with skin cancer). Thus, the purchase decision for the hypothetical sun lotion may have some association with prior knowledge of skin cancer, but this factor would not appear to explain the contrasting results of scope tests between the two surveys.

A similar procedure considered the impact of initial risk perceptions on scope tests. Two dummy variables were constructed to indicate whether parents' initial perceptions of lifetime skin cancer risk for themselves and for their children were greater than 21% (the average for whites according to Ries et al. 2003). Table 4 regressions then were re-estimated twice for both Hattiesburg and KN samples by including one and then the other of these dummy variables along with all original covariates and a full set of interactions. The only difference in the performance of the risk change variables that is significant the 10% level in either regression in either sample is the coefficient of the child risk reduction, which is larger among Hattiesburg parents who see their own risk as relatively high.

A fourth possible reason why scope tests differ between Hattiesburg and KN samples is that KN respondents who took a very long time or a very short time to complete the survey provided systematically different responses than others. Excluding the respondents who took 100 minutes or longer from the KN regression in Table 4 resulted in little change in the estimates and no change in scope test outcomes. Similarly, excluding respondents from the KN regression that took more than 40 minutes or those that took less than 20 minutes had no effect on scope test outcomes. Fifth, the 28% of KN parents that used the WebTV interface may have responded differently than other parents. A dummy variable was created for this aspect and interacted with all other covariates shown in the Table 4 regression. Coefficients of these interaction variables never were significantly different from zero at conventional levels. Thus, use of WebTV rather than a personal computer to complete the survey does not appear to account for the difference in scope test outcomes.

4. Speculative Conclusions

In summary, scope test outcomes and other aspects of the two surveys suggests that the Hattiesburg survey produced better quality data than did the KN survey. Divergence in the various measures of data quality between the two surveys is not explained by differences between the two samples in education or other demographic characteristics, knowledge about skin cancer or perceived risk levels, or in the time taken or the interface used to complete the survey. At this point, it is only possible to speculate on the reasons for this outcome. Nonetheless, at least three differences between the two surveys suggest that respondents may have been more engaged in the Hattiesburg survey than in the KN survey.

First, whereas all of the Hattiesburg respondents completed the survey in a quiet university computer laboratory, KN respondents completed the instrument at home and may have experienced distractions from other family members, visitors, telephone calls, television, and other on-line activities (instant messaging, web surfing, and e-mail). As demonstrated by Ransdell and Gilroy (2001) and Beaman (2005), distractions can impair cognitive performance. Set against this concern, however, is the possibility that KN respondents chose times to complete the survey when they would be unlikely to be distracted or interrupted.

Second, KN respondents could begin the survey, put it aside for a period of time, and return to work on it later. This possibility raises the question of whether respondents would be able to accurately reconstruct their thoughts from a previous session. Hattiesburg respondents, on the other hand, had no realistic option but to complete the survey in one session.

Third, whereas the Hattiesburg respondents were recruited especially for the skin cancer study, the KN panelists complete surveys on a broad range of topics as often as once per week.

Thus, panel conditioning effects, in which respondents become "stale" after completing a number of surveys, may be at least partly responsible for the results presented, even though such effects have been found to be unimportant in prior research (see Bartels 1999). As indicated in Section 2, KN respondents are recruited using offers of free Internet access and other inducements; yet monitoring the quality of responses to questions in subsequent surveys would be quite difficult. On the other hand, in the Hattiesburg survey, respondents had to travel to the University of Southern Mississippi campus and then spend about 30 minutes to complete the survey with costs defrayed only by the token $25 participation fee. Respondents willing to make such an effort may then answer questions more carefully, particularly if they know that completing the survey is a one-time event. In any case, incentives for accurate responses to survey questions may make an interesting topic for further research.

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Table 1. Sample Characteristics

Variable	Hattiesburg (n = 488)	Knowledge Networks (n = 592)
Mean years of age of parents	35	37
Mean years of age of sample children	7	7
Percent of female parents	75%	61%
Percent of female sample children	49%	48%
Percent of white parents	93%	77%
Percent of married parents	83%	82%
Percent of parents with college degree	58%	30%
Average household income	$59,000	$58,100
Average number of persons in household	4.02	4.18
Percent of parents who knew of public figure with skin cancer	51%	26%
Percent of parents who knew of someone personally with skin cancer	82%	55%
Percent of parents who knew of someone who had died from skin cancer	25%	11%

Table 2. Frequency Distribution of Parents' Perceived Risks.

	Hattiesburg (n = 488)		Knowledge Networks (n = 592)	
Risk Range (%)	**Parents**	**Children**	**Parents**	**Children**
0 - 4.75	53	46	84	99
5 - 9.75	24	48	119	130
10 - 14.75	53	78	103	93
15 - 19.75	55	62	65	44
20 - 24.75	56	59	38	47
25 - 29.75	60	63	58	69
30 - 34.75	40	32	22	21
35 - 39.75	21	16	9	16
40 - 44.75	33	23	13	16
45 - 49.75	6	4	7	9
50 - 54.75	49	29	45	25
55 - 59.75	4	2	3	7
60 - 64.75	5	5	6	4
65 - 74.75	4	3	4	2
75 - 84.75	8	8	7	6
85 - 89.75	3	2	1	1
90 - 94.75	8	5	3	0
95 – 99.75	3	1	1	0
100	3	2	4	3

[a]Initial risk assessments.

Table 3. Determinants of Perceived Risk[a]

	Dependent Variable: Parent perception of own risk		Dependent Variable: Parent perception of child's risk	
Explanatory Variable	**Hattiesburg (n = 488)**	**KN (n = 564)**	**Hattiesburg (n = 488)**	**KN (n = 581)**
Constant	12.177* (5.626)	13.039* (4.561)	17.418 (3.231)	14.451* (2.436)
=1 if respondent has a prior diagnosis of skin cancer	22.863* (4.432)	26.870* (4.773)	11.089* (4.092)	12.603* (4.553)
=1 if respondent knows of a public figure with skin cancer	4.669* (1.788)	3.767* (1.711)	0.399 (1.663)	3.090 (1.601)
=1 if respondent knows personally anyone with skin cancer	6.928* (2.342)	6.638* (1.549)	6.564* (2.171)	3.921* (1.429)
=1 if respondent is female	7.234* (2.103)	-0.514 (1.610)	3.147 (1.923)	0.999 (1.434)
Respondent's years of age	-0.054 (0.138)	-0.057 (0.108)	---[b]	---[b]
=1 if respondent has very fair skin	5.017* (2.578)	1.338 (2.677)	---[b]	---[b]
=1 if respondent's skin is sensitive to sunlight	0.372 (2.387)	3.647 (2.399)	---[b]	---[b]
=1 if respondent has had 3 or more bad sunburns in lifetime	5.961* (1.929)	7.471* (1.557)	---[b]	---[b]
=1 if child is female	---[b]	---[b]	-0.452 (1.635)	0.354 (1.401)
Child's years of age	---[b]	---[b]	-0.743* (0.288)	-0.253 (0.241)
=1 if child has very fair skin	---[b]	---[b]	11.949* (2.502)	3.355 (2.258)
=1 if child's skin sensitive to sunlight	---[b]	---[b]	-3.084 (2.369)	0.468 (2.253)
=1 if child has had 3 or more bad sunburns in lifetime	---[b]	---[b]	5.279 (3.505)	5.377 (3.657)
=1 if respondent is married	-4.413 (2.361)	-0.932 (1.949)	----[b]	---[b]
=1 if respondent is a college graduate	0.912 (1.798)	-2.876 (1.683)	---[b]	---[b]
R^2	0.183	0.178	0.117	0.053
F	10.69*	12.01*	7.07*	3.56*

[a] Standard errors in parentheses beneath coefficient estimates
[b] denotes omitted variable
* denotes significance at 5% level

Table 4. The Purchase Decision: Binomial Probit Estimates[a]

Explanatory Variable	Hattiesburg (n = 488)	Knowledge Networks (n = 591)
Constant	1.158* (0.238)	0.263 (0.217)
Sun lotion price	-.010* (0.002)	-0.006* (0.001)
=0.1 if label offered a 10% skin cancer risk reduction for the parent; 0.5 if label offered a 50% reduction	0.284* (0.125)	-0.097 (0.109)
=0.1 if label offered a 10% skin cancer risk reduction for the child; 0.5 if label offered a 50% reduction	0.406* (0.124)	0.123 (0.109)
=1 if the unconditional skin cancer risk reduction label was presented last	-0.198 (0.124)	-0.204 (0.110)
Income of household (in $10,000 of year 2005)	0.0254 (0.0164)	0.032* (0.0143)
Number of children in household	-0.205* (0.065)	0.009 (0.053)
$X^2(6)$	58.17*	55.52*

[a]**Standard errors in parentheses beneath coefficient estimates**
*__Denotes significance at 5%__

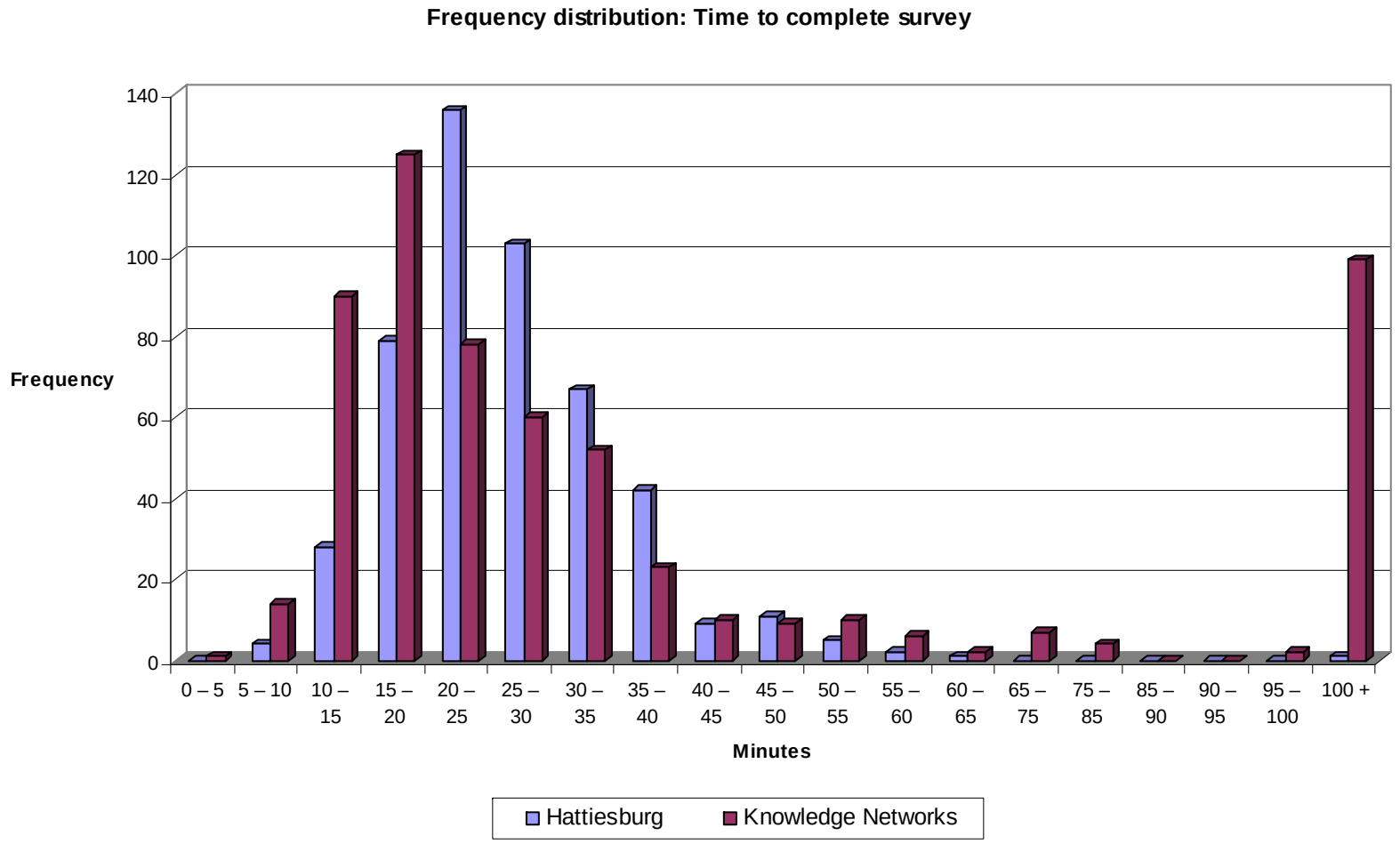

Figure 1: Frequency distribution of time to complete survey, by sample.

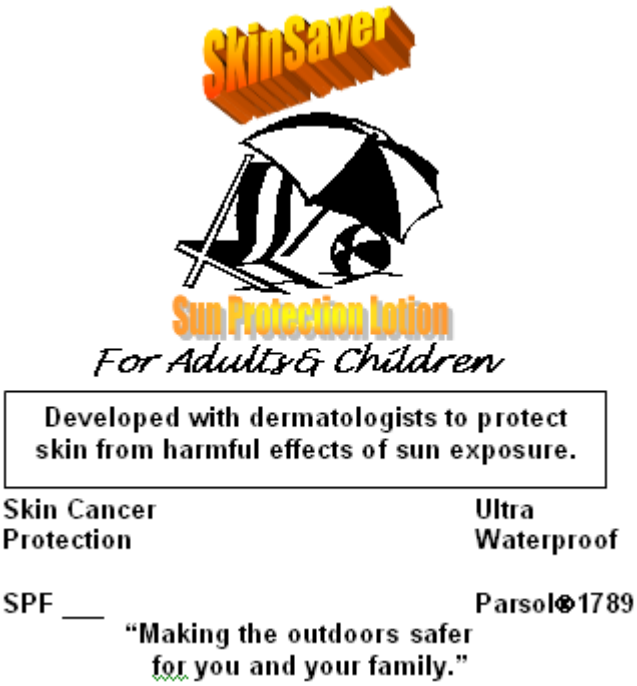

Figure 2(a): Label of sun lotion (front of bottle).

(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.

Figure 2(b): Label of sun lotion (back of bottle).

Table A-1. Determinants of time to survey completion

	Dependent variable: Survey took longer than 100 minutes (yes/no)[a]	Dependent variable: Time in minutes to completion[b]	
Explanatory Variable	**KN (n=592)**	**Hattiesburg (n = 488)**	**KN (n = 493)[c]**
Constant	-0.665 (0.423)	22.033* (3.007)	11.873* (4.410)
=1 if respondent is female	-0.305* (0.130)	1.100 (1.073)	1.623 (1.325)
=1 if respondent is a college graduate	0.125 (0.138)	-2.090* (0.934)	-3.156* (1.402)
Respondent's years of age	-0.005 (0.009)	0.076 (0.071)	0.330* (0.089)
Number of persons in respondent's household	0.002 (0.058)	0.596 (0.462)	0.925 (0.571)
=1 if respondent is married	0.018 (0.174)	-0.429 (1.333)	-4.145* (1.646)
R^2	---	0.019	0.048
$X^2(5)$	6.91	---	---
F	---	1.89	4.88*

[a]Probit estimates with standard errors presented beneath coefficients (* denotes significance at 5%)

[b]OLS estimates with standard errors presented beneath coefficients (* denotes significance at 5%)

[c] 99 respondents taking longer than 100 minutes to complete the survey are excluded.

Table A-2. Determinants of respondent's knowledge of a public figure with skin cancer[a,b]

Explanatory Variable	Hattiesburg (n = 488)	KN (n = 591)
Constant	-0.337* (0.152)	-0.586* (0.131)
=1 if respondent is female	-0.071 (0.536)	-0.024 (0.039)
=1 if respondent is a college graduate	0.042 (0.047)	0.133* (0.043)
Respondent's years of age	0.013* (0.004)	0.007* (0.003)
Number of persons in respondent's household	-0.022 (0.023)	0.007 (0.017)
=1 if respondent is married	0.033 (0.067)	0.051 (0.049)
=1 if residence in northeast		0.057 (0.060)
=1 if residence in midwest		0.020 (0.050)
=1 if residence in west		0.024 (0.049)
=1 if residence in south		---[c]
X^2	18.56*	29.55*

[a]Binomial probit estimates of marginal effects with standard errors presented beneath coefficients.
[b]*Denotes significance at 5%.
[c]Excluded category.