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Perceptions And Their Role In Consumer Decision-making

Raman Khaddaria
University of Central Florida

PERCEPTIONS AND THEIR ROLE IN CONSUMER DECISION-MAKING

by

RAMAN KHADDARIA
M.S. Indian Statistical Institute, 2002
B.Sc. Calcutta University, 2000

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ABSTRACT

This dissertation is an empirical investigation into the roles that different quantifiable and measurable perceptions play in defining individual behavior across a variety of decision-making contexts. In particular, the focus lies on smokers and the choices they make with regard to smoking and beyond. Chapter 1 analyzes a nationally representative sample of adults (23 years and older) in the United States, pertaining to the Annenberg Perception of Tobacco Risk Survey II (1999-2000). It is observed that three dimensions to smoking behavior viz., risk, temporality and addiction, interact to determine the smoking status of an individual. Although previous studies mostly looked into each of these dimensions in isolation, in this chapter, we empirically illustrate how perceptions on risk, time dimensions and addiction, jointly influence the smoking behavior of adults. Chapter 2 casts the smoker in the role of a parent and explores parental behavior towards the general health-risks facing their children. Using the dataset from a survey (2009), conducted in Orlando, Florida, on parents, having at least one child aged between 1 and 16 years, the chapter arrives at two findings relevant for policy: i) In each of the 'smoker' and 'non-smoker' parent categories, parents exhibit equal concern for themselves and their children, and ii) the level of concern shown by smoker-parents, towards health-risks faced by their children, is the same as that shown by their non-smoking counterparts. The analysis in this chapter also affirms the need to incorporate subjective risk assessment in willingness-to-pay (WTP) exercises to facilitate a deeper behavioral analysis of health risk valuation. Lastly, in Chapter 3, we focus on the issue of quantitative assessment of the perception of health risks from smoking. Particular interest lies in understanding how variants of a metric - namely, a survey question - have been employed in academic studies and industry-surveys, in order to measure smoking-related risk-perceptions. In the process of reviewing select tobacco-industry survey

records, we analyze the implications of different features of this metric, (e.g., use of a 'probe', the 'Don't Know' option), and various interview modes (e.g. telephonic, face-to-face), for the estimates of perceived risk arrived at in these studies. The review makes clear that two aspects of health risks from smoking – the risk of contracting a smoking-related disease, as against the risk of prematurely dying from it conditional upon getting affected – have not been jointly explored so far. The dataset obtained from the Family Heart Disease and Prevention Survey (November 2010-March 2011), provides a unique opportunity to explore these two kinds of probabilities, particularly with regard to the risks of lung-cancer from smoking. Chapter 3 concludes by illustrating how individuals evaluate both these aspects of health-risks. While the probability of getting lung-cancer is found to be overestimated in conjunction with previous studies, the conditional probability of premature death is severely underestimated. Additionally, it is found that individuals' subjective assessments of either of these risk aspects predict smoking behavior in an identical manner. This calls into question the so-called 'rationality' of smoking decisions with implications for policies designed for the control of tobacco consumption.

To My Parents

Shyam Khaddaria

&

Kanta Khaddaria

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

This dissertation is an empirical investigation into the roles that perceptions play with regard to various choices that individuals make across different decision-making contexts. In particular, we explore the behavior of smokers and consider their decision-making in the context of smoking and beyond. Our empirical methodology entails the use of different quantifiable and measurable perceptions towards understanding their impact on the decisions that smokers actually make under different scenarios.

Chapter 1 shows how the three aspects of smoking behavior – *risk*, *temporality* and *addiction* interact and determine the smoking status of an adult individual. In the context of smoking, the adverse nature of health consequences comprises the *risk* aspect while *temporality* or the time aspect of smoking lies in the fact that such health-related risks essentially occur in the future. Besides, a smoker could simply indulge in his smoking habit to counter the "withdrawal symptoms" even though he really desires to stop smoking. This brings in the *addiction* aspect. While previous studies have mostly explored these aspects in isolation, our analysis provides evidence that these dimensions simultaneously determine smoking-related choices that people make. The Annenberg Perception of Tobacco Risk Survey II (1999-2000) dataset pertaining to a nationally representative adult population in the United States is analyzed. The sample is divided into various sub-samples using *addiction* and *temporality* as the splitting criteria. Our primary interest lies in exploring the association between beliefs on *risk* and smoking likelihood, controlling for relevant covariates, and allowing for interactions with *temporality* and *addiction* as well. The empirical analysis reveals the following. Firstly, in the context of adults, risk-perception and the likelihood of smoking are found to be negatively associated with each other in each of the sub-samples that we consider. Thus, higher perceptions of *risk* dampen the

likelihood of smoking of the respondents, irrespective of their beliefs on the *addiction* and *temporality* dimensions. Secondly, in our sub-sample created on the basis of the *temporality* criterion, we find that at a given level of risk-perception, adults who perceive adverse health-effects to be occurring in the nearer future are less likely to smoke as compared to those who perceive otherwise. Thirdly, in the sub-sample constructed on the basis of the *addiction* criterion, for a given level of risk-perception adults who perceive a greater difficulty in quitting smoking are more likely to smoke than people who believe quitting to be relatively easier. Thus, results indicate that even though perceptions on *risk* and *temporality* negatively impact smoking likelihood of adults, it is *addiction* (i.e. the associated difficulty in quitting) that prompts adults to continue with their habit of smoking.

Chapter 2 addresses the research question: "Do smoker-parents behave differently from non-smoker parents, when it comes to *general* health-risks (leukemia) faced by their children". A stated preference data set, comprising parent-respondents with children aged between 1 and 16 years, is analyzed. Sub-samples are constructed based on the smoking status of the parents. The two main research hypotheses that this chapter tests are i) parental altruism *within* each parent group and ii) the equality of the marginal Willingness-To-Pay (WTP) for a percentage reduction in risk, *across* different parent groups. Two key findings, relevant for policy, emerge with respect to parental behavior. First, parents in each of the groups, categorized on the basis of their smoking status, exhibit *altruism* towards their children. Second, the level of concern (indicated by the WTP for an additional percentage reduction in risk) by smoker-parents, towards the health risks faced by their *children*, is the same as that shown by their non-smoking counterparts. Parental dimensions apart, we find that the level of concern that parents show towards their *own* health-risks is also the same across the different parent groups. The chapter then focuses solely

on the parent's *own* health risks and strives to interpret the WTP results in terms of both percentage and absolute risks. An analysis of health-risk valuation in terms of absolute risks is facilitated by the data on subjective risk perceptions elicited in our survey.

Chapter 3 exclusively focuses on the issue of quantitative assessment of perception of health-risks from smoking. Of particular interest is the use of variants of a metric – a survey question – which has been commonly featured in academic studies on smoking behavior, starting with Viscusi (1990). Interestingly, this chapter traces the use of such a metric in industry surveys as well, some even dating back to the year 1964 (Baghal, 2011). This allows us an opportunity to review select documents of the tobacco industry, which have particularly made use of this question in field surveys. In the process, we analyze the implications of different features of this metric for the estimates of perceived risk, as obtained from these surveys. More precisely, the chapter explores the likely implications of a 'probe', the 'Don't Know' option etc. Moreover, the different modes under which these surveys were conducted, viz., telephone or face-to-face, are also discussed. This select review of industry records makes clear that the two aspects of health-risks from smoking – the risk of contracting a smoking-related disease, as against the risk of dying conditional upon getting affected – have not been jointly explored so far. The dataset obtained from the Family Heart Disease and Prevention Survey, conducted during November 2010 - March 2011, provides us a unique opportunity to explore these two probabilities, particularly with respect to the risk of lung-cancer from smoking. The Chapter concludes by noting that while the probability of getting lung-cancer is found to be overestimated in conjunction with previous studies, the conditional probability of premature death is severely underestimated. Additionally, it is found that individuals' subjective assessments of either of these risk aspects predict smoking behavior in an identical manner. This calls into question the

so-called ‘rationality’ of smoking decisions with implications for policies designed for the control of tobacco consumption.

CHAPTER 1: SMOKING BEHAVIOR AMONG ADULTS

1.1 Introduction

Most choices that individuals make (such as purchase of health insurance, consumption of addictive substances, opting for certain kinds of jobs etc) generally involve two dimensions, namely, risk and temporality. Therefore, for an effective understanding of behavior involving such choices, both these dimensions may be analytically explored. In this chapter, we focus on the choice of smoking among adults and aim to empirically understand how beliefs on risk and time dimensions may jointly determine human behavior. Numerous studies on smoking behavior (Viscusi, 1990, 1991; Viscusi et al., 2000; Antonzas et al., 2000) have looked at risk and inter-temporality, but have considered these aspects only in isolation. This chapter contributes to the literature by contending that risk and inter-temporality interact with each other and simultaneously determine smoking-related choices that people make. An empirical analysis is conducted in order to supply evidence that supports this claim. In our analysis, not only are risk and temporal elements considered, but the third element of addiction is explored too. The primary motivation lies in understanding the role each of these elements plays, and the importance that one element holds relative to the other, in determining the smoking status of an adult individual.

In the context of smoking, the adverse nature of health consequences comprises the *risk* aspect while *temporality* or the time aspect of smoking lies in the fact that such health-related risks essentially occur in the future. More precisely, the time-dimension becomes clear when one recognizes that the act of smoking and its consequences on health are temporally separated. Generally smoking is initiated during adolescence or young adulthood but, the health shocks or

adversities are likely to occur in late adulthood. Moreover, the choice of smoking itself provides a feedback effect on the risk and temporal aspects associated with it. This latent endogeneity may be explained by the fact that smoking is not quite a one-time decision. Rather, the phase between the time-point when an individual initiates into smoking until such time when he becomes a mature smoker can be thought to be comprised of a series of decisions. For a mature smoker, we conceive that the act of smoking may not merely be a decision to smoke or not. The smoker could simply indulge in his smoking habit to counter the "withdrawal symptoms"[1] even though he really desires to stop smoking. This brings us to the third dimension of importance, namely *addiction*, which plays a particularly crucial role in decisions with regard to quitting[2] smoking or in choosing not to smoke (Jones 1994, 1999; Suranovic, Goldfarb and Leonard, 1999). Its importance notwithstanding, *addiction,* as a construct, has no specific measures. Economic theory tries to explain addiction with the concepts of i) the discount rate[3] and/or ii) consumption capital.[4] The clinical definition associates addiction with the difficulty in quitting[5]. A smoker may often engage in compulsive, repeated and unwanted use of cigarettes, despite having a desire to quit smoking and a clear understanding of the harmful consequences of his behavior (Bernheim and Rangel, 2004). In our analysis we interpret *addiction* in terms of the difficulty in quitting the habit, thus adopting the clinical definition.

[1] When a smoker realizes that reducing cigarette-uptake or not consuming cigarettes altogether, is not a costless option, the phenomenon is summarized under the rubric of "withdrawal syndrome".
[2] Harris and Harris (1996) define quitting as a rational economic decision where the smoker weighs the benefits of quitting against the adjustment costs (which arise out of addiction).
[3] Hyperbolic discounting is attributed to impulsive behavior such as substance abuse or overeating. Immediate consequences are heavily weighted compared to those further apart in time which leads to behaviors such as smoking (see Khwaja, Silverman and Sloan, 2007; Audrain-McGovern et al., 2009).
[4] Consumption capital as a construct puts forward the concept of addiction in terms of reinforcement and tolerance (see Becker and Murphy, 1988).
[5] Addiction is not manifested until one decides not to continue with smoking by quitting altogether or lowering one's consumption from the habitual level.

Our study considers all of the above elements together and aims to analyze the interactions across *risk*, *temporality* and *addiction* in the decisions that adults make with regard to the choice of smoking. For the purpose of the present study, beliefs, which adults hold with regard to these three dimensions, are explored. We recognize that numerous factors may be responsible for the formation of these beliefs. However, the identification of plausible factors that go into belief formation falls outside the purview of this chapter. Also, no attempt is made to disentangle the relative importance or contribution of varied information sources on beliefs that individuals hold. Despite having potential significance, the idea of teasing apart of relative contributions of various sources of information on beliefs may bring in issues of tractability in our analysis. Thus, our focus is on how beliefs on risk, temporality and addiction may interact in determining the likelihood of smoking among adults.

In order to empirically address our research question, the following methodology is adopted. A sample of 1504 adults, representative of the national US population, is considered. The sample comprises both smokers and non-smokers, aged between 23 and 95. The data pertains to the Annenberg Perception of Tobacco Risk Survey II conducted in late 1999 and early 2000. We analyze the impact of risk-perceptions on the smoking decisions of the individuals, while taking into account the possible endogeneity with regard to the perceptions of risk. *Temporality* and *addiction* aspects are considered by splitting the sample into sub-samples using certain criteria. Each of these sub-samples captures the degree or extent of *addiction* and/or *temporality* (with regard to the onset of adverse health effects) that the respondent believes to be associated with smoking. The association between risk-perception and smoking likelihood is explored for each of the sub-samples, controlling for relevant covariates. The split-sample analysis allows unobserved heterogeneity a free reign for each given degree of addiction and

inter-temporality. Thus, estimation of a separate model for each sub-sample allows unobserved heterogeneity to vary and the regression plane to shift across different sub-samples. However, the estimated parameter coefficients cannot be compared across groups since they are scaled by the standard deviation of the error term. Our strategy of resolving this issue involves the use of predicted probabilities, the latter being invariant to the factor by which the parameters are scaled. Also, the use of the differences in predicted probabilities across sub-samples in our analysis mitigates the problem of endogeneity of risk perceptions to a substantial extent.

The primary observations forthcoming from our empirical analysis are the following. Firstly, in the context of adults, risk-perception and the likelihood of smoking are found to be negatively associated with each other in each of the sub-samples that we consider. Secondly, in our sub-sample based on the "immediacy" criterion, we find that at a given level of risk-perception, adults who perceive adverse health-effects to be occurring in the nearer future, are less likely to smoke as compared to those who perceive otherwise. Thirdly, in the sub-sample constructed on the basis of the "addiction" criterion, for a given level of risk-perception, adults who perceive a greater difficulty in quitting smoking are more likely to smoke than people who believe quitting to be relatively easier. The last observation contrasts with a finding in Gerking and Khaddaria (2011) that adolescents with a greater perception of "addiction" are less likely to smoke. One may reconcile this divergence in terms of the difference in the ways "addiction" is interpreted. In Gerking and Khaddaria (2011), perception on addiction in the context of adolescents is more likely to emerge from notions that adolescents hold taking cue from their exposure to surrounding publicity and information campaigns. On the contrary, in the case of adults in our sample, addiction holds a greater chance to have been actually experienced by the respondents (Recall that, generally for adults who try to quit smoking, numerous relapses may

occur and adults may fall victims to the "withdrawal syndromes".) Thus, the possibility that adults already have confronted real-life difficulty in quitting smoking habits, may perhaps induce them to indulge in smoking even more, in the present context.

We organize the rest of the chapter as follows. Section 1.2 discusses how past works have explored the elements of *risk*, *temporality* and *addiction* which are of relevance for our study. In Section 1.3, the survey methodology and data descriptions pertaining to the Annenberg Perception of Tobacco Risk Survey II (1999-2000) are presented. In this section, measures of the three dimensions (*risk, temporality* and *addiction*) as derived from the survey, are clearly illustrated. Section 1.4 lays out the econometric model. In Section 1.5, suitable econometric techniques are analyzed, taking into consideration the plausible issue of risk-endogeneity. Section 1.6 presents the results of our empirical analysis. Section 1.7 concludes.

1.2 Previous Research

Previous studies which tried to identify the reasons why people may choose to smoke mostly looked into the risk aspect of smoking behavior (Viscusi 1990, 1991, 1992; Viscusi and Hakes, 2008; Roviera et al. 2000). These studies show that individuals with higher risk perceptions with regard to adverse health consequences from smoking have a lower likelihood of being smokers. Various alternatives for adverse health consequences, such as lung cancer, lung disease, heart disease or loss of life expectancy have been considered. Past works have used one or a combination of these alternatives to measure the perception of risks from smoking. For example, Antonanzas et al. (2000) consider several questions as alternative measures of risk perception. One of the survey questions they use asks respondents about the loss of life expectancy due to smoking. The question is posed in terms of incremental losses in life

expectancy of twin brothers, one of whom smokes. Viscusi and Hakes (2008) refine the framing of this particular question by providing background risks about the general mortality rates of both men and women, so that incremental increases in the loss of life expectancy from smoking are clearly ascertained and made comparable across respondents. In both the studies, the loss of life-expectancy measure is positively correlated with other measures, such as the incidence of lung cancer or heart disease from smoking. Despite the focus of past studies on identifying an appropriate measure of risk-perception, we believe that perhaps there could be more factors at play (e.g. the *temporality* and *addiction* dimensions) which, if explored, could generate deeper and more nuanced interpretations of how risk-perceptions, themselves, are actually incorporated into smoking decisions. In fact, we find that the temporality aspect has been implicit in the past studies which particularly made use of the responses to the question posed on life-expectancy. This realization prompts our focused treatment of temporal dimensions in our analysis.

Studies such as Khwaja, Silverman and Sloan (2007) and Audrain-McGovern et al (2009) have exclusively focused on the temporal aspect of smoking behavior[6]. The latter, using a cohort of respondents in the age-group 15-21, conclude that delay discounting (or hyperbolic discounting) is causal in determining smoking acquisitions. On the other hand, Khwaja, Silverman and Sloan (2007), using a sample of adults aged 50-70, contend that differences in the rates of time discounting do not account for differences in smoking behavior. Rather, measures of impulsivity[7] and the length of time-horizon as obtained from the domain of financial planning are associated with smoking. The treatment of temporal dimensions as adopted in our study

[6] Other Studies which have emphasized on the time preferences that possibly characterize smokers are Bickel, Odum and Madden (1999), Baker, Johnson and Bickel (2003), Odum, Madden and Bickel (2002), Mitchell (1999), Ohmura, Reynolds et al., (2004), Takashi and Kitamura (2005), Scharff and Viscusi (2009), Song (2011), and Pabilonia and Song (2011).

[7] Indicated by statements such as "I make hasty decisions" or "I do not control my temper".

builds on the same idea of the time-horizon as in Khwaja, Silverman and Sloan (2007). However, we deviate from the financial domain and keep our illustration rather focused on the health-domain. This is done by analyzing responses to questions that exclusively asked respondents about the time-horizon they believe to exist, between the time an individual started smoking and the time that adverse smoking-related health effects may set in. In the process, we have steered clear of issues such as the rate of discounting or expectancy with regard to the loss of life. Additionally, while exploring temporal dimensions in past works, we identify a potential ambiguity. Attributing hyperbolic discounting to smoking behavior (as some studies did) assumes that the time-horizon of interest is the same across individuals; i.e., the age at which the adverse health consequences due to smoking start to manifest is assumed to be identical across all and it is chiefly the rate of time preference which determines the smoking status. We apprehend that such assumptions might constitute a case where uncertainty regarding the time-horizon and the rate of time preference may act as potential confounds.

Lundborg (2007) comprises a study that explores the addiction dimension along with data on risk-perceptions. A sample of Swedish adolescents is analyzed. Risk perception and addiction are measured using the format as in Viscusi (1991) using a 0-100 scale. The author concludes that adolescents with a higher perception of risk and addictiveness of cigarettes are less likely to smoke. In Lundborg (2007), the issue of temporality has not been taken into account, however. Our study, thus, aims at a potential contribution to the literature by attempting to consider all of the three aspects of risk, temporality and addiction, together, in order to analyze how smoking-related choices are made by adults.

1.3 Data Description and Split-sample Criteria

We use data pertaining to the Annenberg Perception of Tobacco Risk Survey II for adults, collected in the later part of 1999 and early-2000. A nationally representative sample of 1504 U.S. residents aged 23 and older was obtained by dialing telephone numbers at random. However, we use only 1362 observations for our analysis. Jamieson and Romer (2001) provide a detailed description of the survey procedures and an overview of data-characteristics. The variables which measure or intend to capture the three aspects of smoking, that this chapter particularly focuses on, are discussed in detail in the subsections below, followed by a discussion on other covariates which are used as plausible controls in our analysis.

Generally, a survey respondent can be identified as a cigarette-smoker in more than one way, namely if one (1) has ever smoked a cigarette (even one or two puffs), (2) has smoked cigarettes of any kind in the last 30 days, (3) has smoked flavored cigarettes ("bidis") in the past 30 days and (4) considers oneself to be a smoker. For persons who indicated that they had smoked in the past 30 days, a follow up question was asked to choose an estimate of the average daily cigarette consumption during that time-period , from 7 given options (<1 cigarette per day ; 1-5 per day; 6-10 per day; 11-14 per day ; 15-19 per day ; 20 per day ; more than 20 per day). For the purpose of our analysis, only those individuals who reported average current consumption of one or more cigarettes per day over the 30 day-period prior to the interview have been assumed as 'smokers'. Based on this criterion, about 17% of the respondents (out of 1362) are identified as smokers in our study. Our criterion of identification is akin, in spirit, to the one generally considered in most surveys, which have often identified smokers based on the responses from the question: *Have you smoked at least 100 cigarettes in your life time*? This similarity renders our analysis comparable to previous studies.

Recall our motivation to compare the association between respondents' risk-perceptions and smoking status, across different sub-samples constructed on the basis of the *addiction* and *temporality*. But before going about comparing this association, first the derived measures on the three elements viz. *risk, addiction* and *temporality* need to be discussed. The following sub-sections explain each of these measures in detail.

1.3.1 Risk

The '*risk'* dimension to smoking (or the perceived health risks of smoking) was quantitatively assessed with a question with a similar format to that used by Viscusi (1990). Each respondent was asked the question*: Now I would like you to imagine 100 smokers, both men and women, who smoked cigarettes for their entire adult lives. How many of these 100 people do you think will die from lung cancer*? Note, that other studies such as Viscusi (1990, 1991) assessed respondents' estimates of the risk of contracting lung-cancer, rather than that of dying from it. In contrast to their focus on morbidity risk dimensions, the Annenberg Survey focuses on the mortality aspect instead. Also, the question we use does not pertain to one's own health risks but to those of a 'typical' adult smoker who has smoked for his or her entire adult life. Such questions in the 'third person' (external to the respondent) are fairly reasonable to ask, especially in the context of lethal causes of death such as lung cancer, as is our case (Smith et al, 2000).

Responses to the *'risk'* question focusing on a single health-point (mortality from lung cancer) can be considered as subjective probability estimates that can be compared across respondents. Table 1 and Figure 1 present the frequency distribution of perceived risks of lung cancer from smoking.

Table 1: Distribution of Risk Perception levels

Range	Frequency	Relative Frequency	Cumulative Frequency
0-5	94	0.06	0.06
6-10	88	0.06	0.12
11-20	103	0.07	0.19
21-30	171	0.11	0.30
31-40	128	0.09	0.39
41-50	314	0.21	0.60
51-60	91	0.06	0.66
61-70	80	0.05	0.71
71-80	182	0.12	0.83
81-90	67	0.04	0.88
91-100	98	0.07	0.94
Don't Know	79	0.05	0.99
Refused	9	0.01	1.00
Total	1504		

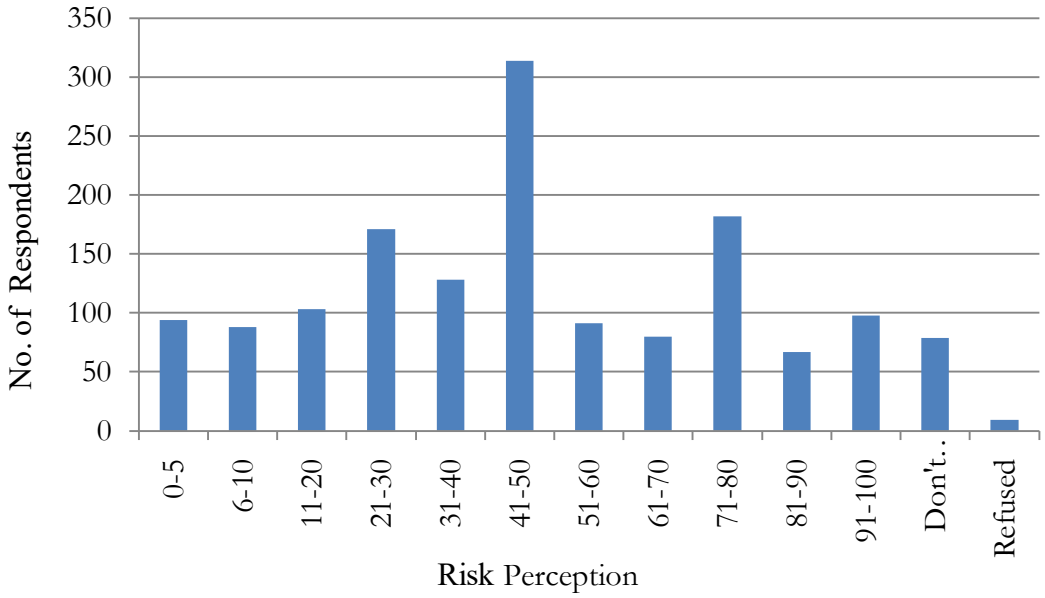

Figure 1: Histogram Risk Perception Levels

Responses exhibited a marked tendency to pile up at risk-points 10, 20, 30 etc. Also, the modal estimate of the number of lung cancer deaths among smokers, 50, raises concerns that

some respondents may have been uncertain as to how to make the requested estimate (see Bruine de Bruin et al., 2000). Overall, however, respondents reported both extreme as well as intermediate risk values. About 75% of the respondents believed that smokers have a 30% or greater chances of dying from lung cancer and 60% of respondents believe this chance is 50% or greater. On the average, respondents perceived that 48.87 % of 100 "typical smokers" would die from lung-cancer. This figure is close to the estimate of lung-cancer risk (42.6%) as obtained in Viscusi (1991) in a sample that consisted largely of adults. Finally, recall that around 6% (of the 1504) respondents did not know or refused to answer the risk-perception question. These responses have not been considered for analysis. A related point to mention here is that unlike Viscusi (1991) and Viscusi and Hakes (2008), the Annenberg Survey (which we use for our analysis) did not employ a 'probe' for the risk-perception question.

1.3.2 Temporality

Beliefs about the immediacy of health-effects of smoking were assessed by asking each respondent a question worded as: *How long, if ever, do you think it takes for smoking to seriously harm the health of a new smoker: A few minutes of smoking/ a few weeks of smoking/ one year/ five years/ more than five years/ or does smoking not affect one's health*? Responses to this question were used to develop split samples based on the extent of the perceived immediacy of adverse health-effects from smoking. Respondents, who believed that harmful effects would occur in "one-year" or less, were classified under the *"*more immediate" health-effects category. Those respondents, who answered that it would take "five years" or "more than five years" for the adverse effects to set in, were categorized as believing health-effects to be "less immediate". Unlike the treatment of "one year" responses under the "less immediate" category (as in Gerking

and Khaddaria, 2011, who explored adolescent behavior), the "one year" option in our analysis falls in the "more immediate" category. Responses under the "one year" option account for about 30% of total responses in our study. Splitting the dataset on the basis of the *"temporality"* criterion, we find that 838 respondents believe health-effects to be "more immediate" while 474 respondents believe them to be "less immediate" (see Table 3). A stringent criterion of immediacy, as in Gerking and Khaddaria (2011) (which does not treat responses under the "one year" option to be "more immediate"), leads to a distribution that is even more skewed. 418 respondents fall in the "more immediate" category while 901 appear in the "less immediate" one.

1.3.3 Addiction

In the Annenberg Perception of Tobacco Risk Survey II (1999-2000), the respondents' perceived difficulties in quitting smoking[8] were assessed using both qualitative and quantitative questions. The qualitative question asked: *In your opinion, if you were to smoke a pack of cigarettes per day, how easy would it be for you to quit and never smoke again*? Options for possible responses included: (i) *very easy; you could quit with no trouble*, (ii) *hard, but you could do it if you really tried*, (iii) *very hard, you do not know that you could do it*, and (iv) *almost impossible, you doubt that you could do it*. About 13% of the respondents said that quitting smoking for good would be easy, 34% said that it would be hard, 37% reported it to be very hard, 12% felt as almost impossible, and about 4% (66 respondents) either did not know or refused to answer. The quantitative question asked: *I would like you to imagine ten people your*

[8] While our chapter associates addiction with the idea of quitting smoking, a substantial literature exists which looks at the decision to quit from points of view, other than addiction. Kabat and Wynder (1987), Orleans et al. (1994), Harris and Harris (1996), Douglas (1998), Keeler et al., (1999), Feng (2005), Goto et al., (2007), Hammar and Carlsson (2005), Kan (2007), Lillard et al. (2007), Wang (2007), and Weimer, Vining and Thomas (2009) are some of the studies which have taken diverse perspective in analyzing quitting behavior among smokers.

age who smoke a pack of cigarettes a day. All ten of these people SAY that they would like to quit in the next five years. How many of the ten do you think would actually quit permanently in the next five years?[9] On the average, respondents thought that about 3.06 of 10 such smokers would quit permanently; 10% thought that no such smokers would quit permanently, 53% reported that between 1 and 3 smokers would quit, and 38% thought that 4 or more smokers would quit.[10] 3% of the total number of respondents did not know or refused to answer the question, and hence, are not considered in our analysis.

Note that both of these questions stated above - qualitative and quantitative - might have some limitations with regard to the measurement of the difficulty in quitting smoking. With the qualitative question, it is difficult to compare answers across respondents because there is no objective standard for classifying tasks as easy, hard, difficult or impossible. The quantitative question is an improvement in this regard since it calls for a numerical response. However, issues with regard to the clarity of answers forthcoming from both the quantitative and the qualitative questions still remain. Respondents were not asked if they had in mind the use of some sort of smoking cessation aids (e.g., nicotine patch, gum, prescription medication) when they answered either questions on addiction. More precisely, while answering the qualitative question, some people might have reported that quitting smoking would be easy if they had smoking cessation products in their minds and, in fact, believed in their effectiveness. On the other hand, others who reported quitting to be almost impossible, might have done so if they had thought in terms of quitting "cold turkey" or if they had believed that smoking cessation products

[9] The survey states that respondents were asked how many smokers out of four they believed would quit smoking. This appears to be a typing error because in the data, responses range from zero to ten.
[10] The Annenberg Risk Perception of Tobacco Survey II question focuses the attention of respondents on smokers that are the same age as the respondent who say that they want to quit and asks how many will succeed within five years.

did not work. Regarding the quantitative question, respondents who mentally factored in the use of smoking cessation products might have provided a higher estimate on the number of smokers who they thought would successfully quit smoking. This issue renders the interpretation of respondents' responses and a comparison of the same difficult. These problems arise as the "technology" envisioned for quitting smoking was not controlled for.

Despite its limitations, the qualitative measure of the difficulty in quitting smoking does have an advantage that considerably motivates its use in our empirical analysis given in section 1.6.2. While the quantitative *"addiction"* variable measures the difficulty that the respondents believe others would face in quitting, the qualitative measure represents an assessment of the difficulty that respondents believe they themselves would face when they would try to quit. This personal assessment is closer in spirit to the model presented in Orphanides and Zervos (1995) where individuals make consumption decisions based on whether they consider themselves to be of the addictive or non-addictive type. In our analysis, respondents are classified according to the relative difficulty which they believe themselves to be facing while trying to quit. Thus, according to their responses to the qualitative *"addiction"* question, respondents fall in the "less difficult" or "more difficult" categories. 51% (49%) of respondents are classified as believing that it would be more difficult (less difficult) for them to quit smoking (see Table 3).

1.4 Econometric Model

Our primary interest in this chapter lies in analyzing the impact of risk-perceptions (together with interactions across *risk*, *temporality* and *addiction*) on the smoking decisions of the individuals. To this end, we lay out an econometric framework where an individual, following the principles of expected utility maximization, will choose (not) to become a smoker

if the net-benefit from smoking [i.e., the monetized expected utility gain minus the expected cost of smoking] is positive (negative). While the perceived net-benefit of smoking is latent, smoking status ($SMOKER_i = 1$ if the i^{th} respondent is a smoker; $SMOKER_i = 0$, otherwise) is observed. Smoking status is expressed as a function of the variables that determine the net-benefit of smoking, as shown in equation (1.1).

$$SMOKER_i = \delta RISK_i + X_i^T \gamma + v_i \qquad i = 1,...n \tag{1.1}$$

We estimate equation (1.1) by Binomial Probit. The explanatory variables considered are (i) perceived health-risks $(RISK_i)$, and (ii) a $K \times 1$ vector of controls (X_i) . δ and the $K \times 1$ vector γ are the parameters to be estimated, and v_i is a disturbance term. The parameter δ is expected to be negative because as perceived health-risks $(RISK_i)$ increase, the costs of smoking increase. Now, as costs of smoking rise, a person is less likely to become a smoker. The magnitude of this parameter is determined by the weighting assigned to perceived health-risks in the expected utility calculation.

Controls considered under the $K \times 1$ vector X_i measure: (i) whether the i^{th} respondent lives in a rural, urban, or suburban area, (ii) the respondent's age, race and gender, (iii) whether parents of respondents smoke[11], (iv)whether respondent's parents are no longer alive, and (v) respondent's education and (6) annual income before taxes. Further classifications of the controls follow. e.g., Education is divided into three categories – High School degree and lower; Technical education after High School degree; and College and Graduate degrees. Annual

[11] The Annenberg Perception of Tobacco Risk Survey II for the adolescents worded this particular question as "Do parents or any adults you live with smoke?" whereas the one for the adults asked "Do your parents smoke?" the latter question actually brings out if parents of adults are still living and are current smokers. Given that the sample considers adults in the age range 23-95, it is likely that for higher age groups parents may no longer be living. 18% of the respondent in the sample reported parents as no longer living, which motivates us to consider it an another covariate in our analysis.

income is considered at three levels – less than $40,000; in the range $40,000-$75,000; and $75,000 -$150,000. 11% of the total responses considered for analysis refused to report their income. We also control for income responses by including a separate variable indicating if people have reported their income. Besides, controls include a complete set of State-effects to account for inter-State differences in attitudes towards smoking and variations in cigarette prices. See Table 2 (column 1) for the complete set of covariates considered in our analysis.

While estimating equation (1.1), a concern arises that the variable *RISK* may be endogenous[12]. Thus, health risk-perceptions may simultaneously determine and be determined by the decision to smoke. To test for this, ideally, instrumental variables (IVs) are needed that are correlated with *RISK* but uncorrelated with the error term, v_i (see Murray, 2006). Viscusi (1991) treats this aspect in a Bayesian learning framework and uses plausible IVs to correct for risk-endogeneity. The Annenberg Survey does not seem ideal in this regard since no available variables stand out to be satisfying the IV criteria. For the purpose of our analysis we do not invoke the instrumental variable technique, but use other suitable methods to recognize that health-risks and smoking status may be jointly determined.

1.5 Endogeneity of Risks and the Use of Predicted Probabilities

In our econometric framework *RISK* is a quantitative assessment of the severity of risks that an individual believes could result from smoking. Note that *RISK* comprises the explanatory variable of primary interest in our econometric estimation exercise (recall Section 1.4). Assuming, for a moment, that *RISK* is exogenous, a negative and statistically significant

[12] Another view about how endogeneity could arise is provided by Adda and Lechene (2001). The authors contend that those individuals who have lower life expectancy self-select themselves into smoking as benefits from smoking outweigh the loss of life-years.

coefficient of *RISK* will imply that an individual considers the likely adverse health-effects from smoking while making the decision to smoke. Given our interest in split-sample analyses, we would also like to compare the strength of the relationship between risk-perception and smoking status across different sub-samples, created on the basis of the "*addiction*" and "*immediacy*" criteria (recall Section 1.3). A probit model which captures the underlying relationship between risk-perceptions and smoking status, shown by equation (1.1), is estimated for each of these sub-samples.

Ideally, a comparison of the coefficients of *RISK* across different sub-samples would indicate how respondents, with varying perceptions on temporality and addiction with regard to smoking, consider risk-perceptions in their decisions to smoke. However, two issues remain with regard to such a comparison. Unlike our idealistic assumption that risk-perceptions are exogenous, the variable *RISK* may be endogenous. Assuming that the formation of risk-perceptions is governed by a Bayesian learning model, and its level determined by the weighted average of different sources of information (Viscusi, 1991), an individual's own experience with smoking is one of the sources of information which impacts her level of smoking-related risk-perceptions. Such an endogeneity renders the coefficient of the variable *RISK* inconsistent. Secondly, we are interested in comparing only the structural coefficients corresponding to *RISK* across different sub-samples. But, in a probit model, the estimated coefficient of *RISK*, in each sub-sample, is actually the estimate of the structural parameter scaled by the standard deviation of the error term. Also, there is no way to tease apart the estimate of the structural parameter coefficient from the standard deviation of the error term in each such sub-sample. Under such circumstances, a comparison of the probit coefficients of *RISK* across sub-samples could lead to erroneous inferences about the strength of association between risk-perceptions and smoking

status. A significant difference in the estimated coefficients between any two sub-samples could simply be the result of a difference in the variances of the error terms, rather than any intrinsic differences across the coefficients (Allison, 1999; Hoetkar, 2007; Williams, 2009).

Through the use of suitable econometric methods, we attempt to account for this endogeneity by constructing predicted probabilities (relating smoking status to risk-perception) for each split-sample. The issue, so far, of not being able to compare the probit coefficients across the sub-samples is resolved (Long, 2009). Besides, the problem of endogeneity is mitigated to a certain extent. Given our econometric probit model,

$$Prob\ (Smoker = 1|RISK, X) = Prob(Smoker^{*} > 0|RISK, X) \quad (1.2)$$

i.e., the likelihood of an individual being a smoker (given in the L.H.S. of equation 1.2) is governed by the probability that the net-benefit from smoking, *Smoker** (which is latent), is positive after controlling for covariates. The net-benefit of smoking is given as a linear function of RISK and X, where X is a vector of covariates, as explained in equation (1.1). Substituting for *Smoker** in equation (1.2), the likelihood of being a smoker is given by the following equation:

$$Prob\ (Smoker = 1|RISK, X) = Prob(v < \delta RISK + X^{T}\boldsymbol{\gamma}|RISK, X\ ) \quad (1.3)$$

In equation (1.3), the error term, *v*, can be assumed to follow a standard normal implying a probit model. The standard normal assumptions imply the following.

$$Prob(Smoker = 1|RISK, X) = Prob(\frac{v}{\sigma} < \frac{\delta}{\sigma} RISK + X^{T}\frac{\boldsymbol{\gamma}}{\delta}|RISK, X) \quad (1.4)$$

However, note that $Prob\ (Smoker = 1|RISK, X)$ remains unchanged irrespective of the value of the standard-deviation (σ) of the error term. Thus, the probit estimates of δ and $\boldsymbol{\gamma}$, given $\widehat{\delta/\sigma}$ and $\widehat{\boldsymbol{\gamma}/\sigma}$, determine the predicted probability of smoking denoted as $\Phi(\delta/\sigma\, RISK + X^{T}\boldsymbol{\gamma}/\sigma)$. The predicted probability being invariant to σ makes it possible for it to be used for comparison

across different sub-samples. In each sub-sample, we estimate the predicted probability, $\Phi(\cdot)$, for different levels of *RISK*. Long (2009) also lays down the procedure by which we can test for the equality of predicted probabilities at different values of $RISK$ and X. Let $\beta = [\delta \quad \boldsymbol{\gamma}]$ denote the vector of structural probit coefficients. Then the variance of the predicted probability is given as follows:

$$Var\,[\Phi(\cdot)] = \frac{\partial\Phi(\cdot)}{\partial\beta'} Var(\hat{\beta}) \frac{\partial\Phi(\cdot)}{\partial\beta} \tag{1.5}$$

Also, note that the variance in the difference between the predicted probabilities between any two groups (say, Group1 and Group2) is given as:

$$Var(\Phi(\cdot)^{Group1} - \Phi(\cdot)^{Group2}) = Var(\Phi(\cdot)^{Group1}) + Var(\Phi(\cdot)^{Group2}).$$

The z-statistic to test H_0: $\Phi(\cdot)^{Group1} = \Phi(\cdot)^{Group2}$ at any value of $RISK$ and X, is

$z = \frac{\Phi(\cdot)^{Group1} - \Phi(\cdot)^{Group2}}{\sqrt{Var(\Phi(\cdot)^{Group1}) + Var(\Phi(\cdot)^{Group2}}}$, which has an asymptotic normal distribution.

At this juncture it is important to recognize that the endogeneity of *RISK* and the resultant inconsistency of the associated probit estimate, makes the predicted probabilities inconsistent too. However, this issue of predicted probabilities being inconsistent does not prove crucial in our analysis. Even though each individual predicted probability is inconsistent, we adopt statistical tests of the difference between the predicted probabilities across any two sub-samples. Next we compare the association between $RISK$ and smoking-status across different split-samples on the basis of such differences. In the process, we explore the importance of risk-perceptions in determining the likelihood of smoking, controlling for other factors like *temporality* and *addiction*, which could plausibly interact with $RISK$.

1.6 Results

The results forthcoming from our empirical analysis are presented in two sub-sections. Section 1.6.1 discusses the association between smoking status and risk-perceptions, based on regression estimates for the entire sample of adults that we consider. Section 1.6.2 illustrates the strength of the relationship between *risk* and smoking likelihood across different sub-samples, which are created on the basis of the two splitting criteria viz. *addiction* and *temporality*.

1.6.1 Full-Sample Analysis

The probit coefficients corresponding to the econometric model given in equation (1.1) are presented in Table 2. The probit coefficient corresponding to RISK is found to be negative and statistically different from zero. This implies that respondents with higher perceptions of the long-term adverse health-effects from smoking (indicated by mortality from lung-cancer in our case) are less likely to smoke, controlling for other covariates. This observation is consistent with the results reported by previous studies such as Viscusi (1991), Viscusi and Hakes (2008) and Antonzas et al. (2000). However, owing to the possible endogeneity of the variable *RISK*, we cannot interpret the relationship between risk-perceptions and smoking status (or smoking likelihood) to be causal. Also, as mentioned earlier, the lack of suitable instruments prevents us from correcting for this endogeneity using IV methods. Note, however, that other covariates may be exogenous to smoking status. Table 2 indicates the extent to which each of these explanatory variables determines the smoking status of an individual. Smoking status does not depend on the area the respondent lives in (between rural, urban or suburban). Neither does it depend on the gender of the respondent. The coefficient corresponding to the variable "Age" is negative and significant, thus, implying, that the older individuals in the sample are less likely to

smoke. Smoking status is also found to be governed by the race of the respondent. An individual who is white is also more likely to smoke than someone non-white.

Individuals with a higher level of education are also less likely to smoke. Recall that the variable education has further classifications in it. Respondents with high-school education or lower comprise the base category. Individuals with an extra year or two of technical education are no different, in terms of their likelihood of smoking, as compared to the base category. Also, our analysis reveals that those individuals who are college-educated or graduates, both professional and otherwise, are less likely to smoke. Besides, the income of the respondent is found to be another variable that is negatively associated with smoking behavior. People in higher income categories are less likely to smoke, in relation to respondents in the lower-income classes. The indicator variable (that accounts for whether respondents have reported their incomes) is negatively associated with smoking behavior. However, a note of caution worth mentioning here is that the association between smoking status and income (and likewise that between smoking status and education), cannot be definitively ascertained to be causal (Douglas and Hariharan, 1994). Our full-sample analysis reveals another interesting result too. Respondents whose parents currently smoke are more likely to smoke. This observation is in conformity with studies which indicate that children of smokers are more likely to initiate into the habit and eventually become smokers (e.g. Gohlman, Schmidt and Tauchmann, 2010; Dohmen and Falk, 2009). We also find that respondents whose parents are no longer alive are more likely to smoke as well. Finally, although not reported in Table 2, State-effects have been considered in our analysis by including dummies for each.

Table 2: Estimates of the parameters of the Probit model

Variable	Estimate (Std. error)	Mean
constant	0.182	
	(0.352)	
=1 if individual lives in an urban area, 0	0.221	
otherwise	(0.137)	0.29
=1, if individual lives in a suburban area, 0	0.049	
otherwise	(0.131)	0.50
Age	-0.022*	
	(0.004)	46.26
=1 if White, 0 otherwise	0.368*	
	(0.127)	0.82
=1 if Male, 0 otherwise	-0.069	
	(0.092)	0.44
=1 if Attended school at least part-time	0.223	
	(0.198)	0.91
=1 if had Technical Education after High School	-0.077	
	(0.20)	0.05
=1 if College Educated, Graduate or Professional	-0.332*	
Graduate	(0.10)	0.50
=1 if 40,001 < Income < 75,000	-0.274*	
	(0.111)	0.30
=1 if 75,001 < Income < 150,000	-0.406*	
	(0.141)	0.17
=1 if individual refused to report income, 0 other	-0.324*	
wise	(0.155)	0.11
=1 if Parents as smokers, 0 otherwise	0.492*	
	(0.103)	0.24
=1 if Parents are no longer living, 0 otherwise	0.439*	
	(0.140)	0.19
Risk Perception	-0.012*	
	(0.002)	48.54
Sample Size	1362	

*significant at 1% level of significance

1.6.2 Split-Sample Analyses

In our empirical exercise sub-samples are constructed splitting the entire sample of adults on the basis of two criteria: "addiction" and "temporality". The probit model given in equation (1.1) is estimated for each sub-sample. Following the estimation, the probit coefficients of the variables *RISK* and *X* are used to construct the predicted probability (of smoking likelihood in relation to risk-perceptions) in each sub-sample. This ultimately helps in exploring how the strength of the relationship between risk-perception and smoking likelihood differs across different sub-samples. In addition we also present the marginal effect and elasticity with respect to the variable *RISK* for each sub-sample (see Table 5 and Table 6). These marginal effects and elasticity estimates, calculated at mean levels of explanatory variables, depict the responsiveness of the predicted probability with respect to *RISK*.

Table 3 below exhibits the sample sizes for the different sub-samples we create[13].

Table 3: Sample Sizes of Split-Samples based on Perception of Temporality and Addiction

	Health effects occur sooner (More Immediate)	**Health effects occur later (Less Immediate)**	**Total**
Less difficult to quit smoking	376	236	638
More difficult to quit smoking	429	223	671
Total	838	474	1362

Recall from Section 1.3.3. (p.17) that under the "addiction" criterion, there are two categories, viz., "more difficult" and "less difficult". Likewise, the two categories under the

[13] See Table 14 for mean levels of perceived health risk for each of the sub-samples.

"temporality/ immediacy" criterion are "less immediate" and "more immediate". Table 3 shows how this set of four split-samples can be further crossed with each other to yield a set of four additional spilt-samples. Thus, in all, we consider eight split-samples in our analysis.

In Table 4, the estimated coefficients of the variable $RISK$ for each sub-sample and the full-sample (without State-effects), are presented. We find that the estimated probit coefficients corresponding to $RISK$ have the expected negative signs in each split-sample and are statistically significant at 5% and lower. This indicates that higher perceptions on *risk* negatively impact the smoking decisions of adults, irrespective of their perceptions on *temporality* and *addiction*.

Table 4: Probit Coefficient of RISK across Split-Samples.

	Health effects occur sooner (More Immediate)	**Health effects occur later (Less Immediate)**	**Total**
Less difficult to quit smoking	-.0088** (.0041)	-.0155** (.0043)	-.0135** (.0026)
More difficult to quit smoking	-.0076* (.0030)	-.0129** (.0040)	-.0112** (.0022)
Total	-.0073** (.0023)	-.01309** (.00278)	-.0114** (.0016)

Standard error is shown in parentheses
* Significant at 5%
** Significant at 1%

This result further motivates us to explore if the strength of this negative association between risk-perceptions and smoking status (or smoking likelihood) varies according to different degrees of perceived *temporality* and *addiction*. In order to investigate the above, we first consider the two split-samples under the "temporality/immediacy" criterion. We compare the predicted probability in the "more immediate" sub-sample with that in the "less immediate" one. The comparison reveals that at a given level of risk-perception, adults who perceive adverse

health-effects to be occurring in the nearer future are less likely to smoke as compared to those who perceive otherwise (See Figure 2 below). Thus, Figure 2 exhibits how the elements of *risk* and *temporality* interact with each other in influencing smoking behavior.

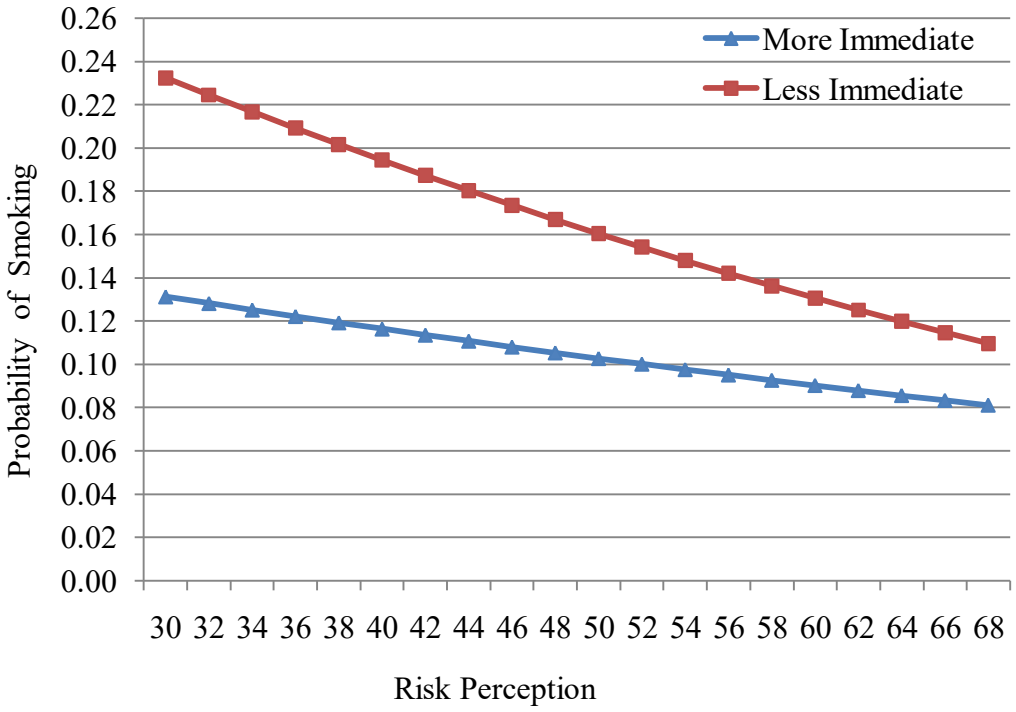

Figure 2: Predicted Probabilities of Smoking for the 'More Immediate' and 'Less-Immediate' Categories

Next, we aim to find out if a "more immediate" belief on the temporality dimension still has the same dampening effect on the association between risk-perception and smoking status when we bring in the additional dimension of *addiction* into the picture. This is done by interacting the "immediacy" based split-samples with the "addiction" based ones. More precisely, Figure 6 shows how, controlling for the responses under the "less difficult" addiction category, individuals who perceive "more immediate" health-effects are less likely to smoke compared to

those who perceive adverse health consequences to be "less immediate", for a given level of risk-perception. This cross-sample analysis and a comparison of the predicted probabilities, thus, reveal that *risk*, *temporality* and *addiction* interact to determine the likelihood of smoking of the respondents. In Figure 7, we repeat the above cross-sample analysis, controlling for responses under the "more difficult" category and find a similar result.

Next we consider the split-samples constructed under the "addiction" criterion. Comparing respondents across the "more difficult" and "less difficult" categories, we find that at a *given* level of risk-perception, adults who perceive a greater difficulty in quitting smoking are more likely to smoke than people who believe quitting to be relatively easier (See Figure 3 below).

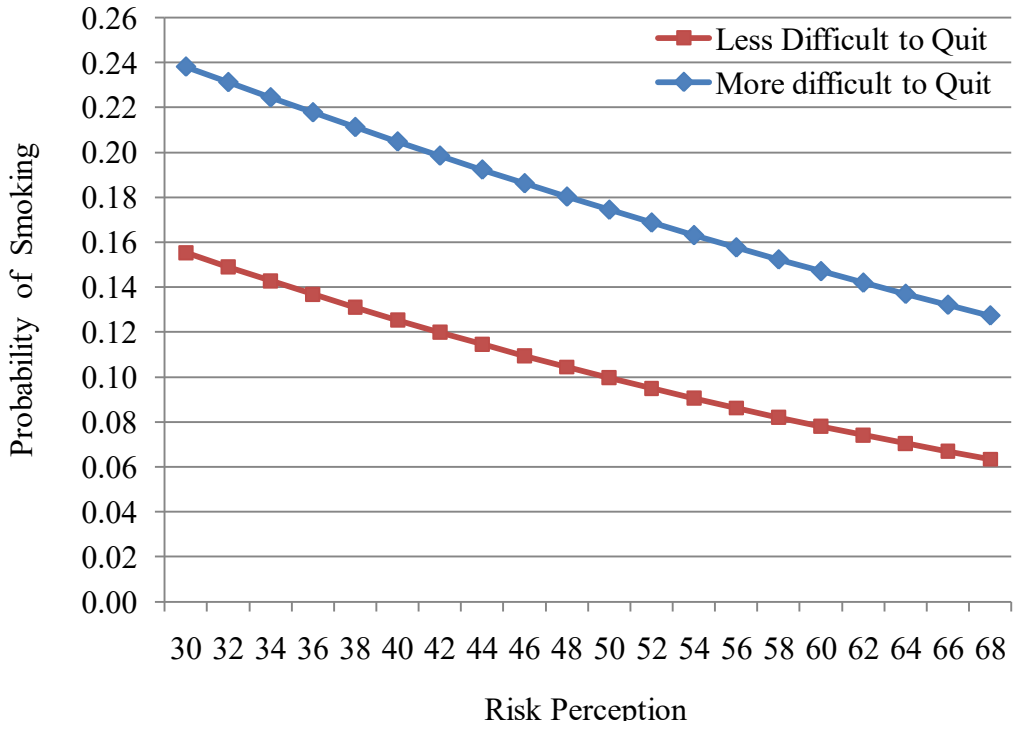

Figure 3: Predicted Probabilities for the 'Less Difficult to Quit' and 'More Difficult to Quit' Categories

This observation contrasts with a finding in Gerking and Khaddaria (2011) who find that adolescents with a greater perception of addiction are less likely to smoke. One may reconcile this divergence in terms of the difference in the ways "addiction" is interpreted. In Gerking and Khaddaria (2011) perception on addiction in the context of adolescents is more likely to emerge from notions that adolescents hold taking cue from their exposure to surrounding publicity and information campaigns. Thus, those who believe smoking to be "more addictive" are likely to keep away from the habit. On the contrary, in the case of adults in our sample, addiction holds a greater chance to have been actually experienced by the respondents by the time the survey is administered. Generally for adults who try to quit smoking, numerous relapses may occur and adults may fall victims to the "withdrawal syndromes". In fact, quite interestingly, we find that 64% of the smokers in our sample had tried quitting between one and five times and 18% had tried more than five times[14]. Thus, the sheer fact that adults may have already confronted real-life difficulty in quitting smoking may perhaps induce them to continue indulging in smoking in our context.

The above illustration show how *risk* and *addiction* interact to influence smoking behavior of adults. Next, we bring in the additional dimension of *temporality* in the analysis. Figure 8 shows that controlling for the responses under the "more immediate" temporality category, individuals who perceive quitting to be "more difficult" are more likely to smoke compared to those who perceive otherwise, for a given level of risk-perception. Likewise, in Figure 9 we control for responses under the "less immediate" category and arrive at a similar observation.

[14] Smokers in the survey were asked the following question: *About how many times, if any, have you tried to quit smoking?*

Estimates of the marginal effect of *RISK* and elasticity of predicted probability for each sub-sample provide additional information (see Table 5 and Table 6) on the interaction across the three dimensions of smoking behavior.

Table 5: Marginal Effects of RISK across Split-Samples

	Health effects occur sooner (More Immediate)	**Health effects occur later (Less Immediate)**	**Total**
Less difficult to quit smoking	-.0009	-.0035	-.0025
More difficult to quit smoking	-.0016	-.0038	-.0028
Total	-.0013	-.0034	-.0025

Table 6: Elasticity of Probability of Smoking with respect to Perceived Risk by Split Samples

	Health effects occur sooner (More Immediate)	**Health effects occur later (Less Immediate)**	**Total**
Less difficult to quit smoking	.8757	1.0056	1.0413
More difficult to quit smoking	.6681	.8271	.8559
Total	.6561	.8426	.8821

Likelihood of smoking is more responsive to increases in risk perception for the "less immediate" category when compared to the "more immediate". This holds true even when the addiction aspect is "controlled" for. Marginal effect of *RISK* is greater for the category which

thinks it is "more difficult to quit" compared to its counterpart – the "less difficult to quit" sub-sample. However, elasticity estimates for these two sub-samples are the other way around (see elasticity estimates in row two compared to row three for the corresponding column in Table 6). If elasticity can be interpreted as the ratio of marginal by average, it implies that even though individuals who think it is "more difficult to quit" are more responsive to increases in risk of cigarette smoking on the margin, the average effect dominates and ultimately makes the "more difficult to quit" group more likely to smoke compared to the "less difficult to quit" one as shown in Figure 3.

1.7 Conclusion

In this chapter, we focus on the choice of smoking among adults and aim to empirically assess how *risk*, *temporality* and *addiction* may interact with each other to jointly determine smoking behavior. In the context of smoking, the adverse nature of health consequences comprises the *risk* aspect while *temporality* or the time aspect arises since the adverse health-effects essentially occur in the future. Besides, a smoker could simply indulge in his smoking habit to counter the "withdrawal symptoms" even though he really desires to stop smoking. This brings in the *addiction* aspect. While previous studies have mostly explored these aspects in isolation, our analysis provides evidence that these dimensions rather simultaneously determine smoking-related choices that people make.

The Annenberg Perception of Tobacco Risk Survey II (1999-2000) dataset pertaining to a nationally representative adult population in the United States is analyzed. The sample is divided into various sub-samples using "addiction" and "temporality" as the splitting criteria. Our primary interest lies in exploring the association between beliefs on *risk* and smoking

likelihood, controlling for relevant covariates, and allowing for interactions with *temporality* and *addiction* as well. Regression exercises are carried out, first, for the full sample, and then, for each of the sub-samples created. The estimation of a separate model for each sub-sample allows unobserved heterogeneity to vary and the regression plane to shift across different sub-samples. However, the estimated parameter coefficients cannot be compared across groups as they are scaled by the standard deviation of the error term. Our strategy of resolving this issue involves the use of predicted probabilities, as the latter are invariant to the factor by which the parameters are scaled. Besides, the comparison of predicted probabilities across sub-samples mitigates the problem of endogeneity of risk-perceptions to a substantial extent.

The empirical analysis reveals the following. Firstly, in the context of adults, risk-perception and the likelihood of smoking are found to be negatively associated with each other in each of the sub-samples that we consider. Thus, higher perceptions of *risk* dampen the likelihood of smoking of the respondents, irrespective of their beliefs on the *addiction* and *temporality* dimensions. Secondly, in our sub-sample created on the basis of the "immediacy" (i.e., the temporality) criterion, we find that at a given level of risk-perception, adults who perceive adverse health-effects to be occurring in the nearer future, are less likely to smoke as compared to those who perceive otherwise. Thirdly, in the sub-sample constructed on the basis of the "addiction" criterion, for a given level of risk-perception adults who perceive a greater difficulty in quitting smoking are more likely to smoke than people who believe quitting to be relatively easier. This finding can be explained by an associated observation that derives from our analysis. Results suggest that a substantive portion of adults in our sample have already experienced actual difficulty in quitting smoking habits. In this regard note that for adults who try to quit smoking, numerous relapses may occur and adults may fall victims to the "withdrawal

syndromes" (as is said in the literature). Thus, combining our third observation with this relevant result, we argue that owing to the already experienced stresses in giving up the habit, adults in our sample are more likely to be continuing with the habit, perhaps falling victims to the "withdrawal syndromes".

Our results suggest that the existing awareness on the *risk* and *temporality* dimensions deter people from smoking. However, even though the *addiction* dimension is perceived by respondents, those who perceive it more are more likely to be smokers. This observation provides support to the policy-implication that smoking cessation efforts need to be emboldened with a view to particularly hitting at the *addiction* dimension. In addition to generating awareness on the risk-dimensions of smoking-related health-effects, efforts need to target at moving smokers away from cigarette-*addiction* even when their personal efforts fail.

CHAPTER 2: DO SMOKERS MAKE BAD PARENTS?

2.1 Introduction

Do smokers make bad parents? Both casual observation and evidence from the scientific literature corroborate the fact that children of smokers tend to be smokers (Gilman et.al, 2009). Since the initiation of the smoking habit takes place mostly during adolescence, parental smoking, as well as the presence of other adult smokers at home, adds to the factors that may lead adolescents to experiment with the risky choice. Thus, smokers are likely to contribute towards their children being inducted into smoking[15]. Though parents, in general, are altruistic and care about the well being of their children, evidence on smoker-parents' concerns in the existing empirical literature with regard to the harm they inflict on their children, is mixed. For example, while Agee and Crocker (2007) report that smoking-mothers of children aged three years value their child's health 55% more than their own and are willing to pay $150 per year for a 17% decrease in the child's average daily exposure to ETS (Environmental Tobacco Smoke), Jacobs-van der Bruggen et al (2007) contend that smoking mothers underutilize health care for their child with mild respiratory symptoms. In this chapter we exclusively focus on the concerns that smoker-parents may have with regard to the *general* health-risks facing their children. More specifically, the research question: "Do smoker-parents behave differently from non-smoker parents when it comes to *general* health-risks faced by their children", comprises the primary motivation of this chapter.

[15] This may, however, not be the only way in which a smoker impacts the well-being of her offspring. Direct effects of parental smoking include exposure to second-hand smoke, especially for children who spend a considerable time at home.

The chapter considers leukemia as a *general* health-risk (not necessarily related to smoking) and tests the following research hypotheses : i) All parents (*Current-Smokers, Never-Smokers* and *Former-Smokers*)[16] are altruistic towards their children, and ii) The parent's willingness-to-pay (WTP) for an additional percentage reductions in health risks, from leukemia, facing the child , is equal across different parent groups. Note that 'altruism' in this chapter is defined as the parent having an equal regard for herself and her child (as in Dickie and Gerking, 2007).

The primary interest of this chapter in evaluating parental attitudes towards their children is motivated by observations in previous studies that health-status experienced during childhood is an important determinant of the child's success at later points in her life (Kaestner, 2009; Becker, 2007; Heckman, 2007). Further motivation in this regard is derived from the findings in the contemporary research on smoking behavior which suggest that *smokers* are generally risk-loving and have higher rates of time preference. Scharff and Viscusi (2009) and Munasinghe (2006) discuss the possible mechanisms which link choices made by smokers to their preferences. Other studies have analyzed the behavior and attitudes of smokers in a variety of contexts ranging from job-risks (Hersch, 1996; Viscusi and Hersch, 2001), future macroeconomic events like depression in the economy, double-digit inflation, loss of social security benefits (Khwaja, Sloan and Salm, 2006), other risky behaviors such as alcohol consumption and gambling (Ida, 2009) etc. Song (2011) analyzes smokers' preferences more directly and finds out how smokers allocate their daily time to activities which provide instant gratification (such as watching television or eating), as against those which provide benefits at a later date (such as exercising or

[16] See Section 2.3 for more details on the basis of such a categorization.

taking classes). Besides, in the context of a *smoker-parent's* attitude towards her child, Pabilonia and Song (2011) need special mention. They use data from the Current Population Survey Tobacco Use Supplements, the American Time Use Survey and the Panel study of Income Dynamics-Child Development Supplement, and find out that , after controlling for parental differences in income and education, single smoking-mothers spend significantly less time with their children (especially with regard to attending to the child's education and enriching care).

For the purpose of our study that focuses on a parent's attitude towards the *general* health risks facing her children, we use a stated preference data set to analyze parental behavior with regard to such health risks. The data set was obtained in a field study conducted in Orlando, Florida, between December 2008 and February 2009, which focused on leukemia risks to parents and their children aged 1-16 years. Sub-samples are constructed based on the smoking status of parents. Given that the two main objectives of this chapter lie in testing for parental altruism and a comparison of marginal WTP for risk reductions across parent groups, an equation relating WTP to risk reductions is estimated for each of the sub-samples. Econometric tests for parental altruism involve testing if the marginal rate of substitution between risk reductions for the parent and the child is equal to unity (see Dickie and Gerking, 2007). Moreover, a comparison of the marginal WTP, for reductions in the risk of leukemia for the parent and her child, across groups, comprise testing for the equality of relevant coefficient estimates across the different parent groups. Results indicate that parents, irrespective of their smoking status, are altruistic. In other words, *within* each of the parent groups, parents show equal regard for health risks facing themselves and their children. Another key result that emerges is that *across* different parent groups, parents show the *same* level of concern towards their children's health risks irrespective of their smoking status. A significant finding of this study, relevant for policy, thus, lies in

observing that smokers care no less about the *general* health risks of their children when compared to their non-smoking counterparts.

Besides observing the above facets of parental attitudes towards their children, this paper additionally throws light on the parents' attitudes towards their o*wn* health risks as well. The Likelihood Ratio (LR) tests performed in this paper reveal that the level of concern that parents show toward their *own* health-risks is also the same across the different parent groups. Thus, smoking status does not lead a smoker to care for her own health less, as compared to non-smokers. This is a departure from previous studies (such as Khwaja, Sloan and Wang 2009) which find that smokers value their health less than non-smokers. This divergence motivates us to inquire into the plausible reason as to why such results may have been arrived at in this chapter and to explore its implications for policy evaluations.

In order to do so, the specific survey methodology used requires mention at this point. In the survey, elicitation of parents' risk perception *levels* was followed by an offer of risk reduction in *percentage* terms for a given amount of money, against which yes/no responses were elicited. Incidentally, smokers are found to have a higher level of risk perception (with regard to their *own* health) compared to non-smokers and former smokers. This result, in conjunction with the results of the econometric tests (that the marginal WTP for a *percentage* reduction in the parent's own health-risks is the same across all parent groups), implies that smokers are willing to pay *less* than their non-smoking counterparts for a unit reduction in *absolute* risk. In terms of an absolute risk reduction, therefore, it is observed that smokers have

less concern for their own health[17], thereby conforming, in spirit, to the results in Khwaja, Sloan and Wang (2009). In this chapter, the survey's emphasis on subjective risk-assessment (elicitation of risk perception levels) prior to the dichotomous choice exercise effectively helps us comprehend as to how the respondents may have interpreted the percentage risks in terms of absolute risks.

This chapter, in addition to evaluating smoker-parents' attitudes towards their children, arrives at an important observation. It asserts that a sole reliance on the valuation of percentage reductions in health-risks may sometimes produce misleading policy evaluation results. Therefore, the study affirms the need to incorporate subjective risk-assessment procedures in WTP elicitation exercises. Such a comprehensive exercise may help the researcher comprehend the respondents' perceptions of a given percentage of risk-reduction in absolute terms as well. This, in turn, may facilitate a deeper behavioral analysis of health risk valuation which can be of importance for the contemporary public health policy evaluation techniques.

The rest of the chapter is organized as follows. Section 2.2 lays out the theoretical model and derives the refutable predictions. Section 2.3 briefly describes the key features of the survey and the associated data characteristics. The econometric specification and testing procedures are discussed in Section 2.4. In Section 2.5 results pertaining to the parents' attitudes towards their children's health as well as their own health are analyzed. This section also contains a brief note on the importance of subjective risk-perceptions in the context of WTP

[17] Note that this observation of a lesser concern on the part of smoker-parents pertain to their *own* health-risks only. In the context of the child's health risk, we do not attempt for an investigation into the absolute health-risk valuation. This is because, in the survey, no significant differences in the risk perception levels emerge with regard to the child's health risks across smokers and non-smokers.

estimation. Section 2.6 concludes by summarizing the findings of this chapter in the light of policy relevance.

2.2 The model

We closely follow the utility maximization framework as laid out in Dickie and Gerking (2007). However, instead of a multi-period model we consider a simple unitary model of family behavior (see Becker 1981). A "family" in our model consists of one parent (*p*) and one child (*k*), with the parent making decisions for one time period. The parent is modeled as a paternalistic altruist i.e., apart from choosing the goods for herself she does the same on behalf of her child as well. The child does not have well-defined preferences respected by the parent, and has neither labor earnings nor asset income.[18] Since our model includes only one parent and one child**,** considerations of possible divergent interests between the two parents in a family[19] and the issue of allocation of resources across different children do not arise.

Both the parent and the child consume a composite good (X) and face risks (R) of getting a potentially life-threatening illness. A parent's behavior towards a health-risk depends partly on her perceptions of two aspects of this risk: (1) Likelihood or probability (ℓ) with which the illness might be contracted and (2) Severity (s) of the illness given that it is contracted. The parent's risk perceptions for herself and for her child may differ in either or both these aspects of risk. The parent's utility (U) function is

$$U = U(X_p, X_k, R_p^{\ell}, R_p^{s}, R_k^{\ell}, R_k^{s}) \tag{2.1}$$

[18] These simplifications would not have been appropriate if the model focused on the behavior of parents toward adult children.

[19] While the unitary family model has been rejected in several empirical tests (e.g., Lundberg *et al.* (1997)), tests presented in Dickie and Gerking (2007) find no significant difference between latent health valuations of fathers and mothers. Blundell, Chiaporri, and Meghir (2005) analyze alternative approaches to modeling family behavior.

where the subscript $j = p,k$ distinguishes between parent and child and superscript $i = \ell$, s distinguishes between the two dimensions of risk. The parent's perceptions of risk (R_j^i; $j = p,k; \quad i = \ell,s$) with regard to both disease likelihood and severity, for herself and her child are determined by a comprehensive index (Ω_j, $j = p,k$) – of genetic factors, environmental exposure history, and information/experience with disease – and the consumption of risk-reducing market goods ($G_j^i, i = \ell,s; \; j = p,k$), as shown in equation (2.2) below.

$$R_j^i = R_j^i(G_j^i, \Omega_j) \qquad j = p,k; \quad i = \ell,s \tag{2.2}$$

The parent faces the budget constraint in equation (2.3)

$$Y = X_p + X_k + q_p^\ell G_p^\ell + q_k^\ell G_k^\ell + q_p^s G_p^s + q_k^s G_k^s \tag{2.3}$$

where Y denotes the income of the parent, q_j^i denotes the price of G_j^i, and the price of X is normalized to unity. As shown in equation (2.3), the model allows for the parent and the child to consume different risk-reducing goods (G_p^i and G_k^i ; $i = \ell,s$) with different prices to reduce the two dimensions of leukemia risk viz., likelihood (l) and severity (s). For the purpose of our study we now assume that $q_p^i = q_k^i = q^i; i = \ell,s.$ i.e. the parent purchases the same risk-reducing good for herself and her child for reducing a given dimension of disease risk, likelihood (l) and severity (s). Therefore, the budget constraint, equation (2.3), becomes

$$Y = X_p + X_k + q^\ell (G_p^\ell + G_k^\ell) + q^s (G_p^s + G_k^s) \tag{2.4}$$

A key feature of the model is that the risk-reducing market-goods are not a direct source of utility to the parent. Moreover, by allocating these goods between herself and her child, the parent can independently vary each aspect of the risk (likelihood and severity) for each person.

Given the model specificities the parent maximizes utility subject to the budget constraint (2.4). The theoretical predictions of the model are derived allowing for corner solutions for X_j and G^i. The first-order necessary conditions include

$$\partial U / \partial X_j - \lambda \leq 0 \text{ and } X_j(\partial U / \partial X_j - \lambda) = 0 \tag{2.5}$$

where λ denotes the Lagrange multiplier for the budget constraint (4), and

$$(\partial U / \partial R_j^i)(\partial R_j^i / \partial G_j^i) - \lambda q^i \leq 0, \quad i = \ell, s,\ j = p, k \tag{2.6}$$

with $G_j^i = 0$ if the inequality (2.6) is strict . Recall that the primary interest of this paper lies in an empirical analysis of the relationship between risk reductions offered to the parent and her true WTP for these reductions across different parent groups with differential smoking status. The utility maximization framework above helps us to theoretically construct this relationship. This relationship, in turn, explains the trade-off the parent makes between her own health risks and that of her child (for both the likelihood and severity dimensions). In essence, the parent buys the same risk-reducing good (G^i) and allocates it between herself and her child such that equation (2.6) holds.

A theoretical implication derived from the above utility maximization exercise is that the parent's marginal rate of substitution (MRS) between her own consumption of X and her child's equates to unity, as long as each person consumes a positive quantity of X (by equation 2.5). Supposing that the parent and the child each consumes a positive G^i, from equation (2.6) we find that

$$\frac{(\partial U / \partial R_p^i)(\partial R_p^i / \partial G_p^i)}{(\partial U / \partial R_k^i)(\partial R_k^i / \partial G_k^i)} = 1 \quad ; i = \ell, s \tag{2.7}$$

i.e. the parent's MRS between her own consumption of $G^i; i = \ell, s$ and her child's consumption of $G^i; i = \ell, s$ is equal to unity. Rearranging terms in equation (2.7) and multiplying both sides by the ratio (R_p / R_k) we get

$$\frac{(\partial U / \partial R_p^i) R_p^i}{(\partial U / \partial R_k^i) R_k^i} = \frac{(\partial R_k^i / \partial G_k^i) / R_k^i}{(\partial R_p^i / \partial G_p^i) / R_p^i} \quad i = \ell, s, \tag{2.8}$$

Now consider an equal percentage change in risk for the parent and the child i.e.

$$(\partial R_p^i / \partial G_p^i) / R_p^i = (\partial R_k^i / \partial G_k^i) / R_k^i \qquad ; i = \ell, s$$

From equation (8) it follows that $\frac{(\partial U / \partial R_p^i) R_p^i}{(\partial U / \partial R_k^i) R_k^i} = 1 \quad ; i = \ell, s$ (2.9)

i.e., the MRS between equal percentage changes in risk facing the parent and the child is equal to unity. Note that the left hand side of equation (2.9) stands for the MRS in *percentage* change in risks. Equation (2.9) represents altruism on the part of the parent towards the health risks facing her child. As in Dickie and Gerking (2007), a parent is regarded as altruistic when she has the same level of concern for her own health and her child's. In section 2.4 an econometric model is specified to test if equation (2.9) holds, and evaluate altruism within each parent group.

2.3 Data and Survey Characteristics

Data on leukemia risk perceptions were collected in a computer-assisted survey conducted in Orlando, FL between December 2008 and February 2009. The survey was

administered to 815 parents with children living at home between the ages of 1 and 16 years. [20] Parent respondents were identified by dialing telephone numbers at random drawn from a data base maintained by the market research firm Insight Orlando, Inc. In this initial telephone call, prospective respondents were told that the survey would deal with health risks faced by adults and children and were offered a $40 participation fee. The survey was completed at the Insight Orlando office, conveniently located close to the intersection of three major expressways near the Orlando International Airport. Two focus groups of 12 parents each made extensive comments on a preliminary version of the survey in May 2008. A revised version of the survey instrument was then pre-tested with 68 subjects in early December 2008.

Among sample parents, 68.5% were white, 14.2% were African-American, 15% were Hispanic, and 21% were under the age of 40. Most of the parents were female (77.9%), employed full-time (56%), and mean household income was $76,000. Most parents indicated that they were aware of leukemia; 90% said that they had heard of the disease, 43% knew someone personally who had had it, 25% had thought about the possibility that they themselves might get it, and 28% had thought about the possibility that one of their children might get it. Survey questions focused on the parent and one child aged 1-16 years. For the 68% of parents with two or more children living at home, one child was randomly selected and designated as the sample child. Roughly half (52.8%) of the sample children were male and the average age of sample children was 10 years.

Parents' smoking status was assessed by asking about lifetime cigarette consumption. No questions were asked about child smoking. Parents who had smoked more than 100 cigarettes in

[20] A total of 839 parents participated in the survey. Of this total, 3 did not answer the question about the number of children in their family, 10 were ineligible because they responded that no children lived with them, and 11 failed to answer key questions about their perceptions of leukemia risks.

their lifetime were classified as ever-smokers. Those who reported lifetime consumption of less than 100 cigarettes were classified as never-smokers. Among ever-smokers, parents who report that they currently smoke cigarettes were classified as current smokers with remaining parents classified as former smokers. Most parents (534 or 66%) are never-smokers, while 188 parents (23%) are former smokers and 93 parents (11%) are current smokers.

Subjective estimates of leukemia risk were obtained using an interactive risk scale similar to that used by Krupnick *et al.* (2002) and Corso, Hammitt, and Graham (2001). The scale depicts 1000 squares arranged in 25 rows and 40 columns. Each square was numbered, beginning with one in the bottom, left-hand corner, so that squares in the leftmost column were numbered 1-25, squares in the next column were numbered 26-50, and so on until squares in the rightmost column were numbered 976-1000. All 1000 squares initially were colored blue. Parents re-colored squares from blue to red to represent amounts of risk. For example, a parent could use the mouse to indicate a risk level of 200 in 1000 by selecting the square numbered 200 in the scale, causing all the squares from 1 to 200 to turn red. Beneath the scale, the level of risk was indicated by displaying the number and the percentage of the 1000 squares that were colored red. Parents also could change red squares back to blue if they wished to reduce their risk estimate and could make as many changes to the scale as desired before recording their final answer by selecting the "Continue" button.

Parents practiced using the risk scale before making subjective leukemia risk assessments for themselves and for their children. First, they were shown four examples of scales representing risk levels of 25%, 50%, 75% and 100% and were told the relationship between these percentages and "chances in 1000." Second, parents were asked to identify which of two people had the smallest chance of getting into an auto accident; Ms. B, a relatively safe driver

who had a 1% chance of an accident, or Mr. A, a relatively careless driver who had a 33.3% chance of an accident. 11% of respondents gave the wrong answer (Mr. A) and were given a second chance at the question. All survey participants got the correct answer (Ms. B) by the second try.

Frequency distributions of initial leukemia risk estimates for parents and their children are shown in Columns (1) and (2) of Table 15. There is considerable variation in risk estimates. Some parents believed that getting leukemia is impossible and one parent believed that it is inevitable. Parents on average estimated that their own lifetime risk of getting leukemia was about the same as that for their sample child. The null hypothesis that mean perceived leukemia risks are equal for parents and children is not rejected at the 1% level in a matched-samples test. Parents also appear to have overestimated leukemia risk both for themselves and for their children. On average, parents estimated their own risk of getting leukemia at about 96 chances in 1000 and estimated their children's chances at about 97 chances in 1000. These mean subjective estimates are about 6-7 times higher than the actual risk of 13 chances in 1000 that can be estimated from National Cancer Institute data. Median risk estimates are 3-4 times higher than actual risk. Overestimation of relatively small risks is a well-known phenomenon (see, for example, Lichtenstein *et al.* 1978).

Parents were given an opportunity to revise their estimates of the chances of getting leukemia after considering information about this disease. After making their initial risk estimates, they were presented with the National Cancer Institute estimate of 13 chances in 1000 and told that a individual's risk may differ from this average because of many factors including cigarette smoking, exposure to pesticides, exposure to benzene as might occur if the parent lived in an area with high automobile traffic, as well as genetic factors. After answering questions

about their exposure to these risk factors, parents were shown their initial leukemia risk estimates (both for themselves and for their sample child) as previously marked on the risk scales and then given a chance to revise their answers.

About 57% of parents revised their own and their children's lifetime risk estimates. Columns (3) and (4) of Table 15 shows that downward revisions predominated. Revised risk estimates for parents averaged about 57 chances in 1000 and revised perceived risk estimates for children averaged about 50 chances in 1000. Thus, even though the downward revisions are substantial, mean perceived risk still overestimates actual risk by a factor of about four. Median revised risk estimates are equal to actual risk (13 chances in 1000).

After revising initial risk estimates, parents were told to imagine that they had received a diagnosis of leukemia from a doctor and were asked to estimate the chances in 1000 of dying within five years of the diagnosis. Parents were unaware that they would be asked about the chance of dying from leukemia when they answered the previously described questions about getting this disease. Estimates of conditional mortality risk, interpreted as a subjective measure of the severity of leukemia, were obtained both for parents and for their sample children using the previously described risk scale.

As shown in Columns (5) and (6) of Table 15, the average parent believed that the conditional risk of death from leukemia is about 299 chances in 1000 for themselves and about 258 chances in 1000 for their children. The difference in mean conditional death risks between parents and children is significant at the 1% level in a matched samples test. Although these risk estimates suggest that parents were aware that leukemia can be fatal, parents appear to have overestimated the chance of dying conditional on a diagnosis of leukemia for their children and underestimated this risk for themselves. As reported in Ries et al. (2003), the five-year survival

probability for leukemia falls with age, from 85% for children younger than 5 years to 49% for those between ages 15 and 19 years. The overall five-year survival probability for all adults is 49% and falls with age beyond age 45 years.

Table 16 presents mean perceived leukemia risk estimates by parental smoking status. Parents' perceptions of their own leukemia risks as well as their children's leukemia risks do not differ by smoking status. For instance, initial risk estimates for getting leukemia by parents who currently smoke (0.144) were higher than for parents who formerly smoked (0.082) or who never smoked (0.093). This outcome may indicate that smoking parents in the sample knew that tobacco use is a leukemia risk factor, but it is also broadly consistent with results from other studies (e.g., Khwaja, Silverman, and Sloan 2007) suggesting that smokers express both higher probabilities of getting various diseases as well as greater pessimism about their future health. Nonetheless, these differences are not significant at conventional levels using independent samples difference in proportions tests; p-values for these tests exceed 0.10. P-values also exceed 0.10 in testing the difference between mean conditional risk of dying from leukemia by smoking status. Revised estimates of risk of getting leukemia show smaller differences between means by smoking status than initial estimates. Parent estimates of both types of leukemia risk for their children show even smaller differences by smoking status.

Perceived risk estimates also suggest that the intra-family distribution of risk differs between families of smoking and non-smoking parents. For example, the difference in mean initial perceived risk of getting leukemia between parents and children is significant at 5% in a matched-samples test for current smokers, but not for former or for never smokers. Revised risk estimates, made after being told that smoking increases risk, are higher for parents than for children at 1% among current smokers, but not among former or never smokers. All parents,

regardless of smoking status, saw their own conditional risk of dying from leukemia as significantly higher at the 1% level than their children's risk.

In the final section of the survey, parents valued leukemia risk reductions by expressing purchase intentions for hypothetical vaccine. The vaccine was described as similar to newly developed vaccines against cervical cancer. As the vaccine was described, its effectiveness was varied randomly across respondents. In all, there were eight descriptions of the effectiveness of the vaccine. Four types varied reductions in risk of getting leukemia, by 10% or 90% from the revised assessments of likelihood risk for the parent and the child. The other four types varied reductions in conditional death risk by 10% or 90% from the previously assessed severity risk for the parent and the child.

Each parent was randomly assigned two of the eight vaccine types. One of the assigned vaccines offered reduced likelihood risk (risk of getting leukemia) and the other offered reduced severity risk (conditional death risk from leukemia). Types of vaccines were presented one at a time in randomized order. The parent was asked to read the description of the vaccine and then was shown the previously marked risk scales for herself and for her child, which now indicated the risk reduction that the vaccine would offer and the amount of risk remaining if the vaccine were taken.

For the first of the two vaccines, the parent was asked, "Now please think about whether you would buy the new vaccine for yourself and your child. Please do not consider buying it for anyone else. Suppose that buying the vaccine 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 $X to vaccinate you and your child?" The cost ($X) was randomly selected from among five values ($150, $300, $600, $1200, $2400). To introduce the second type of vaccine, the

parent was told, "Suppose that instead of the previous vaccine, we showed you the following one." Information then was presented and purchase intentions elicited as before.

Responses to willingness to pay questions are summarized in Table 17. Considering all risk changes and costs, 49% of parents said that they would purchase a vaccine offering a reduction in the risk of getting leukemia and 66% of parents said that they would purchase a vaccine offering a reduction in the conditional risk of dying from this disease. At the 5% level, current smokers were significantly more likely than both former smokers and never smokers to buy the vaccine that reduced the chance of getting leukemia. While smokers purchased the vaccine to reduce the conditional risk of dying from leukemia more often than former or never smokers, differences between these groups were not significant at conventional levels. The general tendency for smokers to state greater willingness to purchase the vaccines is consistent with the outcome reported above that this group saw somewhat greater leukemia risks.

A novel design feature of this survey that involves assessing the level of risk perceptions of the respondents first, followed by offers of risk reductions in percentage term, facilitates a subjective valuation of health risk reductions. Each respondent evaluates a personalized amount of absolute risk reduction for herself and her child. Previous surveys such as Khwaja, Sloan and Wang (KSW 2009; hereafter) differ in this particular aspect. The study contends that smokers have a lower 'cost' of acquiring any given disease (Chronic Obstructive Pulmonary Disease (COPD) in their example) compared to non-smokers, which explains why smokers continue with the habit while non-smokers either quit or never initiated into it[21]. We believe that that the cost of

[21] The valuation of this costs (called internal cost in their paper) is done by using two design methodologies (i) risk-dollar analysis: a trade-off between the risk of acquiring COPD and money and (ii) risk-risk analysis: a trade-off between the risk of getting COPD and the risk of mortality. In the risk-dollar analysis the respondents were informed about the rate of prevalence of COPD in certain residential areas and the corresponding costs of living in those

acquiring a disease, as calculated in KSW(2009) does not necessarily imply that smokers attribute lower risks to COPD. Instead, smokers could have a higher level of risk perception (compared to non-smokers) with respect to contracting COPD, and, thus, their lower costs may only reflect a lower perceived reduction in the risk of acquiring COPD vis-à-vis the non-smokers. Ideally the design should have reduced commensurate quantities in the risk of COPD for smokers and non-smokers, in keeping with their respective levels of perceived risk. The levels of risk perceived by a respondent may substantively influence the WTP that she may report. For example, a respondent with a higher level of risk perception may not react to the "option" (of risk reduction) as offered by the WTP question if she thinks that the risk reduction offered is too small for her in absolute terms. Our chapter, thus, emphasizes the need for the elicitation of subjective risks which may eventually facilitate a deeper behavioral analysis of health-risk valuation.

2.4 Econometric Methods and Issues

The respondents in the Orlando survey were asked about their willingness-to-pay (WTP) for a vaccine that would bring about reductions in the health risks pertaining to leukemia. In our study the purchase decision of the vaccine on the part of the respondents involved a one-time payment that would ensure a life-time reduction in health risks. The parent's willingness to buy the vaccine for herself and her child is denoted by $S^j = 1$, otherwise $S^j = 0$. The superscript j denotes the likelihood (l) or severity(s) as the case may be. The indirect utility function,

areas. A trade-off between the prevalence rate and the cost of living was elicited, indicating the cost that respondents attributed to the disease.

assuming $S^j = 1,$ is given as $U^*(Y - Z^j, q^\ell, q^s / S^j = 1)$ where Z^j is the amount the parent is willing to pay. Derivatives of the indirect utility function with respect to S and Z^j are given as

$$\frac{\partial U^*}{\partial S} = \left(\frac{\partial U}{\partial R_p^j}\right) dR_p^j + \left(\frac{\partial U}{\partial R_k^j}\right) dR_k^j$$

$$\frac{\partial U^*}{\partial Z^j} = -\lambda . \tag{2.10}$$

λ denotes the marginal utility of income for the parent.

Conceptually, the value of Z^j such that $U^*(\bullet) \equiv \tilde{U}$, where $\tilde{U}$ is the parent's level of utility when the vaccine option is not available. Applying the Implicit Function Theorem to the above identity we get the expression for WTP (for an extra set of vaccines for herself and her child) as given in equation (2.11) below.

$$\begin{aligned} \frac{dZ^j}{dS^j} &= \frac{1}{\lambda}\left[\left(\frac{\partial U}{\partial R_p^j}\right) dR_p^j + \left(\frac{\partial U}{\partial R_k^j}\right) dR_k^j\right] \\ \frac{dZ^j}{dS^j} &= \left(\frac{\partial U}{\partial R_p^j}\right)\frac{R_p^j}{\lambda}\left(\frac{dR_p^j}{R_p^j}\right) + \left(\frac{\partial U}{\partial R_k^j}\right)\frac{R_k^j}{\lambda}\left(\frac{dR_k^j}{R_k^j}\right) \qquad j = l, s \end{aligned} \tag{2.11}$$

Here, $\left(\frac{\partial U}{\partial R_p^j}\right)\frac{R_p^j}{\lambda}$ and $\left(\frac{\partial U}{\partial R_k^j}\right)\frac{R_k^j}{\lambda}$ denote the parents WTP with respect to the reductions in her own risk and the child's risk respectively. Proportionate reductions in risk to the parent and child are given by $\frac{dR_p^j}{R_p^j}$ and $\frac{dR_k^j}{R_k^j}$ respectively. Using equation (2.11), for any parent *h*, the relationship between WTP and risk reductions in leukemia can be econometrically specified as

$$WTP_h^i = \gamma_0^i + \gamma_p^i[\Delta_p^i]_h + \gamma_k^i[\Delta_k^i]_h + controls_h + \varepsilon_h^i, \qquad i = \ell, s. \tag{2.12}$$

WTP_h^i denotes the willingness-to-pay by any parent *h* for the vaccine that reduces the *i*th dimension of leukemia risk (likelihood or severity). Δ_p^i and Δ_k^i denote dummy variables coded to represent the percentage reductions in the *i*th dimension of risk for the parent and the child that were randomly assigned in the surveys. ε_h^i denotes a random disturbance term with the standard properties that captures the unobserved parent characteristics, and γ_j^i, *j=p,k* are the parameters to be estimated. We code the risk reductions as 10 and 90 so that γ_p^i and γ_k^i capture the WTP of the parent for a one percent reductions in the ith (*i=l,s*) dimension of risks of leukemia to herself and her child respectively.

Several additional aspects of equation (2.12) warrant further discussion. Firstly, as noted before, risk reductions and the prices of vaccines were randomly assigned. An advantage of this procedure is that the risk reductions and prices presented are orthogonal to each other as well as the parent characteristics included in the *controls* and the unobserved parent characteristics captured in ε_h^i. This means, that if the functional form of equation (2.12) is correct: (1) endogeneity problems in estimating the γ_j^i , *j=p,k* , are avoided and (2) estimates of the γ_j^i , *j=p,k* , are unaffected by the choice of the variables to include in *controls*. Secondly, the WTP for risk reductions is treated in an errors-in-variables framework in which the stated willingness-to-pay (W_h^i) by the parent *h* to reduce the *j*th risk differs from the true willingness to pay (WTP_h^i). This difference is broken down into systematic and random factors given as α^i and ν_h^i respectively.

$$W_h^i = WTP_h^i + \alpha_h^i = WTP_h^i + \alpha^i + \nu_h^i, \qquad i = \ell, s. \tag{2.13}$$

In equation (2.13), α^i is the nonzero mean of α_h^i and ν_h^i is a random disturbance term. α^i is assumed to represent the systematic misstatement of true WTP. For example, parents may mis-state the WTP because either the choice they faced of purchasing the vaccine was purely hypothetical and/or because the respondents might not have considered their financial constraints as binding. Also, ν_h^i captures the unobserved parent-specific heterogeneity as well as the purely random factors that may affect a parent's stated WTP for the vaccine presented. ν_h^i is assumed to be normally distributed with a zero mean and a constant variance. Substituting equation (2.13) into equation (2.12) we obtain

$$W_h^i = (\gamma_0^i + \alpha^i) + \gamma_p^i \left[\Delta_p^i\right]_h + \gamma_k^i \left[\Delta_k^i\right]_h + controls_h + \varepsilon_h^i + \nu_h^i, \qquad i = \ell, s. \tag{2.14}$$

Note that the constant term (γ_0^i) will be not be consistently estimated if, as expected, $\alpha^i \neq 0$. Also, estimates of the coefficients of the parent characteristics included in *controls* will be inconsistent if the controls are correlated with the composite error ($\omega_h^i = \varepsilon_h^i + \nu_h^i$). Nevertheless, consistent estimates of γ_k^i and γ_p^i can still be obtained if equation (2.14) is correctly specified because the two risk reduction variables Δ_p^i and Δ_k^i are the experimental design points that were assigned independent of the parent characteristics. This emphasis on consistent estimation of the coefficients facilitates an effective econometric test for altruism across different groups of parents. The ratio γ_p^i / γ_k^i denotes the marginal rate of substitution (MRS) between the risks facing the parent and the child. If γ_p^i / γ_k^i equals unity, the parent is altruistic towards her child. More precisely, it implies that the parent has equal regard for her own health and her child's. Referring to equation (2.13) the dependent variable W_h^i (the stated WTP for the vaccine) is latent. In the survey parents were asked to only state whether they would be willing to make a randomly

assigned payment for the vaccine. For the parents who answered in the affirmative, it is assumed that $W_h^i > P_h^i$, where P_h^i denotes the cost of the vaccine, that was randomly assigned to parent *h*. Thus, a parent states that she will make the purchase if

$$\omega_h^i / \sigma^i < (\gamma_0^i + \alpha^i)/\sigma^i + (\gamma_p^i / \sigma^i)\left[\Delta_p^j\right]_h + (\gamma_k^i / \sigma^i)\left[\Delta_k^i\right]_h - (1/\sigma^i)q_h^i, \tag{2.15}$$

where the *controls* are suppressed for notational simplicity, $E(\omega_h^i) = 0$ and $\text{var}(\omega_h^i) = (\sigma^i)^2$, and ω_h^i is symmetrically distributed. We estimate equation (2.14) as two independent equations using *Binomial Probit* - one corresponding to the risk of likelihood and the other to that of its severity. Although, the assumption of a normally distributed composite error with an expected non-zero covariance across equations, such as $E(\omega_h^{\ell}\omega_h^s) = \sigma_{\ell s} \neq 0$ and $\rho = \sigma_{\ell s}/\sigma^{\ell}\sigma^s$, would have motivated an estimation by *Bivariate Probit*, for the purpose of this study, such an estimation is not attempted for. Instead, the primary focus of this paper lies in testing for the equality of the relevant coefficient estimates (obtained from *Binomial Probit* estimation) across the parent groups. Following Cameron and James (1987), the coefficient of the randomly assigned price for the vaccine is interpreted as an estimate of $-1/\sigma^i$ that can be used to recover the un-normalized coefficients of risk reductions (γ_j^i) from the normalized estimates of γ_j^i / σ^i. In general, Probit coefficients are normalized by the variance of the error term and this makes it impossible to compare the coefficient estimates across independent equations. If variances differ across groups, such a comparison could lead to misleading interpretations. Allison (1999) has offered a solution in this regard, but under the restrictive assumption that at least one of the coefficients is identical across the groups under comparison. The set up of structural equations in our study as illustrated above, overcomes the problems of unequal variances across different parent groups. This allows

for a comparison of the un-normalized coefficient estimates of the parameters, γ_p^i and γ_k^i, across different parent groups. The motivation behind estimating a separate equation for each parent group arises from the need to allow for the unobserved heterogeneity to be varying across the groups. Contrary to this methodology, estimation of a single equation and consideration of dummy variables for different parent groups would have implied that the unobserved heterogeneity would have been the same across the parent groups. Hence, the latter method is avoided in this Chapter.

2.5 Results

The Binomial Probit estimates of the coefficients pertaining to the risk of likelihood of contracting leukemia are presented in Table 7. The second column (Full Sample) reflects the purchase intentions of the entire sample for reducing the likelihood risks of leukemia. The coefficients corresponding to the parent and child dummy variables (in the Full Sample) are positive and significant. This is indicative of the fact that risk reductions for both the parent and the child are important for the parent to be willing to pay for the vaccine. Cost considerations are important as well, as indicated by the significance of the corresponding coefficient. Now we may pose the question as to how do the full-sample results compare with that of the sub-groups? From Columns 3-6 in Table 17 it is observed, how in their purchase decisions, different parent groups assign different relative importance to the dummy variables with regard to risk-reductions for themselves and their children, and to the costs of such risk-reductions. From Table 7 we find that: i) For *Current-Smokers*, reductions in risk for the parent and the child are not the determining factors of the WTP for the vaccine (since the corresponding coefficients are insignificant); ii)

Former-Smokers consider reductions in the risk of their child's health only in their WTP; and iii) *Never-Smokers* are affected by reductions in their own health-risks only.

Table 7: Binomial Probit Model- Risk of the Likelihood of Leukemia for Parent and the Child

Sub-sample	Full Sample	Ever Smoker	Current Smoker	former Smoker	Non-Smoker
Sample size	815	281	93	188	534
Constant	0.162 (0.117)	0.164 (0.185)	0.610 (0.358)	-0.130 (0.253)	0.168* (0.131)
d.v.=1 if parent had a relatively high reduction in likelihood of leukemia risk	0.003* (0.001)	0.001 (0.002)	-0.002 (0.003)	0.004 (0.002)	0.004** (0.001)
d.v.=1 if child had a relatively high reduction in likelihood of leukemia risk	0.003** (0.001)	0.006** (0.002)	0.006 (0.279)	0.006* (0.002)	0.002 (0.001)
Cost of risk reduction in the likelihood of leukemia	-0.0004** (0.0001)	-0.0004** (0.0001)	-0.0003* (0.0002)	-0.0004** (0.0001)	-0.0005** (0.0001)
LORDER	-0.162 (0.090)	-0.1005 (0.155)	-0.163 (0.277)	-0.021 (0.191)	-0.205* (0.112)

Standard Errors are shown in parentheses.
*5% level of significance
**1% level of significance

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A similar pattern is observed in Table 8 where risk is considered in terms of conditional mortality (severity) from leukemia. Table 8 shows the results of the Binomial Probit equation considering the severity risk leukemia into account. For the entire sample as well as the sub-

groups, the coefficients corresponding to the reductions in severity risk for the parent are negative in sign but insignificant; cost coefficients are significant for all groups. While *Current-Smokers* and *Non-Smokers* do not consider reductions in their child's health as a determining factor in the WTP, for the *Former-Smokers,* the reductions in the severity risk for the child has a significant coefficient.

Table 8: Binomial Probit Model: Severity Risk from Leukemia for the parent and the child

Sub-sample	Full Sample	Ever Smoker	Current Smoker	former Smoker	Non-Smoker
Sample size	815	281	93	188	534
Constant	0.622 (0.116)	0.840** (0.222)	1.034 (0.434)	0.792** (0.261)	0.543** (0.137)
d.v.=1 if parent had a relatively high reduction in likelihood of leukemia risk	-0.001 (0.001)	-0.003 (0.002)	-0.005 (0.004)	-0.003 (0.002)	-0.0001 (0.001)
d.v.=1 if child had a relatively high reduction in likelihood of leukemia risk	0.003** (0.001)	0.006** (0.002)	0.006* (0.004)	0.006* (0.002)	0.002 (0.001)
Cost of risk reduction in the likelihood of leukemia	-0.0003** (0.0001)	-0.0004** (0.0001)	-0.0004* (0.0002)	-0.0005** (0.0001)	-0.0003** (0.0001)
LORDER	0.0117 (0.0928)	-0.0408 (0.1647)	0.0446 (0.2999)	-0.0540 (0.1998)	0.0418 (0.1132)

Standard Errors are shown in parentheses.
*5% level of significance
**1% level of significance

Apparently, the results in Table 7 and Table 8 suggest that the smoking status of a parent can plausibly have an influence in determining the relative importance of the parent's health-risk as against her child's, in the parent's decision to purchase the vaccine. However, a more rigorous testing methodology is warranted, in order to formally compare the structural parameters across the independent regression equations, pertaining to different parent groups. This will facilitate a better way of ascertaining if the smoking status of parents is instrumental in making the parents assign different relative weights to risk reductions for themselves and their children.

We proceed to test for parental altruism in each parent group. Given our model specification, parental altruism implies testing for the null hypothesis: $H_0 : \gamma_p^j / \gamma_k^j - 1 = 0; \; j = l, s$. In other words, a parent is considered altruistic towards the child, if, for equal percentage risk reductions in any aspect (likelihood or severity) of the disease, the marginal rate of substitution (MRS) between the consumption of risk-reducing goods by the parent and the child is equal to unity. Table 9 below provides the results of the Wald test for the above hypothesis for all parent groups.

Table 9: Test of Altruism between Parent Groups: Wald Test Statistic and the Corresponding p-values.

	Likelihood	Severity
Restrictions	$(\gamma_k^l / \gamma_p^l) = 1$	$(\gamma_k^s / \gamma_p^s) = 1$
Current Smoker	.672	3.85
p-value	.412	.04
Former Smoker	.216	2.83
p-value	.641	.09
Never Smoker	.704	.009
p-value	.401	.924

A high p-value would indicate that the null hypothesis, that parents are altruistic, cannot be rejected at conventional levels of significance. The test results indicate that parents falling under each of the three categories are altruistic (i.e., the corresponding p-values are high in all three parent categories). A key finding that emerges from this analysis is that parents who are *Current-Smokers* are altruistic towards their children just like parents who are either *Former-Smoker*s or *Never-Smoker*s.

Our next interest lies in testing if the "*level"* of concern shown by parents towards their children varies significantly according to the parents' smoking status. For this purpose, we perform Likelihood Ratio (LR) tests, the results of which are shown in Table 10. The LR tests are joint tests of the hypotheses that the coefficients γ_p's (and likewise γ_k's) are equal across any two parent groups. The null for such a test (of the level of concern) between any two parent groups say, Group I and Group II, is given as: $H_0 : \left(\gamma_p\right)_{\text{Grp I}} = \left(\gamma_p\right)_{\text{Grp II}}$ and $\left(\gamma_k\right)_{\text{Grp I}} = \left(\gamma_k\right)_{\text{Grp II}}$. A high p-value of such a LR test would indicate that the null hypothesis of the equality of γ_p and γ_k between any two parent groups cannot be rejected at conventional levels of significance.

Note that although the primary focus of the LR tests lies in assessing the level of concern by the parents for their children (i.e. testing for the equality of the γ_k's across different parent groups), the LR tests, being joint tests, help us observe the results of the tests of the equality of the γ_p's also . These, in turn, inform us about the differences (if any) across parent groups with regard to a parent's WTP for reductions in her *own* health-risks, in addition to her WTP for reductions in her *child's* health-risks. In other words, LR tests, in our chapter, are used to

compare the differences in the marginal WTPs between any two parent groups with regard to risk reductions in the parent's as well as the child's health-risks.

Table 10: Likelihood Ratio Test: Comparison of Marginal WTP between Parent Groups

Restrictions	Likelihood	Severity
Current Smoker vs. Non Smoker		
$(\gamma_p)_{\text{Current Smoker}} = (\gamma_p)_{\text{Never Smoker}}$		
And	3.244	2.340
$(\gamma_k)_{\text{Current Smoker}} = (\gamma_k)_{\text{Never Smoker}}$		
p-value	0.197	0.310
Current Smoker vs. Former Smoker		
$(\gamma_p)_{\text{Current Smoker}} = (\gamma_p)_{\text{Former Smoker}}$		
And	1.859	0.469
$(\gamma_k)_{\text{Current Smoker}} = (\gamma_k)_{\text{Former Smoker}}$		
p-value	0.395	0.791
Former Smoker vs. Non Smoker		
$(\gamma_p)_{\text{Former Smoker}} = (\gamma_p)_{\text{Never Smoker}}$		
And	2.018	1.571
$(\gamma_k)_{\text{Former Smoker}} = (\gamma_k)_{\text{Never Smoker}}$		
p-value	0.364	0.455

The LR tests are designed to restrict just the un-normalized coefficients corresponding to the parent and child dummy variables, γ_p and γ_k, respectively. This is possible because the specification of the econometric model allows us to retrieve the estimate of the variance of the error term from the coefficient of the cost variable (see equation 2.15). Moreover, the costs (the

price of the vaccine) were randomly assigned to the parents, thus, facilitating a consistent estimation of the corresponding probit coefficient. We do not include controls such as the number of children or family income in our analysis. By construction, the percentage risk reductions to the parent and child and the cost of vaccine are orthogonal to the observed as well as the unobserved parent characteristics. Hence, further addition of controls should not have any significant impact on the estimates of the coefficients.

The results in Table 10 show a high p-value for the LR tests across all parent groups. Therefore, the Null Hypotheses, as shown in the different rows in Column 1 of Table 10, cannot be rejected at conventional levels of significance. This, in turn, indicates that the γ_p's and γ_k's are equal between any two parent groups. Two implications follow: i) The equality of γ_k's suggests that the parents ,irrespective of their smoking status, exhibit the same level of concern for their children(as reflected in the marginal WTP for reductions in the child's health-risk, γ_k) and ii) the equality of γ_p's indicate that parents show the same level of regard for their own health-risks as well (reflected in the marginal WTP, γ_p) , irrespective of their smoking status.

The econometric analyses (the Wald tests and the LR tests) in this chapter, thus, bring forth some key findings with respect to parental behavior. First, parents in each of the groups categorized on the basis of their smoking status, exhibit *altruism* towards their children. Second, the *level* of concern shown by smoker-parents, towards the health risks faced by their children, is the same as that shown by their non-smoking counterparts. Besides illuminating the above facets of parental attitudes towards their children, this paper additionally throws light on parents' attitudes towards their o*wn* health risks as well. The LR tests reveal that smoker-parents show the same level of regard for their *own* health-risks as do the non-smoker parents. Herein lies a stark

departure of our study from the previous related literature (e.g. KSW, 2009 and others), which find that smokers value their health less than non-smokers. This divergence motivates us to inquire into the plausible reasons as to why such results may have been arrived at in our paper and to explore its implications for policy evaluation exercises.

Recall that the design of the survey was such that, the elicitation of parents' risk perception levels was followed by an offer of risk reduction in percentage terms for a given amount of money, against which yes/no responses were elicited. Table 16 shows the mean risk perceptions with regard to the likelihood of getting leukemia as well as mortality (severity) from the disease, conditional on having contracted it. Difference of Mean Tests reveal that the *Current-Smokers* have a higher level of risk perception (with regard to getting leukemia and dying from it conditional on getting it) than *Former-Smokers* and *Never-Smokers*[22]. A similar pattern is also observed when parents are asked about their *own* chances of getting lung cancer and dying from the disease (not shown). Thus, *Current-Smokers* have a higher level of risk perception than *Former-Smokers* and *Never-Smokers* with regard to lung cancer as well.

We contend that this observation of smoker parents having higher levels of risk perceptions, in conjunction with the results we obtained from the LR tests, (that the marginal WTP for a *percentage* risk reduction in the parent's own health is the same across all parent groups), implies that smokers are willing to pay *less* than their non-smoking counterparts for a unit reduction in the *absolute* risk for their own health. This inference is, in fact, in conformity with the previous studies which claim that smokers are risk-loving and do not care about their health and longevity. This paper, thus, amply points toward the possibility that the results of the

[22] With regard to the health risks of their children, parents' perceptions do not differ significantly across parent-groups.

health-risk valuation exercises may differ starkly depending on whether the risk reductions are interpreted by respondents in percentage or absolute terms. This, in turn, affirms the need to tie subjective risk assessment exercises with WTP elicitation exercises. Below, we briefly digress from the main theme of the paper viz. the relationship between a parent's smoking status and her behavior towards the child's health risks, her own health risks etc. Such an exercise facilitates a closer look at the importance of the subjective risk assessments (or elicitation of the levels of risk perception) in any health-risk valuation exercise.

2.5.1 The Importance of Risk-Perception in Health Risk-Valuation: A Note

In order to explore the role of risk-perceptions in influencing health-risk valuation (or more precisely the WTPs that the respondents report), this paper now treads beyond the smoker/non-smoker categories and fully focuses attention on the *Never-Smoker* parent group. We recognize that intuitively it may be common to associate higher levels of risk perception with smokers per se, which in turn may indicate a lower concern by the smoker for her own health. In contrast, the following exercise illustrates that this intuition may well be applicable to individuals in general. The following analysis which exclusively focuses on the sub-sample of *Never-Smokers* drives home the importance of incorporating subjective risk-assessments in any health-valuation exercise.

Never-Smokers, in our study, comprise 65% (534 respondents) of the original sample. The relatively large size of the *Never-Smoker* group allows us to have two sub-groups of reasonable sizes with statistically significant differences in the mean perceptions levels with regard to leukemia risks facing the parent and the child. Table 11 splits the *Never-Smoker* parent group into two sub-groups: Group I and Group II.

Table 11: Division of 'Never-Smoker' Parents into Subgroups on the Basis of Risk-Perception Levels

Group	No. of Observations	Mean Risk Perception of the Likelihood of Leukemia Risk to the Parent	Mean Risk Perception of the Likelihood of Leukemia Risk to the Child
Group I	250	98.7	101.4
Group II	284	12.6	7.9

Clearly, the levels of perceptions with regard to leukemia risk (facing the parent and the child) are higher for Group I as compared to Group II. A Probit model given by equation (2.14) is estimated for each of these groups. We test the null hypothesis that the coefficients, γ_p and γ_k, which stand for the marginal WTPs , do not differ between Group I and Group II. i.e., the marginal WTP for risk reductions in the likelihood of leukemia for the parent and child do not differ between the two groups. More precisely, the null hypothesis is given as $H_0 : \left(\gamma_p\right)_{\text{Grp I}} = \left(\gamma_p\right)_{\text{Grp II}}$ and $\left(\gamma_k\right)_{\text{Grp I}} = \left(\gamma_k\right)_{\text{Grp II}}$. We perform a LR test by imposing restrictions on γ_p and γ_k while allowing the constant terms and the variances for both the groups to vary. A high p-value of the test (not shown in Table 11) indicates that the null hypothesis is not rejected at conventional levels of significance. This implies that, on the margin, the WTP for a proportionate reduction in risks for the parent and the child is the same across Group I and Group II. For the purpose at hand let us now focus attention on the risks threatening the parents only. Although the marginal WTPs for percentage reductions in the parent's own health risks are found to be the same across Groups I and II , we contend that parents in Group I value a unit of absolute risk reduction less , as compared to the parents in Group II. This is because, parents in

Group I report a higher level of risk perception which, together with results of the LR test, indicate their lower valuation of absolute health-risks from leukemia.

The above analysis, thus, illustrates the general manner in which subjective risk-perceptions of individuals may influence their health-risk assessments (and hence their WTPs for risk reductions).

2.6 Conclusion

This paper explores the concerns that smoker-parents may have with regard to the general health-risks facing their children. More specifically, the research question, if smoker-parents behave differently from non-smoker parents when it comes to general health-risks (leukemia) faced by their children, comprises the primary motivation of this paper. A stated preference data set, comprising parent-respondents having children aged between 1 and 16 years, is analyzed. Sub-samples are constructed based on the smoking status of the parents. The two research hypotheses that the paper tests are: i) parental altruism within each parent group and ii) the equality of the WTP for an additional percentage risk reduction *across* parent groups. Econometric tests for parental altruism involve testing if the MRS between risk reductions for the parent and the child is equal to unity. Moreover, in order to test for the equality of the WTPs we perform Likelihood Ratio (LR) tests of the equality of the relevant coefficient estimates across different parent groups.

Two key findings, relevant for policy, emerge with respect to parental behavior. First, parents in each of the groups categorized on the basis of their smoking status, exhibit *altruism* towards their children. Second, the hypothesis of equal WTPs for an additional percentage reduction in risk between any two parent groups is not rejected, thereby confirming that the *level*

of concern shown by smoker-parents, towards the health risks faced by their children, is the same as that shown by their non-smoking counterparts.

Besides observing the above facets of parental attitudes towards their children, this paper additionally throws light on the parents' attitudes towards their o*wn* health risks as well. The LR tests reveal that the smoker-parents show the same *level* of regard to the percentage reductions in their own health-risks as their non-smoking counterparts. This finding, that smokers care about their own health no less than non-smokers, runs counter to the observation in some of the previous studies, that smokers in general disregard their own health. This paper reconciles this divergence of results in the light of the subjective risk-perceptions that were elicited in the survey in our study. In the survey, the smoker parents reported a higher level of risk perception (or subjective risks) for their *own* health as compared to non-smokers. We contend that this result, in conjunction with the results from the econometric tests (that the marginal WTP for a *percentage* risk reduction in the parent's own health is the same across all parent groups), implies that smokers are willing to pay *less* than their non-smoking counterparts for a unit reduction in the *absolute* risk for their *own* health.

Apart from generating the insights on parental behavior, this paper illustrates that a sole reliance on the valuation of *percentage* reductions in health-risks may sometimes produce misleading policy evaluation results. Therefore, we affirm the need to incorporate subjective risk-assessment procedures in WTP elicitation exercises. Such a comprehensive exercise may help the researcher comprehend the respondents' perceptions of a given percentage of risk-reduction in absolute terms as well. This, in turn, may facilitate a deeper behavioral analysis of health-risk valuation which can be of importance for the contemporary public health policy evaluation techniques. We recognize that our consideration of the respondents' subjective risks

with regard to their *own* health produces divergent health valuation results, depending on whether WTPs are interpreted in terms of percentage or absolute risk reductions.

This renders an unambiguous result with regard to the valuation of a smoker's *own* health risks difficult. Nevertheless, we deem a further investigation into this ambiguity essential and thus, envisage future research efforts to be directed towards studying the implications of such divergent health-risk valuation results for public health policy techniques.

CHAPTER 3: THE MEASURE OF RISK PERCEPTION

3.1 Introduction

This chapter primarily focuses on the issue of quantitative assessment of perceptions of health-risks from smoking. Particular interest lies in understanding how variants of a metric, namely, a survey question, have been employed in academic studies and industry surveys, in order to measure smoking-related risk-perceptions. This metric, in fact, constitutes the state-of-the art technique for assessing the level of risk-perceptions in the context of smoking. Viscusi (1990) represents the first academic use of this metric. The risk-perception question used in Viscusi (1990), which motivated subsequent studies on smoking-related perceptions, was worded as: *Out of 100 cigarette smokers how many do you think will get lung-cancer?* The particular framing of such a question helps in estimating the probability of getting lung-cancer from smoking as perceived by individuals. Delving into the past survey records of the U.S. tobacco industry and reviewing the same, we find that this metric, quite interestingly, has been employed in industry surveys as well, some even dating back to 1964 (Baghal, 2011).

It was after the Master Settlement Agreement in 1998, that the tobacco industry documents which we review came into publication[23]. In particular, we review the following documents: a report prepared by Roper Organization Inc. on behalf of Philip Morris (1964), a series of biennial reports prepared on behalf of the Tobacco Institute (1968 -1984), and a report on the American Cancer Society and American Lung Association prepared by Roper Organization Inc. (1977). These apart, documents related to a survey, conducted in 1985 by the

[23] These documents are now available at the Legacy Tobacco Documents Library (LTDL) at the University of California, San Francisco (UCSF) and other publicly accessible sources.

Audits and Survey Inc. and funded by the tobacco industry, are also studied precisely for two reasons. Firstly, the survey (1985) used the said quantitative metric, mentioned above, to assess risk-perceptions. Secondly, the dataset from this survey was analyzed and the results reported in Viscusi (1990). Incidentally, Viscusi (1990) served as the forerunner for numerous other academic studies[24] (such as Viscusi 1991, 1992; Liu and Hsieh, 1995; Lundborg, 2007; Lundborg and Andersson, 2008; Viscusi et al., 2000; Viscusi and Hakes, 2008) on smoking behavior. In a sense the survey conducted by Audits and Survey Inc. (1985) serves as a vital bridge between industry research and academic studies particularly focusing on smoking behavior.

Alongside a review of select industry survey records, this chapter also discusses the implications of the various ways in which the risk-perception question has been presented in these industry surveys, and the different modes under which surveys have been conducted. We discuss how different aspects of the metric (the risk-perception question), viz., the use of a 'probe' and the 'Don't Know' option, might have plausibly influenced the perceived risk-estimates arrived at in these surveys. We find a general lack of concern in almost all industry surveys, regarding the inclusion of 'Don't Know' as an explicit option when the risk-perception question was initially presented to respondents. In fact, if any respondent was not able to provide a numerical estimate of risk, he or she was probed to provide a 'best guess'. Only when respondents failed to report a numeric guess, the responses were clubbed under the 'Don't Know' category. Thus, in effect, the number of responses finally counted on account of 'Don't Know'

[24] These studies argued that people, irrespective of their age, gender, education level and smoking-status, were fully aware of the health-risks from smoking, to the extent that they over-perceived the risks. These studies looked at not only lung-cancer, but other smoking-related diseases as well, e.g. heart disease, emphysema, COPD and even loss of life expectancy.

from such surveys may have considerably been diminished due to the design of the question. On studying the implications of the use of various survey modes on risk-estimates, we find that estimates derived from surveys conducted over the telephone are substantially greater than those conducted face-to-face, and the difference is attributed to the over-sampling of non-smokers in a telephone survey (Luepker et al., 1989).

Our review of survey methods reveals that the two aspects of health-risks from smoking – the risk of contracting a smoking-related disease, as against the risk of prematurely dying from it conditional upon getting affected – have not been jointly explored so far. In this chapter, we contend that on the issue of appropriate measurement of risk-perceptions, the inclusion of survey questions on both these aspects can plausibly generate interesting insights. However, to date, the joint inclusion of both these aspects of risk has not been explicitly featured in smoking-related surveys. We divide existing surveys into two broad categories. Industry surveys and other studies such as Viscusi (1990, 1992, 2002) and Viscusi and Hakes (2008), comprise the first category as they estimated only the probability of getting lung-cancer from smoking. These studies argue that people not only understand health-risks from smoking, but they also over-estimate it several times over, as compared to objective risk-estimates. The Annenberg Perception Tobacco Risk Surveys II (1999-2000) and a survey (conducted in 1998) in Viscusi and Hakes (2008), comprise the second category of surveys. These surveys employed a variant of the risk-perception metric in terms of estimating the unconditional probability of a smoker dying from lung-cancer, as a single numerical estimate. In this chapter we argue that the assessment of beliefs on just one aspect of risk (as what the existing surveys have done) may not always provide an accurate representation of perceptions.

In order to empirically inquire into the plausible influence of a joint inclusion of both of these risk-aspects on derived perceptions, we make use of the dataset obtained from the Family Heart Disease and Prevention Survey (November 2010-March 2011). The latter provides a unique opportunity to explore two kinds of probabilities - the probability of disease occurrence and the probability of conditional mortality, with regard to lung-cancer from smoking. Two main observations emerge from our empirical analysis. Firstly, individuals do not correctly assess any of these two aspects of health-risks as compared to objective estimates. While risks of disease occurrence (i.e. the probability of getting lung-cancer) have been found to be over-estimated, the conditional mortality estimates are considerably under-estimated in our study. The observation of over-estimation, with regard to the probability of getting lung-cancer from smoking, is in line with previous studies (Viscusi, 1990, and others). Moreover, our second observation affirms that individuals' subjective assessments of beliefs on either risk aspect, i.e., the probability of disease occurrence and the conditional probability of mortality, even though erroneously evaluated, can be effectively used to predict smoking behavior. We estimate how two different risk measures influence the likelihood that an individual would smoke. The magnitude of this likelihood is considered as a measure of the extent to which the individual's smoking status can be predicted in relation to the risk concerned. We find that both these risk aspects, in fact, influence the smoking likelihood of an individual in an identical manner.

Although our study aligns with Viscusi (1990) in finding that over-estimated disease occurrence risks could predict smoking behavior, we arrive at an additional interesting inference. In our analysis, under-estimated conditional mortality risks can also be used to predict smoking behavior. Thus, we argue that a consideration of individuals' responses on only one kind of probability (between the probability of disease occurrence and that of conditional mortality) may

generate a partial representation of the level of smoking-related risk-perceptions prevailing in the society. Depending on which probability (or risk aspect) is considered, policy implications for smoking-control efforts may diverge. On one hand, while an analysis of overestimated disease occurrence risks may indicate that a substantive amount of smoking-related awareness already exists in the society, on the other, consideration of the conditional mortality risks, which are, in fact, under-estimated, may reveal that people may still not fully perceive the adverse health-effects from smoking. Thus, we contend that both these risks may be analyzed jointly for effective policy prescriptions.

The rest of the chapter is organized as follows. Section 3.2 outlines the debate on perceptions of smoking-related health risks: the industry's arguments as against those of their critics. Section 3.3 presents a review of select documents of the tobacco industry. In Section 3.4, the implications of different features of the risk-perception question, which have been used in industry surveys, are discussed. Also explored in this section is the impact of different survey modes on derived risk-estimates. Section 3.5 discusses the importance of considering two aspects of perceived risks (the probability of disease occurrence and the probability of conditional mortality) for an appropriate representation of smoking-related perceptions. An empirical exercise is carried out to illustrate the same. Finally, Section 3.6 summarizes and concludes.

3.2 A Debate on Perceptions of Health Risks from Smoking: Industry vs. Others

Risk-perceptions occupy an important place in the debate on cigarette smoking. On one hand, the tobacco industry maintains, especially in court rooms, that smoking is a rational decision taken by individuals who make their choices, fully understanding the possible consequences of smoking. However, critics complain that public awareness on the issue of

smoking has been compromised and manipulated through the marketing and advertising strategies of the tobacco industry (Hanson and Kysar, 1999a, 1999b; Cummings et. al., 2002; Simpson and Lee, 2003)[25]. Still there are others who counter this criticism by arguing that higher taxes and prohibitions with regard to smoking in public places are manifestations of paternalistic views of the authority (Baehr, 2010). This section of the view contends that authorities, being mostly part of the non-smoking populace, are representative of the latter's views (Viscusi, 2002). In this section we provide a brief perspective of these various arguments on the issue of smoking-related awareness.

The stand that the tobacco industry has commonly taken in litigations is that the consumer "already knows" about the possible health-risks from smoking. The argument forwarded by the industry alludes to the assumptions underlying the theories of rational choice: self-interested individuals make "choices" based on their own preferences. These preferences are assumed to be fairly stable and based on the appraisals of "information" by the individual. The industry claims that it merely supports the consumer's right to make a "choice", thereby indicating that the moral agency of the act of smoking lies with the consumers themselves (Balbach, Smith and Malone, 2006). The industry's arguments in favor of the tobacco products are as follows: "Consuming tobacco is inherently risky, like working with knives or blades or driving a car, but manufacturing of tobacco products (mainly cigarettes) entails nothing that would enhance the riskiness of those products. Rather, the objective of the manufacturers is to deliver taste, which is precisely what the consumers seek in the product. Therefore, products

[25] Even in the absence of manipulation smokers perceptions about health risks could be inaccurate and prone to optimism bias (Weinstein, 1999; Weinstein, Marcus and Moser, 2005)

designed by the industry cater to this preference for taste and expand the choice set of the consumer to choose from" (Cummings, Brown and Douglas, 2006).

In contrast, studies such as Hanson and Kysar (1999a) suggest that perceptions are often manipulated and exploited to lead the consumer in making smoking-related choices in ways the tobacco industry intends. The authors point out that if cognitive biases can be identified, incorporated into the classical model, and are corrected for, by certain governmental actions, they can also be exploited by the manufacturer or the industry to its own ends[26]. Independent of the mandated warnings on the hazard that the product may pose, cognitive biases that individuals may have provide an incentive to the producers to actively manipulate risk perceptions through the use of commensurate pricing, advertisement, promotional strategies, and offers of an array of new product categories. Other studies argue that these manipulations need not be explicit. For instance, the introduction of "filtered" cigarettes in the 1950's and the "ultra-light" cigarettes in the 1970's and 1980's, were design features which communicated that these varieties of products were safer. Even after the use of words such as "light" and "ultra" were prohibited by regulators, the cigarette manufacturers made use of attractive packaging strategies e.g., light-colored packages for cigarettes that were previously labeled as the "light" or "ultra" variety (Wakefield et al., 2002). Given the varied product features, brands and publicity campaigns, smokers are rendered confused with regard to the associated risks (Bansal et al., 2004; Cummings, 2004; Cummings et al., 2004).

[26] In a companion paper, Hanson and Krysar (1999b) provide a historical and empirical account of how consumer's estimates of risks were substantially lowered; how industry practices, such as manipulation of nicotine in the cigarettes, have created and reinforced biases about the risks of cigarettes.

3.3 The Tobacco Industry Survey Documents: A Review

3.3.1 A Study of Reactions to the Surgeon General's Report on Cigarette Smoking

Elmo Roper and Associates prepared a document for Phillip Morris (February, 1964) which was titled, "A Study of Reactions to the Surgeon General's Report on Cigarette Smoking". To the best of our knowledge, the Surgeon General's Report (January, 1964) comprised the first of its kind issued by a government authority in the U.S., that linked smoking to lung-cancer. As the title suggests, the purpose of the study (Roper, 1964) was to find out if the Surgeon General's Report had any impact on smokers' behavior in terms of switching to other brands, in the aftermath of the report. The study was also interested in finding out if respondents had knowledge of the contents of the report, and in exploring smokers' attitudes towards the same. The focus of Roper (1964) being on certain brands of cigarettes only (which were distributed across select areas in the US), the sampling design assigned half of the interviews to respondents in these select locations and the other half of respondents represented the rest of the country. Interviews were conducted on smokers, two weeks after the Surgeon General's Report was published. It was reported that 3 out of 10 smokers had either stopped or cut down on cigarette consumption. Overall, however, there was no indication of a major shift in smoking habits. Roper (1964) is chosen for our review since it comprises the first that have been found of the industry surveys to have used a metric for quantitative estimation of risk-perceptions. The particular framing of the risk-perception question as presented there was: *According to the report, a person who smokes a pack or a more a day has about ten times as great a chance of getting lung cancer as a non-smoker, but what does this mean to you in terms of the likelihood of the pack a day smoker getting lung cancer? Out of 100 pack a day smokers how many would you say would get lung cancer – 5 out of 100, 25 out of 100, 50, 75, 95 out of 100, or how many?* (Roper

1964; p. 24). 26% of the respondents reported the likelihood of getting lung- cancer to be less than 7 out of 100, and 41% said they 'did not know' or did not answer. Also, in Roper (1964) respondents who could not provide a numeric risk-estimate were not probed further. In this connection, note that the implications of the use of a 'probe' on derived risk-estimates is discussed at length shortly (See Section 3.4.2).

3.3.2 Study of Public Attitudes towards Cigarette-Smoking and the Tobacco Industry: A Biennial Report Series (1968-1984)

A series of biennial reports was prepared by the Roper Organization Inc. on behalf of the Tobacco Institute. These reports are based on surveys, conducted every two years between 1968 and 1984, on nationally represented samples of individuals, aged 17 years and older, in the United States. All of the nine reports in the series aimed to assess "public attitudes towards smoking and health issues, and attitudes towards the tobacco industry and government regulation of it". These reports provide a broad perspective of people's views towards smoking, as assessed by the tobacco industry. More precisely, these biennial reports arrived at a pool of information pertaining to topics ranging across: (i) consumers' ideas on smoking as a health issue, (ii) the perceived association between smoking and different health hazards, (iii) the impact of environmental tobacco smoke (or passive smoking), (iv) the role of governmental regulations to control the public health issue of smoking and (v) the rights of smokers and non-smokers. One of the reports, Roper (1976), summarized all relevant information on consumer's attitudes and awareness, in clearly laying down a list of "assets" and "liabilities" for the tobacco industry (See Table 18). Given our interest in understanding the use of risk-perception questions in industry surveys, we find Roper (1980) to be particularly significant in this biennial series since it framed the question in the format of our focus. In particular, Roper (1980) asked: *Out of every one*

hundred people who have been cigarette smokers, how many would you estimate get lung cancer at some time in their lives?

3.3.3 A Four-Part Survey about the American Cancer Society and the American Lung Association

In 1977 the Roper Organization Inc. prepared a report titled "A Four-Part Survey about the American Cancer Society and the American Lung Association". The study sought to explore what individuals thought about the utilization of voluntary contributions generally made to the two institutions. An associated interest of this report lay in finding out if provision of information on how funds are actually spent by these organizations would change the pattern in which people would voluntarily contribute. Four different surveys were conducted: i) A nationally representative survey with regard to the American Cancer Society; (ii) a survey in seven US cities to see how knowledge and attitudes towards the American Cancer Society might differ across these cities ; (iii) A national survey concerning the American Lung Association ; and (iv) A second round of survey in Denver (one of the seven US cities mentioned above) to see if interventions of the Cancer Society Forum and/or the publicity drives by the Tobacco Institute on fund-usage by the American Cancer Society had changed attitudes of city-residents. Roper (1977) suggested that public perceptions on how voluntary contributions are spent are erroneous. For instance, people thought the American Cancer Society to be the highest spender on cancer research, when actually it was not. It was also found that provision of actual information on fund-usage would have no effect on the ways people would like to contribute to these organizations. The report also observed that the incidence of lung-cancer was over-estimated by four to five times, as compared to objective risk-estimates. Moreover, for the purpose of our study, Roper (1977) assumes importance, on the issue of quantitative measurement of risk-

beliefs. In Roper (1977) respondents were asked: *How many out of 100 cigarette smokers, would contract lung cancer at some point in their lives?*.

3.3.4 Survey by the Audits and Survey Inc. (1985)

The survey conducted by Audits and Survey Inc. in 1985 occupies an important place among the scientific and academic documents on smoking behavior and, in fact, serves as a vital bridge between industry research and academic studies as well. Data from this survey and associated results were reported in Viscusi (1990). The latter comprised the first of the smoking-related academic studies to have reported the use of a quantitative metric for risk-perception estimation and, in turn, motivated numerous subsequent studies involving such a metric. The survey (1985) was primarily designed to look into the linkages between smoking status and different notions and ideas that people held about health-risks from smoking. Insights on these linkages were utilized by the industry in various litigations that it was engaged in at the time. One such litigation involved the Liggett and Myers Group, who faced charges on the death of a smoker, Rose Cipollone, who had died of lung-cancer in 1984. In connection with this lawsuit, the Federal District Court, New Jersey, ruled, on February 1, 1988, for the first time ever in history, that the cigarette manufacturer would be liable for the death of a smoker. Compensation damages worth $400,000 were paid to the family of the deceased (Hirschfelder, 2010, p. 167). Our search for associated documents with regard to the said lawsuit brought forth a testimony (provided by Mr. Dexter Neadle[27]) which stated that the results of the survey (1985) were used by the defendant in the Cipollone vs. Liggett Group Inc. Case (Porter et al., 1987). More

[27] Incidentally, it was Mr. Dexter Neadle who was responsible for designing the Audit and Survey Inc. Survey (1985).

importantly, the testimony brings out important details on the survey (1985), viz. questionnaire development, design issues and format of questions, the underlying purpose of the survey etc.

3.4 Implications of Different Survey Features on Derived Risk-estimates

3.4.1 Initial Background Questions on Smoking and Health

Our primary objective in Section 3.4 lies in exploring the implications of different features of risk-perception questions, variously used in past surveys, on the derived estimates of risk. Also, of potential interest to us, is the impact of different survey modes on the levels of risk-perception obtained. However, before a detailed discussion on the same, it may be interesting to study, how in industry surveys different background questions on the association between smoking and health-risks were posed to respondents prior to the actual risk-perception question being presented. The aim of such background questions perhaps lay in gradually conditioning the respondents towards the risk-perception question of interest. This may have provided an opportunity to understand the respondents' overall attitudes towards the adverse health-effects from smoking.

We consider the series of biennial reports prepared by Roper (1968-1984). Several background questions (See Table 20 and Table 21) were posed as follows. A question was presented that aimed at assessing if respondents were aware of the association between smoking and adverse health-effects. The nature of such an association, if it was probabilistic or causal, was further probed into.[28] Further refinements of this probe considered assessing if people

[28] In Roper (1970), around 30% of the respondents believed that it was "definitely true" that cigarette smokers had more illnesses than non-smokers.

thought smoking to be a major cause or one of the many causes of illness[29]. An allied question asked respondents if they believed that smoking contributed to the shortening of smokers' life-spans or, if it was chiefly because of certain other characteristics of smokers that impacted their longevity[30] . In the biennial report series, another question presented was aimed at identifying how people associated different degrees (or extent) of smoking with the hazards they pose on health[31]. In Roper (1974, 1976), we also find the use of questions that required respondents to choose one disease among a set of four diseases (heart disease, high blood pressure, emphysema and lung-cancer), which they believed a 'typical' smoker was most likely to contract. Another background question of interest that we identify in Roper (1984) required respondents to classify tobacco and other products into "addictive" or "habit-forming" categories. Cocaine and heroin intake were reported to be addictive while chocolate consumption was perceived to be "habit-forming". 54% of the respondents thought cigarettes were "addictive" while 44% categorized them as "habit-forming". Thus, the results suggest that people perhaps had little definitive ideas regarding the addictive nature of the nicotine content of cigarettes at that time.

3.4.2 The 'Don't Know' Option and Its Implications

Given our interest lies in the implications of different features of the risk-perception question on the estimates of perceived risk, we identify a strand of research which exclusively

[29] In each of the biennial reports over the period 1968-1984, it was found that increasing percentages of respondents identified smoking as a major cause over the years. In each report, more than half of the respondents believed that smoking was "one of the many causes" of illness.

[30] Though in Roper (1970) more than 40% of the respondents (and the figure rose to 55% in 1984) said that smoking was a cause of premature mortality, one-fifth of the respondents believed that smokers did not live long enough because of the kind of people they were. See Table 20 for details.

[31] Roper (1970) reports that 45% of the respondents believed that only "heavy smoking" was hazardous to health, while 47% believed that "any amount of smoking" was harmful (See Table 21). By the time Roper (1978) was published a substantive portion of respondents largely shifted to the idea that "any amount of smoking" could harm, thus indicating prominent changes in people's beliefs as compared to Roper (1970).

focuses on the use of a 'Don't Know' option in survey questions and its possible consequences. The use of this option may be particularly meaningful for questions the responses of which are supposed to be attitudinal or opinion-specific in nature. Studies that explore this aspect of the survey methodology conclude that the respondent pool, in the context of attitudinal questions, can be divided into four groups in terms of their preferences and associated responses they provide to such survey questions: (i) those who have preferences and provide substantive responses; (ii) those who do not have any preferences and choose the 'Don't Know' option , or at least volunteer for it , if the option is not explicitly provided for ; iii) those who have preferences but do not give substantive answers (for reasons such as too much of cognitive effort is required to answer the questions meaningfully) and (iv) those who do not have any kind of preferences with regard to the questions being asked and yet tend to provide substantive answers (Gilljam and Granberg, 1993). The last two categories, in particular, comprise an issue of concern for social-science research which often make use of attitudinal questions, or probe into individuals' preferences in surveys. The explicit provision of the 'Don't Know' option as compared to the design, that does not clearly do so, has been considerably researched on. Leitz (2010) mentions a study involving nineteen experiments that were conducted to compare responses across questions with and without an explicit 'Don't Know' option. When the 'Don't Know' option was explicitly offered, the percentage of respondents choosing the option went up by 22-25 % irrespective of whether the respondents were familiar with the question being asked.

Surveys by Roper (1977, 1980) and the Audit and Survey Inc. survey (1985), which used the quantitative metric to assess risk-perceptions, did not make use of an explicit 'Don't Know' option. Instead, if the respondent could not provide a numeric response as was required, he was 'probed' by the interviewer to provide a "best guess" on the risk-estimate. Only when

respondents failed to report a numeric guess, the responses were then clubbed under a category akin to 'Don't Know'. One may argue that the absence of an explicit 'Don't Know' option makes it difficult to ascertain how the 'probed' responses were distributed and hence, their impact on the mean risk-estimates cannot be looked into. Thus, in effect, the number of responses finally counted on account of 'Don't Know' from such surveys may have considerably been diminished due to the design of the question. In contrast to these three surveys, in the survey mentioned in Roper (1964) (Recall Section 3.3.1), did not make use of a 'probe'. 41% of the respondents could not provide a definitive answer when faced with the risk-perception question (thus akin to 'Don't Know' responses). It should be additionally noted here that such a high percentage of responses in the 'Don't Know' category pertained to smoker-respondents only, as Roper (1964) was exclusively based on an analysis of smokers' beliefs. In the report, only 4 percent of the responses fell into the '41-60' interval. The mean risk-estimate of smoking from Roper (1964) was found to be substantially lower.

This brings forth an allied issue too, particularly with regard to results derived under an explicit 'Don't Know' option. Francis and Busch (1975) explain that responses arrived under the 'Don't Know' category (both when it is explicitly present and when it is not) may be systematically related to certain respondent-characteristics. For instance, the authors associate the affinity of saying 'Don't Know' to respondent features such as being non-white, lesser educated and earning lower income etc. This observation in Francis and Busch (1975), assumes significance in our context especially since the characteristics they mention, have incidentally been found to be associated with smoking status of respondents in other studies often.

The review of the above studies brings forth an interesting possibility. In smoking-related surveys, the absence of a 'Don't Know' category could plausibly lead to a class of

respondents who might provide some responses that may not be commensurate with actual preferences, thus, bringing in issues of "reliability" and "validity". Rather, respondents might just choose answers at random. Thus, one may argue that the absence of an explicit 'Don't Know' may give an impression that responses are genuine, even though, they might have had an element of randomness in them. However, critics of this argument may contend that not providing for the 'Don't Know' option explicitly may incentivize respondents to exert substantive cognitive efforts in expressing their actual opinions. The easy availability of the 'Don't Know' option might not provide the right incentives for reporting their true preferences (Gilljam and Granberg, 1993; Krosnick et al., 2002).

3.4.3 Implications of Survey Modes: Telephonic & Face-To-Face Interviews

The mode of a survey, e.g., the use of telephones as the medium, or the conduct of direct face-to-face interview methods, often constitutes a significant factor, thereby, considerably influencing the responses to risk-perception questions. This, in turn, impacts the estimated levels of smoking-related awareness, as derived from the surveys. Telephonic survey over-samples 'non-smokers' compared to face-to-face interviews (Luepkar et al., 1989); this has implications on the estimated mean level of perceptions on health-risks from smoking. Since 'non-smokers' have a higher level of risk perceptions than the 'current-smokers', a telephonic survey mode could possibly bias mean risk-perceptions towards a higher figure. We compare risk-estimates across two surveys: the Roper (1980) survey, which interviewed respondents face-to-face, as against the Audits and Surveys Inc. survey (1985), conducted over the telephone. While Roper (1980) shows 63% of the respondents to be 'non-smokers', the Audits and Surveys Inc. (1985) has 75% of the respondents in the said category. Dividing this category of respondents further

into two subgroups, 'never-smokers' and 'former-smokers', reveals that the telephonic survey had 8% more of the 'never-smokers'. Grande, Taylor and Wilson (2005) contend that, even the use of listed telephone numbers only, can create a bias with regard to the smoking-status of the respondents. The use of listed telephone numbers may over-sample non-smokers and as such may be best to avoid in surveys primarily focusing on smoking behavior. We compare another pair of nationally representative surveys viz. the Roper (1977) and Roper (1980) to inquire into how risk-estimates may differ across the two interview modes stated above. It is found that Roper (1977), conducted over telephone, arrived at a higher estimate of perceived risks from lung-cancer as compared to Roper (1980), which was administered face-to-face.

3.5 Alternatives Measures of Risk Perception: An Empirical Analysis

The quantitative metric or the survey question, that we are primarily concerned about in this chapter, essentially estimates the probability of a health-risk, such as lung-cancer, that a respondent believes to be associated with smoking. The risk of lung-cancer (or, in fact, any other fatal disease), in turn, can be thought to be comprising two aspects: (i) the risk of contracting lung-cancer due to smoking (i.e. the probability of disease occurrence) and (ii) the risk of premature death of a smoker conditional upon his getting lung-cancer (i.e. the conditional probability of mortality). The quantitative metric, commonly used in past surveys to measure smoking-related risk-perceptions, helped in estimating respondents' perceptions on mostly the risk of disease occurrence. Our review of past survey records also reveals that the conditional probability of death from lung-cancer, in particular, has not been looked into in explicit terms till date with the exception of Weinstein et al (2004). But, in the process we also identify a few studies that have explored the unconditional probability of death from lung-cancer. Studies such

as Viscusi (1990, 1997), Viscusi and Hakes (2008), Lundborg (2007, 2008), Liu and Hsieh (1995), and others, had estimated either the probability of occurrence of lung-cancer from smoking or the unconditional probability of premature death of a smoker from lung-cancer, as perceived by survey-respondents. Baghal (2011) provides a list[32] of smoking-related surveys which estimated these two kinds of probabilities (that of lung-cancer occurrence or that of unconditional mortality from the disease). For the purpose of our analysis, we reorganize the said list (see Table 22) to see how estimated mean risk-perceptions on account of these two probabilities differ across two broad categories of surveys: (i) surveys which estimated disease occurrence risk and (ii) those which explored the unconditional mortality risk. Note that the surveys listed in Table 22 differ not just with regard to the type of probability elicited, but also with regard to the modes these surveys were conducted in, survey methodologies (viz. use of a 'probe' in risk-questions or the absence of it) etc. Such varied survey features make a comparison of risk-estimates (on the two probabilities) difficult across any two surveys. However, we attempt at a few reasonable comparisons. Viscusi and Hakes (2008) (See list on Table 22) used two surveys in 1997 and 1998 which were mostly similar (both were telephonic and used 'probes' in risk-questions), but evaluated the probability of disease occurrence and that of unconditional mortality respectively. It is observed that the risk-estimates derived from these surveys were almost identical even though the particular probability assessed differed across the surveys. The Annenberg Perception of Tobacco Risk Survey II (1999-2000) for adults, which also assessed the unconditional probability of death from lung cancer, obtained risk-estimates

[32] See Baghal (2011, p. 2, Table 1)

similar to those in Viscusi and Hakes (2008)[33]. Considering all such surveys as listed in Table 3.5, we find that the probability estimates obtained from the surveys largely suggest that individuals misperceive, by a huge margin, the true chances or probability pertaining to both aspects of smoking-related health-risks. Thus, both the probability of getting lung cancer and the unconditional probability of a smoker dying from the disease are highly overestimated.

Recall our observation that past surveys have not explicitly looked into the probability of conditional mortality from lung-cancer due to smoking. [34] Thus, at this juncture, we focus our attention on this dimension of health-risk and compare the same to the other two risk-aspects that past works have already assessed. The unconditional probability of dying from any disease, as it is defined, is the product of the probability of occurrence and the probability of death, conditional upon the disease having occurred. Thus, following the rules of probability, such a product will be smaller than each of the two constituent probabilities. Even though the product (i.e. the unconditional probability of mortality) and one of the constituent probabilities (probability of disease occurrence) have been found to be over-estimated (and, in fact, found to be close to each other) in past studies, the other constituent probability (i.e. probability of conditional mortality) has largely remained unexplored so far. This leads us to contemplate that

[33] See Table 22

[34] A study by Weinstein et al (2004) did recognize the necessity of asking respondents about the conditional mortality of lung cancer. However, the questions seem to focus on the curability of lung cancer rather than premature mortality from lung-cancer, which is actually the 'severity' aspect of the disease. The following questions in the study pertained to mortality from lung-cancer: 1) "once someone gets an illness, there are three possible outcomes: They might get cured; or they might die from the illness; or they might not get cured but die of something else. Out of 100 people who get lung cancer, how many do you think get cured? Your best estimate is fine. How many people out of 100 who get lung cancer do you think die from it? Your best estimate is fine." 2) Once a person is diagnosed with lung cancer, how many years do you think he or she typically lives: 1 or 2 years, 3 to 5 years, 6 to 10, 11 to 20, or more than 20 years? The study reported conditional mortality to be underestimated. Even though lung cancer can be mostly attributed to smoking, these questions, however, seem to ask about mortality from lung cancer in general and not necessarily from lung cancer contracted due to smoking. Also, the question about the loss of life expectancy does not control for baseline life expectancy or the life expectancy of people without lung cancer.

the assessment of individuals' beliefs on just one aspect of risk in isolation (as what the existing surveys have done) may not always provide an accurate representation of perceptions. We, thus, envision the potential importance of an exercise that could jointly assess these probabilities.

For empirically inquiring into the plausible influence of a joint inclusion of both of the risk-aspects (i.e. the constituent probabilities) on derived perceptions, we make use of the dataset obtained from the Family Heart Disease and Prevention Survey (November 2010-March 2011). The latter provides a unique opportunity to explore two kinds of probabilities - namely the probability of disease occurrence and the probability of conditional mortality, with regard to lung-cancer from smoking. Also, estimates on these two probabilities, in turn, facilitate computation of the unconditional probability of mortality. This renders ours analysis more comparable to past studies.

3.5.1 Design of Survey Questions and Data

The Family Heart Disease Risk and Prevention Survey, focusing on different issues to children's health, was conducted on parents of children aged between 6 and 17. Between November 2010 and March 2011, data pertaining to 3155 respondents were collected from respondents comprising a combination of married and single parents. 966 parents in the sample are 'matched' to their spouses, i.e. both parents are interviewed about the same child. The survey design, in addition to ensuring that the respondent had a child in the required age-group, also screened respondents to confirm the absence of a history of any heart disorders. In order to ascertain the respondent's smoking status, respondents were asked if they had *smoked more than 100 cigarettes during their life time*, *smoked more than one cigarette per day in the last one month*, *the number of packs of cigarettes usually smoked in a day,* and if they *had stopped*

smoking altogether. This helps in categorizing respondents into different groups, viz. 'current-smoker', 'former-smoker' or 'never-smoker'. In this section, we consider a respondent to be a 'current-smoker' if he or she has smoked more than 100 cigarettes during his or her lifetime and has not quit altogether. Those who have "stopped smoking altogether" are categorized under the 'former-smoker' group. The rest comprise the 'never-smoker' category. 12% of the respondents have been found to be 'current-smokers'; 20% are classified as 'former-smokers' and 67% clubbed under 'never-smokers'.

A computer-assisted risk-metric, for assessing perceptions on the probability of getting lung-cancer from smoking, was used as follows. Each respondent was asked the question: *Think about a group of 100 average or typical smokers, who smoke cigarettes for all of their adult lives. How many smokers out of 100 do you think would get lung cancer?* The respondent was provided with an interactive grid with 100 blue squares marked 1-100 starting from the upper left hand corner of the grid. If the respondent selected a square, all squares from 1 to the one she selected, would turn to red, indicating her level of perceptions on the particular risk presented. Answers could be changed as many times as the respondent wished before she would finalize her decision of square-selection, by clicking onto the 'next' button. If the respondent did not choose a square in reply to the risk-question, she was asked the question: *Do you think that any smokers out of 100 would get lung cancer*? A "Yes" would lead to the repetition of the original risk-question (and the provision of the interactive grid) but a "No" would lead to skipping of both risk-questions (pertaining to disease occurrence and conditional mortality) altogether.

Following the above question on health-risk occurrence, respondents' perceptions on conditional mortality from lung cancer due to smoking were assessed. The question presented to each respondent was worded as: *Now please consider a group of 100 smokers who are*

diagnosed with lung cancer. Some smokers who get lung cancer live longer than five years, and others die within five years. Out of 100 smokers who are diagnosed with lung cancer, how many do you think would die of lung cancer within five years of being diagnosed? The interactive grid followed and the respondent was then required to click on the square that best represented her perceptions on conditional mortality risks.

3.5.2 Conditional and Unconditional Probabilities of a Smoker Dying from Lung-Cancer: A Comparison

The above survey design in Section 3.5.1 helps in the computation of the unconditional or the compound probability of mortality from lung-cancer, combining estimates for the probability of getting lung-cancer from smoking and the conditional probability of dying from it. The mean estimate for the probability of getting lung-cancer is .5143 while the conditional probability of dying from it is .5489. Compared to the objective risk estimates of conditional mortality (.80-.90, American Cancer Society) subjective perception figures on the same are found to be underestimated. On the other hand, perceptions on the occurrence of lung-cancer from smoking are overestimated in our analysis (objective risk of occurrence being less than .20). These two estimates, when multiplied with each other, yield the unconditional probability of mortality as .2973. Our mean estimate of perceptions on unconditional mortality from lung-cancer is found to be larger than the objective risk on the same. Also, the margin-of-error, in our case , is much smaller as compared to the margins-of-error arrived at in past studies where the unconditional probability of lung-cancer mortality was estimated as single numerical estimate, rather than through a joint assessment of the constituent risks which we do.

At this juncture, it is important to note that the objective risk of conditional mortality from lung-cancer is substantially higher than the objective probability of contracting it due to

smoking (American Cancer Society, 2010). Thus, it is of significance to enquire if our results on the perceived counterparts of such risks follow the objective relationship. Quite in keeping with our expectations, on the average, the conditional probability of a smoker dying from lung-cancer (.5489), in our sample, is found to be greater than the probability of getting lung-cancer due to smoking (.5143), at 1% level of significance. Following up on this result, now it is of interest to explore if the same relationship between risks of conditional mortality and disease occurrence holds for each respondent in the sample. In order to study the same, we construct a two-way table (see Table 12) to show how respondents are distributed based on their beliefs about these risks.

Table 12: Distribution of Respondents based on their Perception of the risk of getting lung cancer from smoking and dying from it conditional upon getting it.

		Probability of dying from lung cancer conditional on getting Lung Cancer due to smoking									
Probability of getting lung cancer	**Intervals**	**0-10**	**11-20**	**21-30**	**31-40**	**41-50**	**51-60**	**61-70**	**71-80**	**81-90**	**91-100**	**Total**
	0-10	39	8	8	11	24	9	8	27	11	6	151
	11-20	20	12	19	28	32	12	13	40	10	1	187
	21-30	37	44	40	28	72	30	29	60	14	13	367
	31-40	14	40	56	37	88	37	46	85	16	5	424
	41-50	10	22	123	59	148	36	33	127	20	12	590
	51-60	4	12	37	31	61	32	31	75	27	8	318
	61-70	4	6	18	46	88	27	29	79	35	13	345
	71-80	3	9	26	38	172	42	48	106	65	31	540
	81-90	1	1	2	7	22	13	14	33	15	20	128
	91-100			3	1	31	6	5	20	11	23	100
	Total	132	154	332	286	738	244	256	652	224	132	3150

Consider Row 1 of Table 12 as an example. Of the 151 respondents who reported the probability of getting lung-cancer from smoking to be lying between 0 and 10, only 39 believed that someone detected with lung-cancer due to smoking would have the same probability (i.e.,

0-10) of dying from the disease. The remaining 112 (74% out of 151) responses are distributed across class-intervals indicating a higher conditional probability of mortality, as compared to the probability of disease occurrence. Thus, along Row 1 of Table 12, 74% of the respondents' beliefs conform to the objective relationship between risks of disease occurrence and conditional mortality. In Table 13 below, for each class-interval of the probability of disease occurrence (Column 1), we compile the number of respondents who reported the risks of conditional mortality to be greater than the risks of disease occurrence (See Columns 2 and 3, Table 13).

Table 13: Distribution of Respondents across the probability of getting Lung Cancer

		P(D/LC)* > P(LC)**		P(D/LC) < P(LC)	
	Intervals	**# of Respondents**	**Rel. Freq**	**# of Respondents**	**Rel. Freq**
Probability of getting lung cancer	**0-10**	112	0.74		
	11-20	155	0.83	20	0.11
	21-30	246	0.67	81	0.22
	31-40	277	0.65	110	0.26
	41-50	228	0.39	214	0.36
	51-60	141	0.44	145	0.46
	61-70	127	0.37	189	0.55
	71-80	96	0.18	338	0.63
	81-90	20	0.16	93	0.73
	91-100			77	0.77
	Total	1402		1267	

*P(D/LC)=Probability of a smoker dying in the next five years conditional upon getting Lung Cancer
**P(LC)=Probability of getting Lung Cancer

Likewise, respondents having beliefs that conditional mortality risks were less than disease occurrence risks are compiled over Columns 4 and 5 (Table 13). Combining results in all the columns, we find that while 1402 respondents (out of the total of 3150) conformed to the objective relationship on risks (in terms of conditional mortality risks being higher than the disease occurrence likelihood i.e., P[D/LC] > P[LC]), a sizeable portion of the sample (1267

respondents accounting for 40 % of the sample) reported beliefs in a manner that failed to satisfy the objective relationship (i.e. for these respondents, P[D/LC] < P[LC]). Thus, even though the objective risk relationship is confirmed for the sample on average, the same fails to hold for a substantive part of the respondents who perhaps do not quite appreciate the fatality risks of lung-cancer from smoking.

Thus, the important observations can be summarized as follows. (i) Past studies found unconditional mortality risks to have been overestimated, (ii) Our analysis reveals unconditional mortality risks, obtained as a product of the perceived risk of disease occurrence and the perceived conditional mortality risk, to be overestimated too, (iii) Disease-occurrence risks are overestimated in our study, while (iv) Perceived conditional mortality risks (which our study looks into unlike past studies) are underestimated. The underestimation of conditional mortality risks, together with our illustration that many of the respondents do not perceive the fatality of lung-cancer as is objectively required, may lead one to contemplate the importance of considering conditional mortality risks in any smoking-related risk-assessment exercise. Thus, we argue that a consideration of individuals' responses on only one kind of probability (among the three alternative measures viz. probability of disease occurrence, the unconditional probability of mortality and conditional probability of mortality) may generate a partial representation of the level of smoking-related risk-perceptions prevailing in the society. Depending on which probability is considered, policy implications for smoking-control efforts may substantively diverge. On one hand, an analysis of overestimated disease occurrence risks (or overestimated unconditional mortality risks derived as a single estimate instead of the product form we employ) may indicate that a substantive amount of smoking-related awareness already exists in the society. On the other hand, a consideration of the conditional mortality risks

only, which are, in fact, under-estimated, may reveal that people may still not fully perceive the adverse health-effects from smoking. Thus, we contend that these probability measures need be jointly analyzed for an effective understanding of people's overall attitudes towards different dimensions to smoking-related risks. This can, in turn, inform comprehensive policy prescriptions.

Our contention gathers evidence from the following empirical exercises. In the next section, using the probability of disease occurrence (i.e. P[LC]) and the conditional probability of mortality (i.e. P[D/LC]) as alternative measures of risk perception, we assess how each of them impacts the likelihood of smoking (i.e. the smoking status) for the respondents.

3.5.2.1 Prediction of Smoking Behavior Using Alternative Measures of Risk-Perception

In the last section we demonstrated how the probability of disease occurrence is found to be overestimated in our sample while the probability of conditional mortality is underestimated. We, thus, argued that the consideration of any one measure of risk-perception in isolation, may generate divergent policy implications. In this section, it is shown that each of these two probabilities, in fact, impacts the likelihood of smoking in the same manner and hence predicts smoker's behavior identically. Our empirical exercise in this section, thus, in conjunction with our earlier results on underestimation/overestimation of these two risks, provide strength to our argument that consideration of both of these risk-aspects in the analysis of smoking behavior may be worthwhile.

The empirical exercise proceeds as follows: Two separate probit equations are estimated. One for each measure of risk perception assessed using the probabilities of lung-cancer occurrence and the conditional mortality of lung-cancer. The underlying aim remains in

exploring if beliefs on each such risk significantly determine the likelihood of smoking. Next, predicted probabilities (Long, 2009) are constructed using the probit-estimates to facilitate a comparison. Such a comparative exercise reveals if the manner in which the probability of disease occurrence impacts smoking likelihood is identical to the way the other probability, viz. the conditional mortality, does so. Ultimately we infer that the impacts are, in fact, identical.

3.5.2.2 Estimation of Separate Probit Equations for Two Alternative Risk Measures

We assume that an individual solves an expected utility maximization exercise to decide whether to smoke or not. A person will choose (not) to become a smoker if the net-benefit from smoking [i.e., the monetized expected utility gain minus the expected cost of smoking] is positive (negative). While the perceived net-benefit of smoking is latent, smoking status ($SMOKER_i = 1$ if the i^{th} respondent is a smoker; $SMOKER_i = 0$ otherwise) is observed. Smoking status, in turn, is expressed as a function of variables that determine the net-benefits of smoking, and is given as

$$SMOKER_i = \delta RISK_i + X_i^T \gamma + v_i \quad (3.1)$$

Also in this regard, recall that in Section 3.5.1 the smoking status of an individual was classified into: 'current-smoker', 'former-smoker' or 'never-smoker'. In equation (3.1), the explanatory variables which determine the net-benefits are (i) perceived health-risks *(RISK*) and (ii) a vector of controls (*X*). Two alternative assessments of the level of risk-perceptions *RISK* are considered, namely, (i) the probability of getting lung-cancer from smoking and (ii) the probability of dying conditional upon having contracted lung-cancer from smoking. Equation (3.1) is estimated using a probit model for each of the probabilities. In equation (3.1), *X* includes the socio-economic and demographic factors such as age, gender, race, household-size, marital status, employment status, education, income and number of children of different age-groups in the household. We account

for the variation in education and income by considering separate variables for different categories of these two explanatory variables. We also control for the State in which the respondent resides to take account of the inter-state price differences and varied smoking restrictions. Different age-groups for children are also considered as explanatory variables. The age of child could have a possible influence on the smoking behavior of the parents. However, those respondents who are 'matched' to their respective spouses in the dataset (i.e., the cases when both parents were interviewed with regard to the same child) are not considered in our empirical analysis. A consideration of the 'matched' parents would imply that some of the error terms in equation (3.1) are correlated to each other. This violates the assumption of the v_i term being independently identically distributed. Thus, our sample is made of 2189 sample-points, comprising single and married 'unmatched' parents only.

In our analysis, the parameter δ, indicating the strength of association between risk-perception, *RISK*, and smoking status, is of prime focus. δ is expected to be negative intuitively. As perceived health-risk increases, the cost of smoking increases, and thus, reduces the likelihood of an individual being a smoker. Ideally, we want to compare the value of δ (or even the associated marginal effects) corresponding to alternative assessments of *RISK* (i.e. the two kinds of probabilities under consideration). However, probit estimation yields only the standardized coefficients of the parameters. Thus, a comparison of structural parameters of interest across two probit models is not meaningful.

3.5.2.3 Use of Predicted Probabilities and a Comparative Exercise

In order to compare the impact of *RISK* on the smoking-status of an individual across alternative assessments of *RISK* (i.e. the probability of disease occurrence and the conditional probability of

mortality) we use predicted probabilities which are constructed on the basis of the probit estimates (See Table 23 for a list of the estimated probit coefficients). The predicted probabilities are invariant to the scale by which the parameters are standardized and hence, facilitate the comparison that we intend.

The two curves in Figure 4 represent the predicted probabilities corresponding to the two alternative measures of *RISK*, considering our entire sample. The blue line denotes the predicted probability in the context of the probability of disease occurrence. On the other hand, the red line represents the predicted probability with the conditional probability of mortality as the reference. Each predicted probability curve illustrates the impact of a measure of *RISK* (i.e. a particular probability) on the likelihood of smoking and is negatively-sloped. Thus, in the full-sample, for each of the two *RISK* measures, as the level of risk-perception increases, the likelihood of smoking decreases.

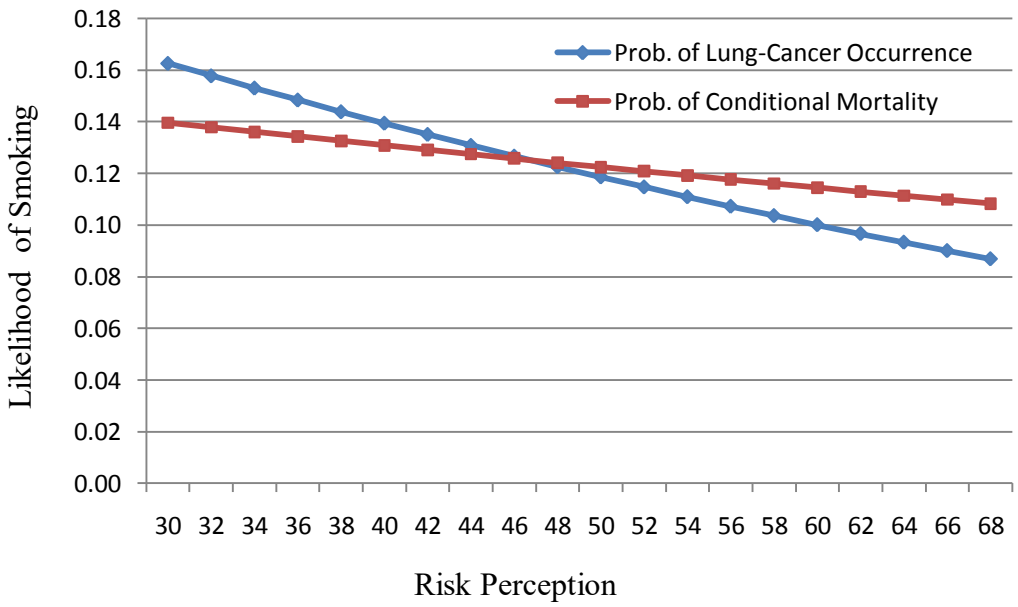

Figure 4: Predicted Probabilities for Alternative Measures of RISK (Full Sample)

At any given level of risk-perception in Figure 4, the difference between the two predicted probabilities is tested and found not to be statistically different from zero. Thus, in essence, the probability of contracting lung-cancer and the conditional probability of mortality from the disease predict smoking behavior in an identical manner.

We repeat the above procedure considering only those respondents in our sample who are 'current-smokers' and 'never smokers'. Thus, two probit equations are estimated for this group of respondents corresponding to two alternative *RISK* measures. The probit estimates are reported in Table 24. Figure 5 presents the two said predicted probability curves constructed using the respective probit estimates. As in the full sample, here too, we find that at a given level of *RISK*, the difference between the predicted probabilities (corresponding to the two alternative *RISK* measures) is statistically insignificant at conventional levels of significance.

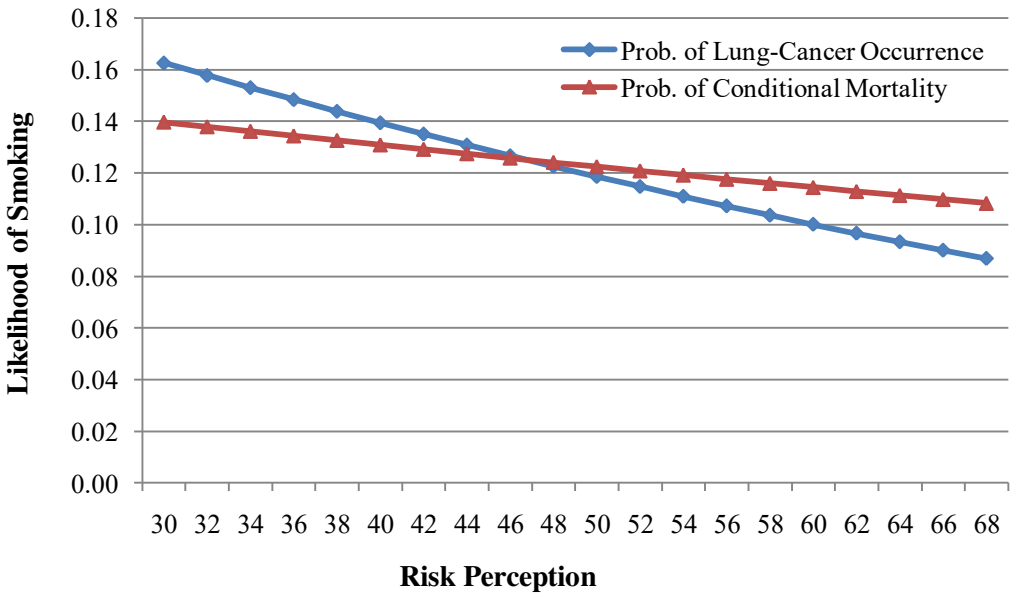

Figure 5 : Predicted Probabilities for Alternative Measures of *RISK* (Sample of Current & Never Smokers)

3.5.2.4 Discussion and Policy Implications

Our analyses in the previous sub-sections (in Section 3.5.1) and the above empirical exercise yield the following. Individuals' subjective assessments of beliefs on either risk-aspect (i.e., the probability of lung-cancer occurrence and conditional probability of mortality from the disease), even though erroneously evaluated, can be effectively used to predict smoking behavior. Although our results corroborate the findings of previous studies (such as Viscusi, 1990) that over-estimated disease occurrence risks could predict smoking behavior, we arrive at an additional interesting inference. It is found that under-estimated conditional mortality risks can also be used to effectively predict smoking behavior. More importantly, the two probabilities predict the likelihood of smoking in a statistically identical manner. Thus, we argue that a consideration of individuals' responses on only one kind of probability (between the probability of disease occurrence and that of conditional mortality) may generate a partial representation of the level of smoking-related risk-perceptions prevailing in the society. Depending on which probability is considered, policy implications for smoking-control efforts may diverge. On one hand, while an analysis of overestimated disease occurrence risks may indicate that a substantive amount of smoking-related awareness already exists in the society, on the other, consideration of the conditional mortality risks, which are, in fact, under-estimated, may reveal that people may still not fully perceive the adverse health-effects from smoking. Thus, we contend that both these risks may jointly be analyzed for effective policy prescriptions.

3.6 Conclusion

In this chapter we exclusively focus on the issue of quantitative assessment of perceptions of health-risks from smoking. Of particular interest is the use of variants of a metric – namely, a survey question – which has commonly featured in academic studies on smoking behavior, starting with Viscusi (1990). Interestingly, this chapter traces the use of such a metric in industry surveys as well, some even dating back to the year 1964 (Baghal, 2011). This allows us an opportunity to review select documents of the tobacco industry, which have particularly made use of this question in field surveys. In the process, we analyze the implications of different features of this metric for the perceived risk-estimates obtained from these surveys. More precisely, we explore the likely implications of a 'probe', an explicit appearance of the 'Don't Know' option (or the absence of the same) etc, in risk-questions. Besides, the implications of different survey modes (viz., telephone or face-to-face,) are discussed. This select review of industry records makes clear that the two aspects of health-risks from smoking – the risk of contracting a smoking-related disease, as against the risk of dying conditional upon getting affected – have not been jointly explored so far. Also, past studies have only looked into the probability of disease occurrence or the unconditional probability of mortality from lung-cancer. Thus, we identify that perceptions on the risk of conditional mortality have still scope to be analyzed which can, in turn, provide new insights for smoking-related risk assessments.

The dataset obtained from the Family Heart Disease and Prevention Survey (November 2010 - March 2011), provides us a unique opportunity to explore the stated probabilities, particularly with respect to the risk of lung-cancer from smoking. Both the probabilities of lung-cancer occurrence and that of conditional mortality are computed. These, in turn, help us estimate the unconditional probability of mortality too, following the rules of probability. This

renders our analysis comparable to past survey results. Our finding, that the lung-cancer occurrence risks are overestimated as compared to objective risks, is in conjunction with past studies like Viscusi (1990, 1991). Also, by constructing predicted probabilities (Long, 2009) we find that overestimated disease occurrence risks significantly (and negatively) influence the likelihood of smoking. Another result of significance follows. We find that conditional mortality risks are underestimated in our sample in comparison with objective risks. Making use of predicted probabilities, we also confirm that the underestimated conditional mortality risks significantly impact the likelihood of smoking. Owing to conditional probability of mortality not being analyzed so far, this observation of ours comprises a potential contribution to the literature. In this regard, we also empirically enquire if the probability of lung-cancer occurrence and the conditional probability of mortality impact the smoking likelihood (and hence, predict smoking behavior) in an identical manner. Statistical tests of the difference between the predicted probabilities reveal that, in fact, both the probabilities (that of lung-cancer occurrence and of conditional mortality) impact smoking likelihood identically.

Thus, we argue that a consideration of individuals' responses on only one kind of probability (between the probability of disease occurrence and that of conditional mortality) may generate a partial representation of the level of smoking-related risk-perceptions prevailing in the society. Therefore, both these risks may be jointly analyzed for effective policy prescriptions.

APPENDIX A: TABLES

Table 14: Mean Risk Perceptions by Split-Sample

	Health effects occur sooner (More Immediate)	Health effects occur later (Less Immediate)	Total
Less Difficult to quit smoking	48.45	41.06	45.28
More difficult to quit smoking	53.75	46.89	51.31
Total	51.33	44.13	48.54

Table 15: Frequency Distribution of Parents' Perceived Leukemia Risks (n=815).

Risk Range (chances in 1000)		Lifetime Risk of Getting Leukemia				Conditional Risk of Dying from Leukemia	
		Initial		Revised			
		Parent	Child	Parent	Child	Parent	Child
0-	49	402	412	586	603	183	210
50-	99	107	99	76	75	45	74
100-	149	123	102	60	61	73	81
150-	199	34	44	20	15	29	33
200-	249	41	40	22	16	50	66
250-	299	40	47	20	15	80	58
300-	349	23	22	10	9	50	45
350-	399	7	4	3	4	11	14
400-	449	6	14	5	5	23	21
450-	499	0	4	0	0	8	9
500-	549	21	19	7	8	142	101
550-	599	1	2	0	0	3	6
600-	649	3	0	1	1	20	4
650-	699	0	1	0	0	5	5
700-	749	1	2	1	1	13	15
750-	799	1	1	1	1	32	39
800-	849	0	0	0	0	18	10
850-	899	0	0	0	0	8	5
900-	949	1	0	0	0	12	7
950-	999	3	2	2	1	8	11
	1000	1	0	1	0	2	1
	Median	50	37	13	13	250	200
	Mean	96	97	56	50	299	258
	Std. Dev.	141	135	109	97	261	255

Table 16 : Parents' Perceived Leukemia Risks Categorized on the basis of Smoking Status: Means (Standard Deviations) of Chances per 1000.

	Lifetime Risk of Getting Leukemia				Conditional Risk of Dying from Leukemia	
	Initial		Revised			
	Parent	Child	Parent	Child	Parent	Child
Never Smokers (n=534)	93 (141)	97 (134)	53 (116)	52 (104)	278 (250)	249 (249)
Former Smokers (n=188)	82 (106)	86 (116)	48 (76)	40 (70)	324 (270)	274 (260)
Current Smokers (n=93)	144 (187)	119 (172)	87 (118)	62 (107)	365 (290)	278 (283)

Table 17: Proportion of Parents Categorized on the basis of Smoking Status Who Would Purchase Vaccines to Reduce Leukemia Risks.

	Risk of Getting Leukemia	Conditional Risk of Dying from Leukemia
Never Smokers (n=534)	0.47	0.65
Former Smokers (n=188)	0.48	0.66
Current Smokers (n=93)	0.66	0.74
Full Sample (n=815)	0.49	0.66

Table 18: Classification of findings as "assets" and "liabilities" – Roper (1978)

"ASSETS"	"LIABILITIES"
1. The overall saliency of the "cigarette issue" is low. Compared to crime, drugs, pollution, and a half a dozen other items, smoking is at the bottom of the list of personal concerns.	1. More than nine out of every ten Americans believe that smoking is hazardous to a smoker's health.
2. There is little sentiment for a total ban on cigarette smoking in public places (but see #3 under "Liabilities").	2. A majority of Americans believes that it is probably hazardous to be around people who smoke even if they are not smoking themselves.
3. There is overwhelming approval of placing notices outside places that restrict cigarette smoking.	3. There is majority sentiment for separate smoking sections in all public places we asked about.

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Classification of findings as "assets" and "liabilities" – Roper (1978)

"ASSETS" (continued)

4. Few people favor job discrimination based on cigarette smoking.

5. The percentage of smokers in the 17 to 24 year old age group is up, and the amount smoked per day per young smoker is also up (but see #5 under "Liabilities").

6. There is broad support for FTC regulation of "public service" advertising sponsored by non-profit groups like the Cancer Society and Ralph Nader.

7. There is less than majority sentiment in favor of a graduated tar cigarette tax.

"LIABILITIES" (continued)

4. There is majority acceptance of the idea that the cigarette warning label should be made stronger and more specific.

5. The percentage of people who smoke cigarettes is at the lowest level measured in the past ten years.

6. A steadily increasing majority of Americans believes that the tobacco industry knows that the case against cigarettes is true.

7. Favorable attitudes toward the tobacco industry are at their lowest ebb.

8. There is widespread support for anti-smoking education in the schools--and at the very early years.

9. Two-thirds of smokers would like to give up smoking.

10. Nearly half the public thinks that smoking is an addiction.

11. More people say they would vote for than against a political candidate who takes a position favoring a ban on smoking in public places.

Table 19: PercentageDistribution of Responses for the survey question "Out of 100 smoking how many will get lung cancer?" in the Roper (1977, 1980) Reports

Year	1980*	1977**
0-10	29	13
11-20	13	8
21-30	13	14
31-40	8	9
41-50	13	20
51-60	3	6
61-70	2	4
71-80	4	9
81-90	1	3
91-100	1	2
Don't Know/ No answer	14	12
Mean	26.25	42.58
smokers	20.1	37.54
Non smokers	29.68	45.01

* A study of Public attitudes toward cigarette smoking and the tobacco industry Vol I 1980, *Prepared for the Tobacco Institute*
** A Four Part Survey about the American Cancer Society and the American Lung Association, *Prepared for the Tobacco Institute*

Table 20: Respondent Attitude on Smoking, Associated Illnesses and Loss of life: Roper (1968-1984)

Survey Questions	Cigarette smokers have more of certain illnesses			Smoking as cause of illness		Smokers don't live as long		
Survey Year	Definitely true	Probably true	Possibly true	major cause	only one cause	Definitely True	Probably True	Possibly True
1968				20%	50%	11%	20%	
1970	30%	26%	26%	24%	52%	16%	28%	29%
1972	30%	26%	26%	21%	54%	15%	26%	30%
1974	31%	27%	27%	23%	55%	18%	28%	32%
1976	31%	27%	24%	23%	51%	18%	28%	29%
1978	33%	29%	23%	27%	51%			
1980	35%	27%	23%	29%	50%	24%	28%	24%
1982								
1984						34%	26%	19%

Table 21: Respondent Attitude on Self-Selection and Hazardousness of Smoking: Roper (1968-1984)

Survey Question	Smokers don't live as long		How hazardous smoking is to health		
Survey Year	Because they smoke	Because of the kind of people they are	isn't Hazardous	only heavy smoking	any amount is hazardous
1968					
1970	41%	22%	5%	45%	47%
1972	36%	23%	6%	42%	48%
1974	42%	23%	4%	39%	54%
1976	40%	22%	4%	38%	54%
1978			5%	31%	61%
1980	44%	22%			
1982					
1984	55%	17%			

Table 22: Estimates of Probability of getting lung cancer and Unconditional probability of dying from Lung Cancer - Reconstructed from Baghal (2011)

Probability of Contracting Lung Cancer due to Smoking					
Survey Year	Source	Mean Estimate (Out of 100) of contracting Lung Cancer	Survey Interview Mode	Use of Probe?	Age-Group
1964	(Industry)	16.4	Face-to-Face	No	17 and older
1977	(Industry)	45.6	Telphone	Yes	17 and older
1980	(Industry)	26.3	Face-to-Face	Yes	17 and older
1985	(Viscusi 1990)	42.6	Telphone	Yes	16 and older
1997	(Viscusi and Hakes 2008)	47.2	Telphone	Yes	18 years and older
2000	(Krosnick 2001)	43.4	Telphone	No	19 years and older
Unconditional probability of Dying from Lung cancer caused by Smoking					
Survey Year	Source	Mean Estimate (Out of 100) of dying from Lung Cancer			
1991	(Viscusi 1992)	38.0	Telephone	NA	Not Available
1998	(Viscusi and Hakes 2008)	47.6	Telephone	Yes	18 yrs and older
1999	(Annenberg 2 youth)	60.4	Telephone	No	14-22 years old
1999	(Annenberg 2 Adult)	48.5	Telephone	No	23 years and older
1995	(Sutton 1998)	19.0	Face-to-Face	No	16 years and older

Table 23: Probit Estimates under Alternative estimates of Risk Perception (Full Sample)

Variables/Risk Perception Measure	Mean	Conditional Probability of dying	Probability of getting Lung Cancer
Constant		0.655	0.991*
		(0.471)	(0.478)
Age	42.31	-0.013	-0.016*
		(0.007)	(0.007)
=1 if Male, 0 otherwise	0.27	0.106	0.080
		(0.091)	(0.092)
=1 if White, 0 otherwise	0.77	0.205*	0.165
		(0.095)	(0.096)
=1 if has a High School Degree, 0 Otherwise	0.12	-0.577	-0.516
		(0.303)	(0.306)
=1 if has Technical Education after High School, 0 Otherwise	0.03	-0.306	-0.243
		(0.330)	(0.333)
=1 if has some College Education, 0 Otherwise	0.32	-0.696*	-0.656*
		(0.295)	(0.298)
=1 if has a College Degree, 0 Otherwise	0.32	-1.139**	-1.098**
		(0.30)	(0.31)
=1 if has a Graduate Degree, 0	0.21	-1.325**	-1.325**
		(0.32)	(0.32)
=1 if $5000 <Income <$30,000,	0.12	0.183	0.144
		(0.257)	(0.258)
=1 if $30,000 <Income <$70,000,	0.34	0.134	0.078
		(0.257)	(0.257)
=1 if $70,000 <Income <$125,000,	0.33	-0.095	-0.145
		(0.267)	(0.267)
=1 if Income > $125,000,0 Otherwise	0.19	-0.169	-0.259
		(0.286)	(0.287)
=1 if Employed, 0 Otherwise	0.73	-0.136	-0.147
		(0.091)	(0.092)
=1 if Married, 0 Otherwise	0.78	-0.443**	-0.443**
		(0.102)	(0.103)
Size of the Household (hh)	2.12	-0.374*	-0.396*
		(0.168)	(0.170)

*significant at 5%
**significant at 1%

Probit Estimates under Alternative estimates of Risk Perception (Full Sample)

Variables/Risk Perception Measure	Mean	Conditional Probability of dying	Probability of getting Lung Cancer
Number of Children of ages 2-5 in the household	4.18	0.339 (0.191)	0.369 (0.193)
Number of Children of ages 6-12 in the household	1.02	0.200 (0.174)	0.243 (0.177)
Number of Children of ages 13-17 in the household	0.66	0.236 (0.177)	0.271 (0.180)
No. of Adults (> 18 years old) in the household	4.18	0.444* (0.178)	0.477* (0.181)
Risk Perception	30.30	-0.004** (0.002)	-0.009** (0.002)
Sample Size	2189		

*significant at 5%
**significant at 1%

Table 24: Probit Estimates under Alternative estimates of Risk Perception (Sample of Current-Smokers and Never-Smokers)

Variables/Risk Perception Measure	Mean	Conditional Probability of dying	Probability of getting Lung Cancer
Constant		1.154*	1.507**
		(0.537)	(0.543)
Age	42.09	-0.011	-0.014
		(0.007)	(0.008)
=1 if Male, 0 otherwise	0.26	0.167	0.132
		(0.099)	(0.100)
=1 if White, 0 otherwise	0.76	0.300**	0.248*
		(0.104)	(0.105)
=1 if has a High School Degree, 0 Otherwise	0.11	-0.951**	-0.843*
		(0.364)	(0.367)
=1 if has Technical Education after High School, 0 Otherwise	0.03	-0.433	-0.365
		(0.395)	(0.397)
=1 if has some College Education, 0 Otherwise	0.30	-1.053**	-0.978**
		(0.357)	(0.360)
=1 if has a College Degree, 0 Otherwise	0.33	-1.598**	-1.516**
		(0.36)	(0.37)
=1 if has a Graduate Degree, 0	0.22	-1.824**	-1.785**
		(0.38)	(0.38)
=1 if $5000 <Income <$30,000,	0.12	0.202	0.163
		(0.280)	(0.281)
=1 if $30,000 <Income <$70,000,	0.34	0.177	0.127
		(0.278)	(0.279)
=1 if $70,000 <Income <$125,000,	0.33	-0.066	-0.107
		(0.289)	(0.289)
=1 if Income > $125,000,0 Otherwise	0.19	-0.151	-0.236
		(0.308)	(0.309)
=1 if Employed, 0 Otherwise	0.73	-0.145	-0.152
		(0.099)	(0.100)
=1 if Married, 0 Otherwise	0.79	-0.548**	-0.556**
		(0.112)	(0.113)
Size of the Household (hh)	2.12	-0.432*	-0.442*
		(0.180)	(0.183)

*significant at 5%
**significant at 1%

Probit Estimates under Alternative estimates of Risk Perception (Sample of Current-Smokers and Never-Smokers)

Variables/Risk Perception Measure	Mean	Conditional Probability of dying	Probability of getting Lung Cancer
Number of Children of ages 2-5 in the household	4.20	0.400	0.421*
		(0.206)	(0.208)
Number of Children of ages 6-12 in the household	1.04	0.229	0.265
		(0.187)	(0.191)
Number of Children of ages 13-17 in the household	0.65	0.289	0.309
		(0.189)	(0.192)
No. of Adults (> 18 years old) in the household	4.20	0.512**	0.533**
		(0.193)	(0.196)
Risk Perception	30.53	-0.004**	-0.010**
		(0.002)	(0.002)
Sample Size	1726		

*significant at 5%
**significant at 1%

APPENDIX B: FIGURES

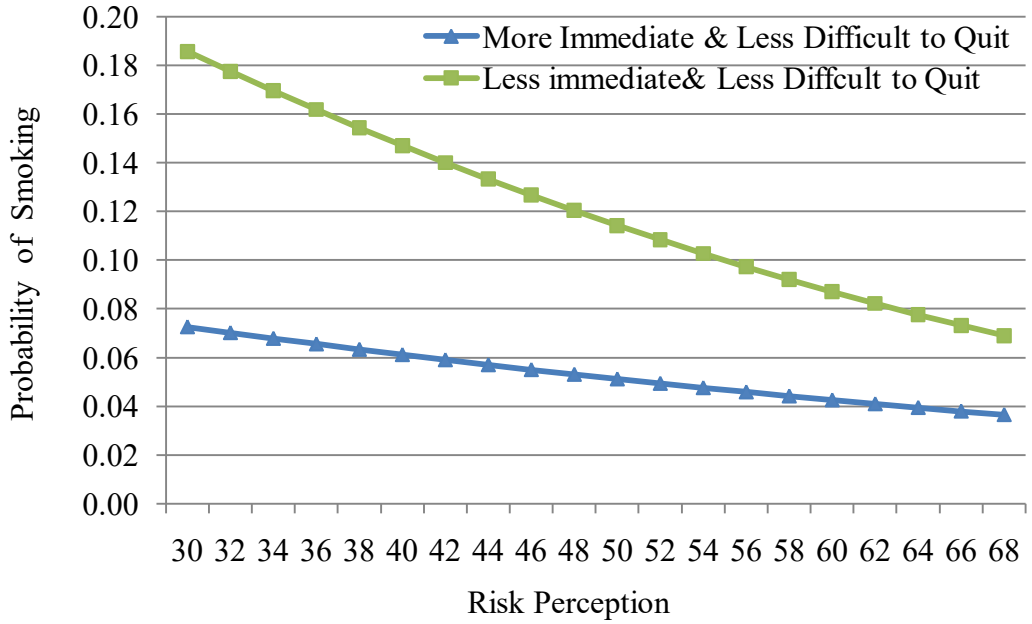

Figure 6: Predicted Probabilities for 'Less Immediate & Less difficult to Quit' and 'More Immediate & Less difficult to Quit' Categories

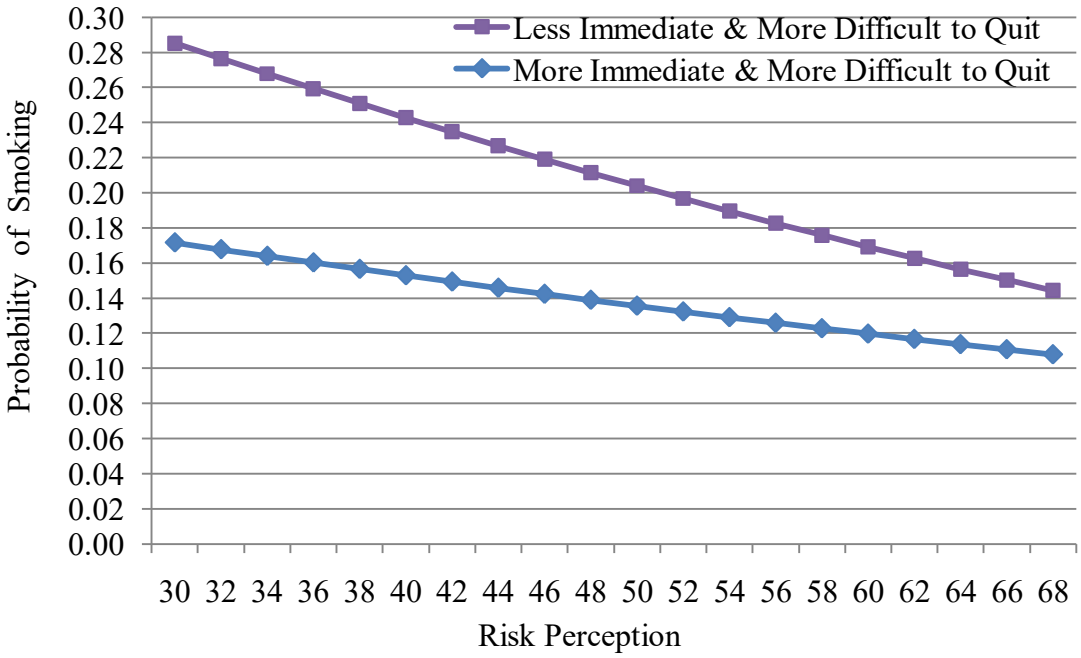

Figure 7: Predicted Probabilities for 'Less Immediate & More Difficult to Quit' and 'More Immediate & More difficult to Quit' Categories

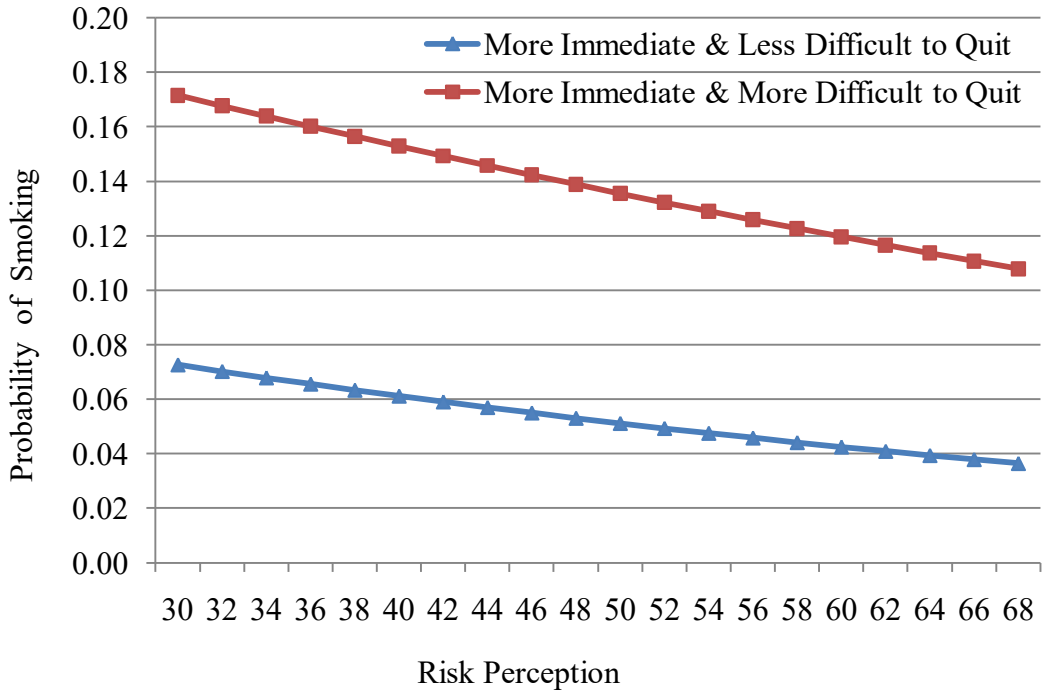

Figure 8: Predicted Probabilities for "More Immediate & Less Difficult to Quit' and 'More Immediate & More Difficult to Quit' Categories

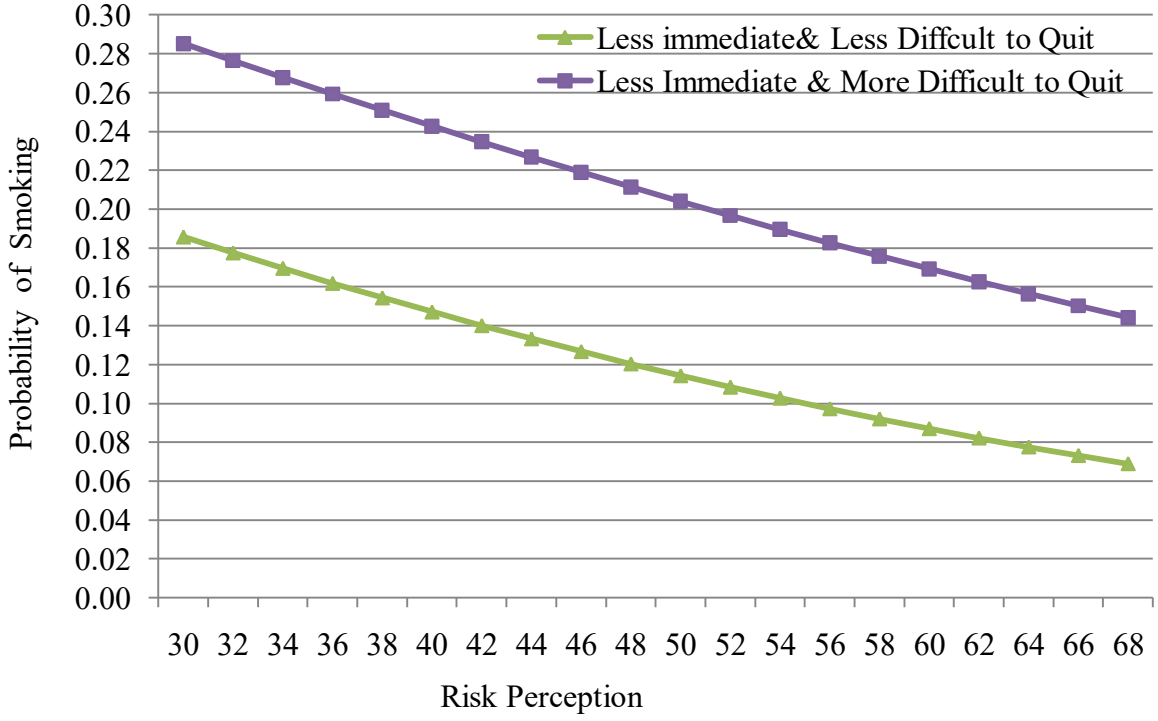

Figure 9: Predicted Probabilities for 'Less Immediate & Less difficult to Quit' and ' Less Immediate & More difficult to Quit' Categories

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