

**Americans' Perceptions of the Health Risks of Cigarette Smoking:
A New Opportunity for Public Education**

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Abstract

The public health community long ago declared victory in their effort to educate the American public about the health risks of cigarette smoking, because very large proportions of Americans recognize that smoking causes lung cancer and other serious diseases. Yet the public health community is also frustrated by the fact that the massive public education campaign they waged on this issue did not translate into bigger declines in rates of smoking in this country. In this paper, I explore the possibility of a provocative explanation for this seeming failure: although most Americans seem to recognize that smoking brings with it health risks, most people may underestimate the magnitudes of those risks, thereby muting the deterrent effects of those beliefs. By reviewing past studies of public beliefs about cigarettes' health risks and reporting the findings of a new study, I provide evidence that people's probability judgments are indeed out of line with medical evidence and that these probability judgments may be behaviorally consequential in a way that offers a handle for constructive future public health interventions. In reviewing this literature, I compare and contrast two ways in which people may think about the risk of taking an action: the risk difference and relative risk. This distinction seems likely to be useful for understanding cognition in other domains of risky choice as well.

Americans' Perceptions of the Health Risks of Cigarette Smoking: A New Opportunity for Public Education

Despite a seemingly endless flow of messages informing the American public about the health risks of cigarette smoking during the last fifty years, more than one quarter of Americans smoke regularly today, and there is no sign that this figure will shrink considerably in the near future. The health care costs and personal suffering by smokers and their loved ones that results from this behavior continue to be staggeringly huge, especially in light of the facts that the medical risks posed by smoking are now so well understood. The availabilities of pharmacological systems and social programs designed to help people to quit smoking are now so well-developed and widely-available as to suggest that the physiological addictiveness of tobacco can be overcome, even if not easily, giving smokers the ability to quit if they choose to do so. Why, then, do so many smokers choose not to try to quit, and why do young people continue to start smoking at alarming rates?

In this paper, I reconsider one possible explanation that in recent years has come to be viewed as implausible. According to this explanation, Americans do not truly recognize the health costs of smoking, and this underestimation of risk allows many people to take up the habit in the first place and allows them to be comfortable maintaining smoking once initiated.

On its surface, this explanation seems patently implausible. Of course, Americans now overwhelmingly recognize that smoking is dangerous, a skeptical observer might say. And indeed, there is some existing survey evidence that is consistent with this claim. And there is even survey evidence suggesting that most Americans overestimate the health risks of smoking.

But a careful look at the existing evidence on public opinion and at newly collected evidence indicates that in fact, most Americans underestimate the magnitude of the health risks associated with smoking, at least as gauged in one particularly consequential way.

I begin below by describing the findings of past surveys assessing Americans' perceptions of the health risks of smoking, differentiating judgments about whether people think smoking is risky at all from judgments about how risky it is. Because existing evidence was inadequate for assessing the latter perceptions, I conducted a new survey, the findings of which are described next. Taken together, this work offers some new insights into how Americans think about smoking in particular and raises interesting issues for the study of risk perceptions more generally.

Prior Survey Studies of Public Opinion on the Risks of Smoking

Many national surveys of representative samples of American adults have been conducted during the last five decades on perceptions of smoking and health issues. Some of these studies were sponsored by government agencies responsible for promoting the public's health. Other studies were sponsored by private organizations dedicated to public health promotion. And still other studies were sponsored by tobacco companies. Taken together, the results of these studies indicate that although large portions of Americans did not believe there were any health risks of smoking during the 1950s, this fraction has fallen precipitously. Nonetheless, even today, non-trivial portions of the American public do not recognize that smoking is risky.

For a person to be accurate in understanding the health risks posed by smoking, that person must (1) believe that smoking definitely increases a person's chance of contracting some specific diseases, such as heart disease, lung cancer, and/or emphysema, (2) accurately recognize

the extent to which a person's chances of contracting these diseases is increased by smoking, and (3) hold these beliefs with high confidence. Therefore, if a person says that smoking "might" increase a person's chances of contracting lung cancer, that would not be accurate, because smoking definitely increases a person's chances of contracting lung cancer.

One relevant series of surveys was conducted by the Gallup Organization. Respondents were asked, "Do you think that cigarette smoking is or is not one of the causes of lung cancer?" The proportion of respondents saying "is not" or "don't know" was 59% in 1954, 50% in 1957, 56% in 1958, 50% in 1960, 30% in 1969, 29% in 1971, 30% in 1972, 19% in 1977, 17% in 1981, 6% in 1990, and 8% in 1999.¹ The proportion of respondents saying "is not" or "don't know" in a comparable question about heart disease was 64% in 1957, 66% in 1958, 66% in 1960, 40% in 1969, 32% in 1977, 26% in 1981, 15% in 1990, and 20% in 1999.² Regarding cancer of the throat, the proportion of respondents saying "is not" or "don't know" was 21% in 1977, 19% in 1981, and 10% in 1999.³

In another series of surveys done by the Gallup Organization, respondents were asked, "Do you think cigarette smoking is or is not harmful to your health?" The proportion of respondents answering "is not" or "don't know" was 10% in 1977, 10% in 1981, 8% in 1983, 6% in 1985, 6% in 1987, and 5% in 1989. In a related series of surveys in which respondents were asked "Do you think cigarette smoking is harmful, or not?", 40% said "no" or "don't know" in 1949, 30% said that in 1954, 10% said that in 1977, 9% said that in 1981, 4% said that in 1990, and 5% said that in 1999.

¹ The question wording in 1999 was slightly different: "Do you think cigarette smoking is one of the causes of lung cancer, or not?"

² The question wording in 1957, 1990, and 1999 was slightly different: "Do you think cigarette smoking is one of the causes of heart disease?"

³ The question wording was slightly different in 1999: "How about cancer of the throat (do you think cigarette smoking is one of the causes)?"

The Roper Organization conducted a series of surveys for the Tobacco Institute in 1970, 1972, 1974, 1976, and 1978. In each of these surveys, respondents were asked: "It's been said that cigarette smokers have more of certain illnesses than non-smokers. Would you say this is definitely true, probably true, possibly true, or not true? In each of the years, the following proportions of respondents said the assertion was "not true" or said they didn't know whether or not it was true: 18%, 18%, 14%, 18%, and 15%, respectively.

Respondents who answered definitely true, probably true, or possibly true were asked a follow-up question: "Do you think cigarettes are a major cause of smokers having more of certain illnesses, or only one of many causes, or that cigarettes are really not a cause of smokers having more illnesses?" In each of the years, the following proportions of respondents said that smoking was not a cause of smokers' increased illness rates: 3%, 5%, 4%, 4%, and 3%, respectively. Thus, these individuals also apparently did not recognize health risks of smoking.

Another relevant survey was conducted for the National Clearinghouse for Smoking and Health in the Spring of 1970. In this survey, about 70% of respondents strongly agreed that "smoking cigarettes is harmful to health." About 17% of respondents mildly agreed with this statement, and another 13% of respondents disagreed with the statement or said they didn't know whether they agreed or disagreed. Therefore, about 30% of respondents did not express an accurate perception on this issue.

In a 1985 survey done by ABC News and the Washington Post, a national sample of respondents was asked: "Do you think that a link between cigarette smoking and lung cancer has been established convincingly or not?" 19% of respondents said it had not been established or that they didn't know whether or not it had been established.

Another survey was conducted for the Office on Smoking and Health of the Centers for Disease Control in 1986. In this survey, respondents were asked "Do you think a person who smokes is any more likely to get heart disease than a person who doesn't smoke?" About 79% of respondents said a smoker is more likely than a non-smoker, and about 21% of respondents said a smoker is not more likely or that they didn't know. In comparable questions, 92% of respondents said the smoker was more likely than the non-smoker to get lung cancer and about 8% of respondents said no or don't know. About 89% of respondents said the smoker was more likely than the non-smoker to get emphysema, and about 11% said no or don't know. Thus, 21%, 8%, and 11% of Americans did not recognize these risks of smoking.

In a 1992 survey by the Gallup Organization done for the American Lung Association, respondents were asked: "Which of the following health problems, if any, have been related to smoking?", and respondents were then read a list of health problems. 96% of respondents said "yes" for lung cancer, 85% said "yes" for emphysema, and 73% said "yes" for cardiovascular disease. Thus, 4%, 15%, and 27% of respondents, respectively, failed to acknowledge these health effects of smoking.

In a 1993 survey done by the Gallup Organization and sponsored by SmithKline Beecham, respondents were asked: "Does smoking cause or make these conditions worse?", and respondents were then read a list of medical problems. 84% of respondents answered "yes" for lung cancer, 75% answered "yes" for heart disease, 66% answered "yes" for oral cancers, and 65% answered "yes" for stroke. Thus, 16%, 25%, 34%, and 35% of respondents, respectively, failed to acknowledge these health effects of smoking.

Taken together, these surveys paint a coherent picture. In the 1950s and 1960s, large proportions of Americans did not recognize the health risks of cigarette smoking, and these

proportions have been falling during the past four decades. But very recent surveys show that the proportions of people not recognizing certain risks have not yet fallen to zero.

Many of the figures offered above are likely to be underestimates of the proportions of people who did not recognize health risks of smoking. This is because many of the questions asked in those surveys had a built-in bias likely to exacerbate the proportion of people appearing to hold accurate beliefs about risks. A large social science literature now documents what has come to be called "acquiescence response bias." This is a tendency of between 10% and 20% of just about any sample of people to agree with just about any assertion presented in an agree/disagree question or a yes/no question (for a review of this literature, see Krosnick & Fabrigar, forthcoming). Many of the questions described above involved such formats, so the proportions of people who said "agree" or "yes" probably overstated the proportions of people who actually held the beliefs that those responses appeared to express. In all likelihood, then, even more people failed to recognize certain well-established health effects of smoking than those survey studies suggest.

There is an additional reason why these surveys are likely to understate the proportion of people who failed to recognize the health consequences of smoking as well. Much research documents that people typically see themselves as less at risk for experiencing undesirable life circumstances than they believe other people are (Weinstein, 1980, 1982, 1987). All the survey questions reviewed above asked respondents about their perceptions of other people's risk rather than their own. Had these respondents been asked whether smoking increases the chances that they personally would experience adverse health outcomes, even more respondents would probably have said "no" or "don't know" than said so about other people.

Perceptions of the Magnitude of Risk

None of the questions asked in the surveys reviewed above are useful for quantifying the magnitude of the risk that people perceived to be associated with smoking. We must therefore turn to other evidence to assess whether Americans are accurate or inaccurate in gauging how much a person's risk of experiencing serious health problems is increased as a result of smoking cigarettes.

One survey that has been used to assess people's perceptions of the magnitude of the health risk of smoking cigarettes was conducted by Audits & Surveys Worldwide in September, 1985. A question in this survey asked: "Among 100 cigarette smokers, how many of them do you think will get lung cancer because they smoke?" Viscusi (1992) made extensive use of this question in his book, Smoking: Making the Risky Decision, to assess smokers' perception of the risk of smoking.⁴ Viscusi reported that the average probability reported by respondents in this survey who reported a probability was 42.6% for all respondents and 36.8% for people who were current smokers at the time of the survey. The medians for these two groups were 50.0% and 33.0%, respectively. Table 1 displays the distribution of probabilities reported by all respondents and by only people who were current smokers at the time of the survey, as presented by Viscusi (1992).

For comparison, Viscusi (1992) estimated the true percentage of smokers who get lung cancer due to smoking by dividing the number of people who die annually of lung cancer due to smoking (e.g., 93,000 in the 1980s) by the total number of smokers (e.g., 52.9 million in 1985)

⁴ Viscusi reported that 3,119 respondents provided valid answers to the smoking risk question in the survey, but the field report for the Audits & Surveys survey that Viscusi analyzed indicates that only 1250 respondents were interviewed for that survey. One possible explanation for this is that the data were weighted to enhance demographic representativeness, but the N was accidentally not corrected after the weighting was done. All computations of statistical significance tests and standard errors that Viscusi reported are therefore probably made using an inappropriately large N, so they are most likely not correct. We will focus here on the distributions of responses he reported, rather than tests of significance or standard errors.

and converting the result from an annual figure to a figure applying to the lifetime of a smoker. This calculation approach yielded a probability of between 5% and 10%, which Viscusi (1992) treated as a benchmark of the true rate of lung cancer deaths due to smoking. By comparing this rate to the 43% average answer given by the Audits & Surveys respondents, Viscusi concluded that most people overestimate the risk of lung cancer due to smoking, vastly in fact. According to the figures in Table 1, at least 78.5% of all respondents and 72.7% of current smokers overestimated the risk, because they reported probabilities of 20% and higher.

However, there are at least four potential reasons to hesitate before drawing this conclusion from these data. First, in the Audits & Surveys question, the definition of smokers is not precise or clearly equivalent to the “truth” measure generated by Viscusi (1992). Viscusi reported that his calculation of the “true” rate was based upon the number of deaths per year attributable to smoking and the total number of people who were smokers in a year, but he did not explain how much a person had to smoke in order to be classified as a smoker in this calculation. Likewise, the survey question “Among 100 cigarette smokers, ...” was not specific about what it meant to be a cigarette smoker (i.e., how many cigarettes smoked for how long). Survey respondents may have understood “100 cigarette smokers” to imply a different dosage for a different time period than was presumed in Viscusi’s calculation of the “truth.” Therefore, it may not be appropriate to expect that the survey reports will match the “truth” estimate.

Another potential problem with the Audits & Surveys question is the phrase “because they smoke.” The purpose of including this phrase was presumably to lead respondents to estimate the number of lung cancer cases attributable fully and completely to smoking. But respondents may not have understood it this way. Rather, they may have believed this phrase to mean “partly or completely because they smoked.” In other words, people may have believed

that smoking enhances the chances that a person will contract lung cancer, and they may believe other causal factors play roles as well (e.g., exposure to asbestos). Therefore, people may believe that smoking is partly responsible for some lung cancer cases (along with other causal factors), and Viscusi's calculation of the "truth" may not include such cases, because they are deaths not fully attributable to smoking. This would lead the rate of lung cancer attributable to smoking as estimated in the Audits & Surveys survey to be higher than Viscusi's "truth" estimate.

The concept of "subadditivity" (Mulford & Dawes, 1999; Redelmeier, Koehler, Liberman, & Tversky, 1995; Rottenstreich & Tversky, 1997; Tversky & Koehler, 1994) and a related notion, "the focus of judgment effect" (Lehman, Krosnick, West, & Li, 1992), point to another potential problem with the Audits and Surveys question. According to much research, the Audits & Surveys question makes a consequential choice about how to focus respondents' attention. The question could presumably have been written either to ask about the number of 100 smokers who would get lung cancer (as it did) or to ask instead about the number of 100 smokers who would not get lung cancer. The choice to employ the first of these wordings rather than the second might appear to be inconsequential, because whatever answer a person gave to the first, he or she would presumably have given an answer of 100 minus that answer had he or she been asked the second question.

But in fact, this typically does not occur. A question such as "Among 100 cigarette smokers, how many of them do you think will get lung cancer because they smoke?" focuses respondents' attention on just one of the possible outcomes of smoking: getting lung cancer. And this cognitive focusing typically leads people to overestimate the probability of the event in question. So the average of answers to that question, added to the average of answers to the

mirror image question (“Among 100 cigarette smokers, how many of them do you think will not get lung cancer because they smoke?”) would most likely total more than 100. This would be partly because answers to the mirror image question would also overstate people’s perceived probabilities by focusing their attention on not getting lung cancer.

Lastly, Viscusci may have focused on a perception of risk that people don’t actually use in making decisions about whether or not to smoke. The Audits & Surveys question only permits calculation of what might be called the risk difference. The risk differential is the difference between the probability that a non-smoker will get lung cancer and the probability that a smoker will get lung cancer which is attributable to smoking by the latter individual. If ordinary people think about the risk they take by smoking in terms of the risk difference, they would say to themselves something like, “If I smoke, I will increase my chances of getting lung cancer by 10 percentage points.” But this may not actually be the way people naturally think about the risks they take.

In fact, the public health community routinely focuses on a different way of describing the magnitude of risk associated with a particular course of action: relative risk. Relative risk is the ratio of the incidence rate of a disease among people exposed to a risk factor to the incidence rate of the disease among people not exposed to the risk factor (e.g., Mausner & Bahn, 1974). Therefore, to gauge the risk of getting lung cancer that people take by smoking, public health professionals usually focus on relative risk, which is the ratio of lung cancer incidence among smokers to the incidence among non-smokers. Ordinary people may also think about the risk of smoking in these terms, by saying to themselves something like, “If I smoke, I will increase my chances of getting lung cancer 10 times.” Even though the Audits & Surveys survey suggests that most people may overestimate the lung cancer risk difference attributable to smoking, it is

mathematically possible that those same people substantially underestimate relative risk. And if people make behavioral decisions based on perceptions of relative risk rather than based on perceptions of the risk difference, then underestimation may be a better characterization of risk perceptions than would Viscusi's (1992) conclusion of overestimation.

Taken together, these issues suggest that the data from the Audits & Surveys survey considered by Viscusi (1992) may not be capable of yielding useful and valid measurements of the accuracy of Americans' perceptions of the magnitude of the health risks caused by smoking.

A New Survey

To complement the evidence reported by Viscusi (1992), I conducted a new survey exploring Americans' beliefs about the health risks of smoking in different ways. The survey solicited the views of a representative national sample of American adults who were current smokers or former smokers. Perceived risk was measured differently from the approach taken in the Audits & Surveys study, to permit more versatile theory-testing. Specifically, perceived risk was measured differently in two ways.

First, rather than asking a single question about the increase in risk of lung cancer attributable to smoking, respondents were asked two separate questions, one about the risk to nonsmokers, and the other about the risk to smokers. Asking these two questions is advantageous if one's goal is to measure perceptions of the risk difference or relative risk, for two reasons. First, subadditivity is likely to bias both reports upward, so subtracting or dividing one judgment from or by the other should help to minimize the impact of overestimation in reporting. The second advantage comes from the fact that these two separate measurements constitute decomposed measurements of the ingredients of the risk difference and relative risk,

and decomposition enhances the accuracy of people's reports of complex beliefs or inferences (e.g., Armstrong, Denniston, & Gordon, 1975).

Decomposition refers to the breaking down of a single, global question into a series of sub-questions, each of which a respondent would have to answer anyway in the process of generating a response to the global question. In this case, in order to gauge people's perceptions of relative risk, they could be asked directly about "how many more times likely a smoker is to get lung cancer than a nonsmoker." But to answer that global question, a respondent would presumably have to generate his or her perception of the likelihood that a nonsmoker will get lung cancer and his or her perception of the likelihood that a smoker will get lung cancer and then mentally compute the ratio of the two. Because a person can accidentally make a computational error in doing this mental math and reporting the result, it yields more accurate measurements of people's beliefs to ask about the sub-components of the judgment: the likelihoods that a nonsmoker and a smoker will get lung cancer, and then the researcher can compute the ratio. The same logic applies to the measurement of perceived risk difference.

In measuring people's perceptions of the lung cancer risks of nonsmokers and smokers, we departed from the Audits & Surveys survey question by expressing more specifically the amount of smoking that the smokers had done and at what age they started to smoke. Much public health research documents that the likelihood of adverse health effects resulting from smoking is proportional to the number of cigarettes smoked and the length of time during which the smoking occurs. Therefore, it is reasonable to imagine that Americans might also perceive lung cancer risk to rise with dosage. If a group of respondents are asked about smokers in general (with no dosage specified), these respondents might infer the distribution of smoking dosage in the population and report perceived risk corresponding to their perceived distribution.

And if different respondents infer different distributions, their reported risk perceptions would presumably vary as a result, but not because they truly believe smoking poses different risks. Consequently, it seems desirable to specify dosage for the survey respondents in order to make the obtained measurements more interpretable.

Survey methodology. The new survey was conducted by Schulman, Ronca, Bucuvalas, Inc. (hereafter SRBI). The SRBI survey involved random digit dialing (RDD) from their computer-assisted interviewing facility in New York City to contact a nationally representative sample of American adults. Interviews were conducted between August 24, 2000, and October 2, 2000, and up to 10 call-backs were made to telephone numbers that were classified as “no answer” or “busy.” The adult resident (age 18 or older) of each household selected to be interviewed was the person with either the most recent birthday or the person who would have a birthday next; which of these two criteria was used for a household was determined randomly. The response rate for the survey was 51%; 4473 people were interviewed. Prior to the beginning of the interviewing, a quota was set such that a total of at least 2,000 interviews with current or former smokers would be conducted.

After answering a couple of warm-up questions at the start of the interview, contacted respondents were asked whether they had smoked 5 cigarettes or more during the past 7 days (people who said "yes" were classified as current smokers). Respondents who said "no" to this question were asked whether they had smoked 100 cigarettes or more during their entire lives (people who said yes were classified as "former smokers"). 46% of the 4,473 people interviewed identified themselves as current or former smokers, and these individuals continued with the interview. The remaining individuals were not asked any further questions.

Measures of perceived risk. Among the questions asked of the current and former smokers were the following two:

"Next, I'd like to turn to a different topic: what you personally think about the effect of cigarette smoking on people's health. I'm going to read these next two questions very slowly to let you think about each part of them, and I can repeat each question as many times as you like before you answer, so you can be sure they are clear to you. First, if we were to randomly choose one thousand American adults who never smoked cigarettes at all during their lives, how many of those one thousand people do you think would get lung cancer sometime during their lives?"

"And if we were to randomly choose one thousand American adults who each smoked one pack of cigarettes a day every day for 20 years starting when they were 20 years old, how many of those one thousand people do you think would get lung cancer sometime during their lives?"

Perceptions of risk. The distributions of answers to these two questions appear in Table 2, and at the bottom of the columns are the mean and median values for the columns and the number of respondents who provided answers to each question.⁵ The average number out of 1,000 20-year pack-a-day smokers that respondents thought would get lung cancer was 433.5, or about 43%, and the median value was 500, or 50% (see the last column). The distribution is bimodal, with a plurality of respondents (21.4%) saying 500, and 12.3% of respondents giving answers between 0 and 50.

The first column of percentages in Table 2 shows that the average number out of 1,000

⁵ When a telephone survey sample is generated via Random Digit Dialing and a single respondent from each contacted household is selected to be interviewed, it is necessary to weight the obtained data by the number of working voice telephone lines in the household and the number of adults living in the household in order to yield figures that are generalizable to the national population. This was done for all analyses reported here.

non-smokers that respondents thought would get lung cancer was 188.2, or about 19%, and the median value was 100, or 10%. 41.2% of respondents said that between zero and 50 out of 1,000 nonsmokers would contract lung cancer. Thus, these respondents thought nonsmokers were less likely on average to contract lung cancer than they thought smokers were.

In order to gauge people's perceptions of the risk difference, each respondent's answer to the question about nonsmokers was subtracted from his or her answer to the question about smokers, yielding the differences shown in Table 3. Listed on the left side are various ranges of risk difference. The middle column of the table shows the percentage of respondents whose perceived risk differences fell in the range shown on the left side. The last column shows the cumulative percentage of respondents who fell in each risk difference range or in one of the ranges listed above it in the table.

Only 5.4% of respondents thought smokers were less likely to get lung cancer than nonsmokers (a belief revealed by risk differences less than 0), possibly because these respondents thought smokers would die of other diseases instead. 11.8% of respondents thought smokers and nonsmokers were equally likely to contract lung cancer; their risk difference score was 0. And a large majority of 82.8% of respondents reported that smokers were more likely to contract lung cancer than nonsmokers. The mean perceived risk difference was 246.05, or about 25 percentage points, and the median was 200, or about 20 percentage points.

In order to gauge people's perceptions of the relative risk of contracting lung cancer due to smoking, each respondent's answer to the question about 1,000 smokers was divided by his or her answer to the question about 1,000 non-smokers.⁶ The observed distribution of relative risk

⁶ Because this quantity is undefined for respondents who said none of the 1,000 non-smokers would get lung cancer (because the denominator of the relative risk formula for these people would be zero), 1 was added to these respondents' answers to the question about non-smokers to allow the relative risk quantity to be defined for all respondents. Recomputing all analyses reported below treating these people as having missing data on the relative

figures for the sample appears in Table 4. 5.7% of respondents perceived a relative risk of less than 1, meaning that they thought smokers developed lung cancer less often than non-smokers. 11.6% of the sample perceived a relative risk of 1.0, meaning that they thought smokers and non-smokers were equally likely to develop lung cancer. 17.3% of people perceived a relative risk between 1.01 and 1.99, and 16.0% of people perceived a relative risk between 2.00 and 2.99. The mean relative risk was 29.7, and the median was 2.8.

These estimates can be compared to the figures that appear in the 1989 Surgeon General's report, which indicate that the relative risk of death due to lung cancer for one-pack-a-day smokers as compared to non-smokers is about 13. This figure can be viewed as an estimate of the relative risk of contracting lung cancer if we assume that almost everyone who is diagnosed with lung cancer dies of it, which is quite reasonable in light of the fact that about 90% of lung cancer victims die of it within 5 years of diagnosis.

The cumulative percentage shown in the last column of the table demonstrate that 80.6% of the sample perceived a relative risk less than 13. Thus, the vast majority of respondents perceived the relative risk of contracting lung cancer due to smoking to be less than the actual relative risk. Indeed, 50% of the respondents could be said to have vastly underestimated this relative risk, believing it is less than 3. Only about 0.6% of respondents estimated the relative risk about right (based on the figures in the 1989 Surgeon General's report), and 18.6% of respondents overestimated the relative risk of lung cancer due to smoking.

These results illustrate the difficulty of characterizing the accuracy of public perceptions of the health risks of smoking using only a single measure. If one considers absolute risk or the risk difference, the majority of the SRBI respondents appear to have substantially overestimated

risk measure has negligible impact on the reported results, because only 62 people (3.1% of all respondents) said that none of the 1,000 nonsmokers would contract lung cancer.

the danger of contracting lung cancer associated with smoking. But according to perceptions of relative risk, the majority of the respondents substantially underestimate the danger. The question, then, is which of these measures is an appropriate focus for claims about public risk perceptions and their accuracy.

Choosing a risk measure. One way to address this problem is to ask which of these risk perceptions seems to drive people's decisions about whether or not to smoke. Many possible configurations of risk perception use are possible, ranging from very heterogeneous to very homogeneous. Most heterogeneous would be the case in which some people decide whether to smoke based upon their perception of the risk difference while others make this decision with reference to perceptions of relative risk, and these two groups of people are about equally large. Most homogeneous would be the case in which everyone uses just one of these risk perceptions to make their behavioral choices regarding smoking. If we can gauge which risk perceptions have how much impact for how many people, we can begin to understand whether smoking behavior overall in a population is driven mostly by perceptions that overestimate risk, mostly by perceptions that underestimate risk, or by a mixture of perceptions that sometimes overestimate and other times underestimate.

The SRBI data allowed me to explore whether perceptions of the risk difference and relative risk inspire people to quit smoking. This is because the survey measured risk perceptions among people who were either current smokers or former smokers. If perceptions of health risks are indeed a principal motivator of smoking cessation (e.g., Ahluwailia et al., 1998; Crowe et al., 1994; Dappen et al., 1996; Dozois, Farrow, & Miser, 1995; Duncan et al., 1992; Haaga et al., 1993; Halpern & Warner, 1993; Lichtenstein & Cohen, 1990; Schneider, 1984; Swenson & Dalton, 1983), then perceived risk should be greater among people who current

smoke than among people who used to smoke but have since stopped. Put the other way around, the greater a person's perception of the risk of smoking, the more likely he or she should be to have quit smoking instead of continuing to smoke. Based upon this assumption, the better a risk perception measure is at predicting whether a person has quit smoking, the more likely it is to be driving quitting decisions.

The SRBI data afford a very simple way to begin addressing this question, because a point-biserial correlation can be computed of smoking status (current vs. former, coded 1 and 0, respectively) and each risk perception measure. Using data from the 1,902 respondents whose answers permit computing both measures of perceived risk, the correlations for perceived risk difference and relative risk are both statistically significant and in the expected directions: $-.083$ ($p < .001$) and $-.058$ ($p = .011$), respectively. The correlation involving risk difference is stronger than the correlation involving relative risk, which might be an indication that the former has more impact on quitting decisions than the latter. Furthermore, the correlation between these two perceptions of risk is $.37$ ($p < .001$). And in a logistic regression predicting smoking status, the effect of perceived risk difference is in the expected negative direction and statistically significant ($b = -.001$, $p = .004$), whereas the effect of perceived relative risk is in the same direction but non-significant ($b = -.001$, $p = .19$). This might be viewed as evidence that quitting decisions are driven somewhat by perceptions of the risk difference and are not influenced at all by perceptions of relative risk.

However, there are at least two reasons to hesitate before accepting this conclusion. The first reason involves the shapes of the distributions of the predictor variables displayed in Tables 2 and 3. Perceived risk difference and perceived relative risk have very wide ranges, from $-1,000$ to $1,000$ in the former case and from 0 to $1,000$ in the latter case. Furthermore, these

distributions are highly skewed with long tails containing very few cases. Outliers located so far away from the concentration of cases can substantially distort parameter estimates yielded by procedures such as logistic regression, and it is standard practice to transform such variables to reduce the distorting impact of those outliers.

Second, there is no reason to require that the effect of perceived risk on smoking status be represented in the linear fashion employed by logistic regression. Certainly, if people are using their risk perceptions to make behavioral decisions, the relation of perceived risk to smoking status should be monotonic. That is, any increase in perceived risk should never be associated with a decrease in the likelihood of quitting. But an increase in perceived risk need not always be associated with an increase in the likelihood of quitting. The law of decreasing marginal returns suggests that an increase in perceived risk starting at or near zero is likely to be perceived as a more substantial change than the same magnitude in increased risk beginning at a relatively large value. For example, an increase in the risk difference from zero to one hundred (on a zero to 1,000 scale) is likely to be perceived as more notable and threatening than an increase in the risk difference from 800 to 900. Therefore, the relation of smoking status to perceived risk difference or relative risk may be non-linear, with increases in perceived risk yielding smaller and smaller increases in quitting likelihood as perceived risk climbs, perhaps eventually reaching the point where increased perceived risk yields no increase in quitting likelihood. Eventually, perceived risk may reach a sufficiently high level to be a maximally powerful smoking deterrent; increases beyond that level of perceived risk may be inconsequential for behavior. If this is so, the logistic regression described above may mischaracterize the relation of one or both risk perception measures to quitting behavior.

To explore this possibility, we can examine the shapes of the relations between perceived risk and quitting behavior. The relation of likelihood of quitting to perceived relative risk is shown in Figure 1. Here, respondents are assigned to one of six groups, arrayed along the x-axis, each group composed of approximately one-sixth of the total sample. The height of each bar indicates the proportion of respondents in each group who had quit smoking.

As expected, the proportions of quitters in each of the six groups defined by relative risk generally increased as perceived relative risk increased. Likelihood of quitting was lowest in the two lowest groups in terms of perceived relative risk (39% and 38%), somewhat higher in the third group (48%), higher still in the next two groups (58% and 57%), and highest in the group with the greatest perceived relative risk (60%). Thus, the probability of quitting was apparently equivalently low for people with perceived relative risks less than 1.8, rose as perceived relative risk increased from 1.8 to 5.0, and remained about equally high across people with higher perceptions of relative risk. In other words, the relation of perceived relative risk to smoking status was non-linear but monotonic, with a positive slope at low levels of perceived relative risk and a decrease in the magnitude of this positive slope as perceived relative risk rose.

To test this notion more formally, we estimated a logistic regression equation predicting smoking status with perceived relative risk and perceived relative risk squared. Both effects had statistically significant effects, in the expected direction. The effect of perceived relative risk was negative ($b=-.450$, $p=.001$), and the effect of perceived relative risk squared was positive ($b=.046$, $p=.005$).⁷ Thus, consistent with the law of diminishing marginal returns, the greatest impact of an increase in perceived relative risk appears to occur when initial perceived risk is

⁷ For this regression and all those to follow, perceptions of relative risk and the risk difference were divided by 100, to yield parameter estimates that are larger and therefore easier to display in this report.

near zero. The same size increase from a higher starting point seems to have had much less impact on likelihood of quitting.

To be sure that this analysis accurately characterized the shape of the relation shown in Figure 1, I estimated one more logistic regression, predicting smoking status with perceived relative risk, perceived relative risk squared, and perceived relative risk cubed. And interestingly, the cubic term in this equation was statistically significant. As expected, the effect of perceived relative risk was negative and significant ($b=-.884$, $p<.001$); the effect of perceived relative risk squared was positive and significant ($b=.210$, $p=.011$); and the effect of perceived relative risk cubed was negative and significant ($b=-.013$, $p=.042$). These parameter estimates suggest a wrinkle in the application of the law of decreasing marginal returns in this context: the impact of perceived relative risk on quitting appears to grow a bit just before perceived relative risk reaches its maximum value.

A quick glance at Figure 2, which displays the relation of perceived risk difference to quitting likelihood, reveals a somewhat different pattern. To yield these results, the sample was divided into six about equal-size groups, ranging from people with the lowest perceived risk differences to those with the highest perceived risk differences. As expected, likelihood of quitting was lowest among people in the group perceiving the lowest risk difference (39%). But there appears to be more striking non-monotonicity here than in Figure 1 - the proportions of quitters in the top five groups did not always either increase or remain constant with increasing perceived risk: these proportions were 55%, 49%, 47%, 56%, and 55% respectively. Thus, the likelihood of quitting was equivalently high for people in the second-to-the-lowest group in terms of perceived risk differential and for people in the highest perceived risk differential group (i.e., 55). In other words, likelihood of quitting increased as people moved from perceived risk

differences of zero or less to positive perceived risk differences, but there did not appear to be any notable increase in quit rates as perceived risk difference increased.

To test this more formally, I conducted a logistic regression predicting quitting with perceived risk difference, perceived risk difference squared, and perceived risk difference cubed. In this regression, the cubed term was not significant ($b=.001$, $p=.152$), which indicates that the relation is not cubic, so I re-estimated the equation dropping that term. In the new equation, the squared term was non-significant ($b=.003$, $p=.389$), meaning that the relation was not quadratic, so I re-estimated the equation one last time dropping the squared term. In the final equation, the effect of perceived risk difference was negative and statistically significant ($b=-.062$, $p<.001$). Thus, a simple linear effect seemed to capture the expected relation best.

These analyses suggest that smoking status is related to perceived relative risk and to perceived risk difference. But these two variables are correlated with one another as well ($r=.37$, $p<.001$, $N=1,905$), so if we were to examine the effects of both predictors on smoking status simultaneously, we might find that the relation with smoking status is sustained for both or for only one. I therefore estimated a logistic regression predicting smoking status using perceived risk difference, perceived relative risk, perceived relative risk squared, and perceived relative risk cubed. The resulting parameter estimates appear in the first column of Table 5.

Surprisingly, the coefficient for perceived relative risk cubed was not significant ($b=-.01$, n.s.) in this equation, so I re-estimated the equation dropping that term – the result appears in column two of Table 5. Here, the effect of perceived risk difference is negative and significant, as expected ($b=-.05$, $p<.05$), meaning that a greater perceived risk difference was associated with a higher rate of quitting. In addition, the effect of perceived relative risk was negative and significant ($b=-.36$, $p<.01$), and the effect of perceived relative risk squared was positive and

significant ($b=.04$, $p<.05$). Thus, a greater perceived relative risk was associated with a higher rate of quitting, though at a decreasing rate as perceived relative risk rose. These results are consistent with the notion that some people base their smoking decisions on their perceptions of the risk difference, whereas others base their smoking decisions on perceptions of relative risk.

Before concluding this set of analyses, I explored the robustness of the solutions generated above to a potential problem identified by Fischhoff and his colleagues (Bruine de Bruin, Fischhoff, Millstein, & Halpern-Felsher, 2000; Fischhoff & Bruine de Bruin, 1999). These investigators proposed that when people are asked to report a probability but do not know the answer to the question, they sometimes answer by saying “50,” meaning “fifty-fifty” or “unknown,” rather than genuinely meaning a 50% chance. If this occurred in the SRBI data, it could potentially distort the results reported thus far, because some of the instances in which people gave the answer “500” to the questions about smokers and nonsmokers may not have been substantively meaningful responses of 50%.

To check the impact of this potential source of error on my conclusions, I reran the regression in the second column of Table 5 after dropping the respondents who answered “500” to either the question about non-smokers or to the question about smokers. As expected, the effect of perceived relative risk remained negative and significant ($b=-.45$, $p=.012$), and the effect of perceived relative risk squared remained positive and significant ($b=.049$, $p=.016$). But the effect of perceived risk difference, while remaining negative, was now only marginally significant ($b=-.036$, $p=.094$). Thus, if anything, it continues to appear that perceptions of relative risk and risk difference both contribute to smoking decisions, though the latter more tenuously than the former.

The effect of correcting people's perceptions of risk. These findings have potentially important implications. If the vast majority of Americans underestimate the relative risk of contracting lung cancer from smoking and overestimate the risk difference, then there is much potential public health education to do to correct people's perceptions of the risks involved. But it is not clear from the information presented thus far whether such education would yield a decreased smoking rate or an increased smoking rate in America.

If only one of the risk perception measures had effectively predicted quitting rates, it would be relatively straightforward to characterize the public as either overestimating risk or underestimating risk, depending upon which of the two measures was consequential. And we could also easily infer whether making people's perceptions of the risks more accurate would most likely yield higher rates of smoking or lower rates. But because both measures appear to be consequential in decision-making, such characterization is more difficult.

Given the results in Tables 2 and 3, enhancing the accuracy of people's perceptions of the health risks of smoking would lead to a decrease in perceptions of the risk difference (because most people currently overestimate that) and an increase in perceptions of relative risk (because most people underestimate that). The equation in the last column of Table 5 suggests that a decrease in perceived risk difference would increase the likelihood that people would smoke, whereas an increase in perceived relative risk would lead to a decrease in the likelihood that people would smoke. But the shapes of the two relations are different, so they may not completely cancel one another out.

To project what smoking rates would be if people accurately perceived the risk difference and relative risk, I used the parameters in the equation in the last column of Table 5 to calculate the predicted percentage of smokers in the sample if everyone were to perceive a risk

difference of 10% and a relative risk of 10. These two figures were selected simply based upon the figures offered by Viscusi (1992). The resulting predicted percentage of smokers turns out to be 44.5%, as compared to the 49.1% of respondents in the SRBI survey who reported being current smokers at the time of the survey. Thus, it appears that making perceptions more accurate in this way would lead to a net decrease in smoking, because in this case, relative risk underestimation outweighed risk difference overestimation.

Generalizing beyond lung cancer. The focus of this analysis has been people's perceptions of the relative risk of getting lung cancer due to smoking. As some of the surveys reviewed above indicate, lung cancer is one of the best-known health risks of smoking, if not the single best known. Consequently, Americans were less likely to underestimate the relative risk of lung cancer than they were to underestimate the relative risk of other diseases that are known to be caused by smoking. This means that if the two SRBI survey questions had asked about heart disease, oral cancers, or stroke instead of lung cancer, the prevalence of underestimation of relative risk would probably have been even greater than I observed for lung cancer, and correcting misunderstandings may have decreased the expected smoking rate even more than documented above regarding lung cancer risk perceptions.

Implications. Taken together, the above findings encourage consideration of a new educational effort in America to inform citizens about the health risks of smoking. But this educational effort would need to take an approach that is quite different from that implemented during the decades since the Advisory Committee to the Surgeon General issued its first warnings to the American public in 1964. As evidenced by the warnings printed on cigarette packages, the nation's public information campaign simply spread the word that smoking increases a person's chances of experiencing health problems. And indeed, this campaign

appears to have worked very well, because the vast majority of Americans endorse this assertion. But almost no effort has yet been devoted to educating Americans about how much their risk of serious disease increases as a result of smoking. Therefore, much constructive work can potentially be done in this regard in the future.

But for such an educational campaign to be consequential, people's beliefs about the health risks of smoking must be behaviorally consequential. That is, increasing people's perceptions of the health risks of smoking must make them less likely to start smoking and more likely to quit smoking. Thus far, I have assumed that these beliefs do in fact affect smoking behavior and, more particularly, smokers' decisions about whether or not to quit. But nothing I have reported thus far provides any evidence regarding whether or not that assumption is reasonable. I therefore turn next to a brief review of evidence from past studies exploring the causal impact of beliefs about health consequences on smoking initiation and cessation.

The Effects of Beliefs About the Health Consequences of Smoking on Smoking Onset or Quitting: Previous Evidence

The social science literature offers a number of studies that can be used to address the questions of whether beliefs about the health consequences of cigarette smoking influence smoking onset or quitting. That is, of interest here is whether believing that smoking is less risky enhances the chances that a non-smoker will begin to smoke cigarettes and that a smoker will quit smoking. If some non-smokers began to smoke cigarettes partly because they underestimated the health consequences of smoking, then making their beliefs about health consequences more accurate would have decreased the likelihood that they would have begun to smoke. And if some smokers failed to attempt to quit because they underestimated the health consequences of smoking, then making their beliefs about health consequences more accurate would have increased the likelihood that they would have quit or tried to quit.

In fact, numerous studies have reported evidence consistent with these two claims. For example, if health beliefs are indeed causes of smoking onset, then people who smoke should, on average, believe that smoking is less risky than people who do not smoke. And indeed, a large number of studies show that, as compared to people who do not smoke cigarettes, people who do smoke are less likely to believe that smoking causes adverse health problems for people in general (e.g., American Cancer Society, 1969-1970; Bauman & Chenoweth, 1984; Beaglehole et al., 1978; Benthin, Slovic, & Severson, 1993; Bewley & Bland, 1977; Boyle, 1968; Brownson et al., 1992; Burns & Williams, 1995; Cannell & MacDonald, 1956; Cartwright et al., 1960; Cartwright & Martin, 1958; Cecil, Evans, & Stanley, 1996; Chapman et al., 1993; Crowe et al., 1994; Dawley et al., 1985; Eiser, Reicher, & Podpadec, 1995; Eiser, Sutton, and Wober, 1979; Fodor et al., 1968; Greenlund et al., 1997; Grønhaug & Kangun, 1979; Halpern & Warner, 1994; Hansen & Malotte, 1986; Harrison et al., 1996; Hill & Gray, 1984; Kelson et al., 1975; Klesges et al., 1988a; Lawton & Goldman, 1961; Levitt & Edwards, 1970; Loken, 1982; McCoy et al., 1992; Murray & Cracknell, 1980; Murry, Swan, Johnson, & Bewley, 1983; Murray et al., 1994; Pervin & Yanko, 1965; Pyke, 1955; Reppucci et al., 1991; Roper Organization, 1978; Rudolph & Borland, 1976; Saad & O'Brien, 1998; Salber et al., 1963; Slovic, 1998, 2000a; Stacy et al., 1994; Steptoe et al., 1995; Swinehart, 1966; Tipton & Riebsame, 1987; Wang et al., 1995; Wang et al., 1998; Warner, Halpern, & Giovino, 1994; Williams & Clarke, 1997; Zagona & Zurcher, 1965). And Charris, Corty, Presson, Olshavsky, Bensenberg, and Sherman (1981) and Presson, Chassin, Sherman, Olshavsky, Bensenberg, and Corty (1984) found that people who believed that smoking has less adverse impact on health were more likely to say they intended to smoke cigarettes in the future. Only four studies found no difference between smokers and non-smokers in the extent to which they believed smoking causes undesirable health effects (Burns &

Williams, 1995; Grube, McGree, & Morgan, 1986; McKenna et al. 1993; Schneider & Vanmastrigt, 1974).

However, there is a theoretical basis for expecting that at least some of the above correlation between health beliefs and smoking behavior is due to post-hoc rationalization of smoking behavior. As Festinger (1957) argued in his original statement of cognitive dissonance theory, cigarette smokers are likely to find it very uncomfortable to hold simultaneously the beliefs that they smoke cigarettes regularly and that smoking cigarettes regularly is damaging to their health. One way to reduce the discomfort associated with holding these beliefs simultaneously is to deny or underestimate the health risks of smoking. Therefore, if a person begins to smoke for a reason unrelated to health considerations (e.g., an adolescent is especially anxious in social settings and believes smoking will help him or her relax or be viewed acceptably by his or her peers), he or she may subsequently reduce the extent to which he or she believes that smoking causes health problems.

Festinger's (1957) idea may well be true and may be partly responsible for the robust correlation observed between smoking/non-smoking status and belief in the health effects of smoking. However, evidence reported by McMaster and Lee (1991) suggests that smokers may reduce this cognitive dissonance by a different cognitive mechanism that Festinger (1957) also identified: downplaying the importance of the health risk by believing that health problems caused by smoking can be caught early and cured and that other risks posed in life are more threatening. Likewise, Loken (1982) found that smokers perceived the health consequences of smoking to be less undesirable than did non-smokers. Thus, it appears that smokers cope with their cognitive dissonance at least partly by this mechanism, though they may also strategically

downplay their perceptions of the likelihood of undesirable health consequences following from smoking.

Regardless of whether or how smokers cope with their cognitive dissonance, it is also possible that pre-existing differences between smokers and non-smokers in their beliefs about the health consequences of smoking may partly determine whether or not these individuals subsequently become smokers or not. In order to test this idea directly, it is necessary to collect data from a group of non-smokers repeatedly over time, initially measuring their beliefs about the health effects of smoking, and then assessing whether these beliefs predict who later becomes a smoker. In fact, some studies have done such analyses and have found that people who initially believed smoking has less deleterious impact on health were subsequently more likely to become smokers (Bauman & Chenoweth, 1984; Chassin, Presson, Pitts, & Sherman, 2000; Chassin, Presson, Sherman, & Edwards, 1991; cf., Collins et al., 1987). This is considered very strong evidence of causal impact of one factor on another (Finkel, 1995; Kessler & Greenberg, 1981).

Weinstein (1980, 1982, 1987, 1998) has done and catalogued a great deal of research showing that people typically believe that they are less at risk personally of experiencing an undesirable life circumstance than are other people. This highly robust finding makes clear the importance of recognizing the distinction between people's beliefs about the health risks of smoking to people in general (which we have considered thus far) and their beliefs about the health risks of smoking for themselves personally. In principle, smokers may be less likely than non-smokers to acknowledge the health effects of smoking on others, but smokers and non-smokers may be equivalent in perceiving the impact of smoking on their own personal health. But a series of studies contradict this claim: Benthin, Slovic, and Severson (1993), McCoy et al.

(1992), Grønhaug and Kangun (1979), Hansen and Malotte (1986), Leventhal et al. (1987), Marshall (1990), Murray et al. (1994), Urberg and Robbins (1984), and Virgili, Owen, and Severson (1991) found that smokers were less likely to believe that smoking would cause undesirable health effects for them personally than were non-smokers. These findings are therefore consistent with the notion that these personalized health beliefs partly determine smoking behavior.

Another set of relevant evidence comes from studies that asked non-smokers why they don't smoke. In studies by Levitt (1971) and Kahn and Edwards (1970), the most frequently given reason was to avoid the undesirable health effects of smoking. This, too, is consistent with the claim that perceptions of the health effects of smoking are important determinants of whether a person does or does not smoke.

Yet another finding of relevance here involves the strength of people's beliefs about the health effects of smoking. Even if a person is completely convinced that smoking substantially increases his or her risk of experiencing health problems, this belief may have no impact on his or her smoking behavior if he or she attaches no personal importance to those health effects (see, e.g., Petty & Krosnick, 1995). Therefore, attaching greater importance to health effects of smoking, coupled with the belief that smoking is deleterious, should lead to less smoking. Consistent with this logic, Mettlin (1973) reported that people who attached more importance to the effects of smoking on health were indeed less likely to smoke.

One very robust finding at first appears to challenge the general conclusion that beliefs about the health effects of smoking are partial causes of smoking behavior. Gerrard et al. (1996), Harrison et al. (1996), Lee (1989), McKenna et al. (1993), McMaster and Lee (1991), Pervin and Yatko (1965), Strecher et al. (1995), Swinehart (1966), Weinstein (1987), and Williams and

Clarke (1997) found that smokers were more likely than non-smokers to say that they themselves would get a smoking-related disease during their lifetimes. Likewise, Hurd and McGarry (1995) and Schoenbaum (1997) found that smokers were less likely to believe they would live to ages 75 and 85 than non-smokers said of themselves. And Greening and Dollinger (1991) reported that smokers said "a person like them" was more likely to die of cancer, stroke, or emphysema than did non-smokers. At first glance, these results seem to conflict with the ones reported previously, showing that smokers think the health risks of smoking are less than non-smokers do.

But it is important to recognize that the questions used to measure beliefs about likelihood of experiencing illnesses and life expectancy in these studies did not mention cigarettes or smoking. That is, these questions did not measure people's perceptions of the impact of smoking on their own health or likelihood of death. And it turns out that smokers do not in fact see themselves to be more likely to experience smoking-related diseases uniquely. Instead, smokers perceive themselves to be more likely than non-smokers perceive themselves to experience a wide range of undesirable physical conditions, including ones clearly unrelated to smoking. For example, Swinehart (1966) found that smokers said they were more likely than did non-smokers to get the flu. Harrison et al. (1996) found that smokers said they were more likely to "have an accident" or develop arthritis than non-smokers said of themselves. And McKenna et al. (1993) found that smokers were more likely than non-smokers to say they would get arthritis, become sterile, get venereal disease, and develop cirrhosis of the liver.

It appears that these perceptions are grounded in observable real-life events and general risk factors. For example, smokers report having had more recent hospitalizations, more recent visits to doctors, more chronic health conditions, and more restricted physical activity than do non-smokers (Halpern & Warner, 1994). And smokers perceive themselves as having higher

levels of risk factors other than smoking. For example, Reppucci et al. (1991) found that smokers reported experiencing more stress than did non-smokers. Thus, although the rates at which smokers report experiencing health problems and expect to experience health problems exceed the rates reported by non-smokers, this is not confined to smoking-related health problems.

Lastly, much research is consistent with the general claim that beliefs about the health consequences of smoking are important instigators of efforts to quit smoking. For example, Dozois, Farrow, and Miser (1995) found that 72% of a sample of current cigarette smokers had reported attempting to quit smoking at least once previously, and the reason given most often for trying to quit was to avoid the undesirable health consequences of smoking. Likewise, Ahluwalia et al. (1998), Crowe et al. (1994), Dappen et al. (1996), Duncan et al. (1992), Haaga et al. (1993), Halpern and Warner (1993), Lichtenstein and Cohen (1990), Schneider (1984), and Swenson and Dalton (1983) reported that the reason ex-smokers gave most often for quitting or wanting to quit was improved physical health and longevity. And Stone and Kristeller (1992) found that the deleterious health effects of smoking were the most commonly given reason by smokers for wanting to quit smoking.

Consistent with that evidence, Curry et al. (1990) found that people who were motivated to quit for health reasons had a greater desire to quit than people motivated by other reasons. Borland (1997a) found that people who were more motivated by health concerns were more likely to intend to quit and were more likely to attempt to quit subsequently. And Rose et al. (1996) and Klesges et al. (1988b) found that people who believed more in deleterious health consequences of smoking were subsequently more likely to attempt to quit (c.f., Ahluwalia et al., 1998; Chassin, Presson, & Sherman, 1984).

Also consistent with the notion that beliefs about health consequences partly determine success of quitting attempts, Tipton (1988) and Kaufert et al. (1986) found that among people who participated in a smoking cessation program, those who initially believed more strongly that smoking causes health problems were most likely to be successful in quitting smoking (c.f., Klesges et al, 1988b). And a number of studies found that people who tried to quit smoking for health reasons were subsequently more likely to succeed than people who tried to quit for other reasons (Borland, 1997a; Curry et al., 1990; Duncan et al., 1992; Halpern & Warner, 1993; c.f. Rose, Chassin, Presson, & Sherman, 1996).

If beliefs about the health risks of smoking are indeed causes of smoking onset and quitting, then we should observe in the SRBI survey data the same relation documented in the dozens of studies reviewed above: current smokers should perceive less risk of smoking than do current non-smokers. The SRBI survey sample included both current and former smokers, so I could test this hypothesis by assessing whether the latter individuals manifested higher perceived relative risk than did the former individuals. And in fact, the median relative risk perceived by current former smokers was twice the median relative risk perceived by current smokers (4.00 vs. 2.00; difference: Mann-Whitney $U=371895$, $p<.001$, $N=1903$). This finding not only reinforces confidence in the claim that smoking onset and quitting are affected by health beliefs but also reinforces confidence in the validity of the SRBI survey's measure of perceived relative risk.

The SRBI survey data also permit testing another notion that should be true if beliefs about health consequences are causes of quitting behavior: people who perceive greater relative risk of lung cancer from smoking should regret smoking more and should be more motivated to quit smoking (beliefs that are presumably instigators of quitting attempts). The SRBI survey

permits testing this idea because all respondents were asked two pairs of questions measuring regret regarding smoking, and respondents who said they were currently smokers were asked additional questions about their desire to quit:

Regret. "Do you wish at all that you had never started to smoke cigarettes, or do you not wish that at all?"⁸ [IF DO WISH:] How much do you regret having started to smoke cigarettes? A great deal, quite a bit, somewhat, or a little?"⁹

Unhappy. "When you think about having smoked cigarettes in the past, does that make you feel unhappy at all, or does it not make you feel unhappy?"¹⁰ [IF DOES:] "How unhappy does that make you feel? Extremely unhappy, very unhappy, somewhat unhappy, or slightly unhappy?"¹¹

Like to stop. "Would you like to stop smoking cigarettes, or would you not like to stop smoking cigarettes?"¹² [IF WOULD:] "How much would you like to stop smoking cigarettes? A great deal, quite a bit, somewhat, or a little?"¹³

⁸Because respondents expect questions with dichotomous positive/negative answer choices to offer the positive option before the negative option and violating this expectation disrupts people's cognitive processing of the question and reduces the accuracy of their answers (Holbrook et al., 2000), these two response choices were read to all respondents in the order in which they appear here.

⁹For half the respondents (chosen randomly), the response options were read in the order shown here, and the other half of the respondents heard those response options in the reverse order. This was done to prevent presentation order from biasing respondents toward one end or the other of the rating scale (see, e.g., Krosnick & Fabrigar, forthcoming, chapter 8).

¹⁰Because respondents expect questions with dichotomous positive/negative answer choices to offer the positive option before the negative option (Holbrook et al., 2000), these two response choices were read to all respondents in the order in which they appear here.

¹¹For half the respondents (chosen randomly), the response options were read in the order shown here, and the other half of the respondents heard those response options in the reverse order.

¹²Because respondents expect questions with dichotomous positive/negative answer choices to offer the positive option before the negative option (Holbrook et al., 2000), these two response choices were read to all respondents in the order in which they appear here.

¹³For half the respondents (chosen randomly), the response options were read in the order shown here, and the other half of the respondents heard those response options in the reverse order.

Likelihood of trying to quit. "How likely is it that you will try to quit smoking during the next 3 months? Definitely will try, probably will try, may or may not try, probably will not try, or definitely will not try?"¹⁴

Answers to each of the first three pairs of questions were combined to yield three 5-point scales (e.g., 5=regret a great deal, 4=regret quite a bit, 3=regret somewhat, 2=regret a little, and 1=not regret at all). The four resulting 5-point scales measuring regret and desire to quit were correlated as expected with perceived relative risk of smoking: $r=.12$ ($p<.001$, $N=1887$), $r=.12$ ($p<.001$, $N=1884$), $r=.18$ ($p<.001$, $N=938$), and $r=.12$ ($p<.001$, $N=942$), respectively, for Regret, Unhappy, Like to stop, and Likelihood of trying to quit.⁸ Likewise, the correlations between these four measures of regret and perceived risk difference were $-.14$ ($p<.001$, $N=1887$), $-.16$ ($p<.001$, $N=1884$), $-.16$ ($p<.001$, $N=938$), and $-.13$ ($p<.001$, $N=942$), respectively. These correlations mean that people who perceived a higher relative risk and risk difference of lung cancer from smoking were more likely to regret having smoked and were more likely to want to quit and to intend to try to quit in the near future.

Conclusion

Taken together, these various sorts of past studies offer a strong array of empirical support for the claim that beliefs about health consequences are causes of cigarette smoking onset and cessation. Believing that smoking is less damaging to health allows a person to begin smoking more readily, and believing that smoking is more damaging to health inspires people to try to quit smoking and to succeed in quitting. Therefore, if public health efforts are initiated in the future to encourage Americans to more fully recognize the health consequences of smoking,

¹⁴ For half the respondents (chosen randomly), the response options were read in the order shown here, and the other half of the respondents heard those response options in the reverse order.

this may well lead to a reduction in the nation's smoking rate and a consequent reduction in smoking-related morbidity and mortality.

In addition to these practical implications, the work reported in this paper is interesting in basic psychological terms. Probability judgments are increasingly of interest to researchers in many social science disciplines, and here, we have studied probability judgments in an especially consequential domain. Many aspects of the findings yielded by the SRBI survey suggest that people are in fact able to make and report probability judgments about health risks and that they appear to use such judgments when making behavioral decisions in this domain. This encourages further study of probability judgments in this domain and others as well.

What is relatively new here is the distinction between risk differences and relative risks, a distinction recognized by public health researchers studying diseases (Morabia, 2001) but thus far mostly ignored by researchers studying people's perceptions of risks. We look forward to future, careful study of the value of this distinction in understanding how people make risky decisions and, more generally, how people trade off probabilities when making choices. There are many interesting questions left to answer with regard to risk perceptions involving smoking, such as how people inferred risk differences and relative risks, who uses one rather than the other perception to make behavioral decisions, and more. Our findings suggest that future studies of these sorts of issues are merited.

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Table 1:

Perceived Numbers of Smokers Out of 100 Who Will Get Lung Cancer “Because They Smoke”: Viscusi (1992)

Number of People Who Will Get Lung Cancer	Respondent Group	
	All Respondents	Current Smokers
0 - 4	5.2%	9.2%
5 - 9	4.6%	5.1%
10 - 19	11.7%	13.0%
20 - 29	13.6%	14.6%
30 - 39	9.0%	11.4%
40 - 49	5.2%	5.0%
50 - 59	23.9%	22.8%
60 - 69	7.0%	5.6%
70 - 79	8.4%	5.0%
80 - 89	4.2%	2.7%
90 - 99	4.1%	2.8%
100	3.0%	2.6%
Total	100.0%	100.0%
Mean	42.6	36.8
Median	50.0	33.0

Table 2:

Perceived Numbers of Non-Smokers and Smokers Who Will Get Lung Cancer: SRBI Survey

Number of People Who Would Get Lung Cancer	Out of 1,000 Non-Smokers	Out of 1,000 Smokers
0 - 50	41.2%	12.3%
51 - 100	18.1%	8.4%
101 - 150	2.3%	2.3%
151 - 200	7.3%	6.4%
201 - 250	4.8%	3.3%
251 - 300	4.4%	6.0%
301 - 350	1.2%	1.9%
351 - 400	1.9%	6.2%
401 - 450	0.1%	1.4%
451 - 499	0.0%	0.0%
500	13.4%	21.4%
501 - 550	0.0%	0.3%
551 - 600	0.9%	4.8%
601 - 650	0.3%	1.4%
651 - 700	0.9%	5.4%
701 - 750	0.7%	3.4%
751 - 800	1.0%	6.3%
801 - 850	0.0%	0.6%
851 - 900	0.5%	3.3%
901 - 950	0.0%	0.5%
951 - 1,000	0.8%	4.3%
Total	100.0%	100.0%
Mean	188.2	433.5
Median	100.0	500.0
N	1,916	1,936

Note: Respondents are current or former smokers.

Table 3:

Perceived Risk Difference of Getting Lung Cancer from Cigarette Smoking:
SRBI Survey

Risk Difference	Percent of Respondents	Cumulative Percentage
-1,000 - -1	5.4%	5.7%
0	11.8%	17.2%
1 – 49	10.3%	27.5%
50 – 99	7.0%	34.5%
100 – 149	6.5%	41.0%
150 – 199	5.8%	46.8%
200 – 249	8.4%	55.2%
250 – 299	1.6%	61.3%
300 – 349	6.9%	68.2%
350 – 399	2.4%	70.6%
400 – 449	5.6%	76.2%
450 – 499	6.6%	82.8%
500	3.3%	86.1%
501 – 549	0.4%	86.5%
550 – 599	1.8%	88.3%
600 – 649	1.9%	90.2%
650 – 699	1.9%	92.1%
700 – 749	1.9%	94.0%
750 – 799	1.9%	95.9%
800 – 849	1.1%	97.0%
850 – 899	1.2%	98.2%
900 – 949	0.4%	98.6%
950 – 1,000	1.4%	100.0%
<hr/>		
Total	100.0%	
<hr/>		
Mean	246.05	
Median	200.00	
N	1,905	
<hr/>		

Table 4:

Perceived Relative Risk of Getting Lung Cancer from Cigarette Smoking: SRBI Survey

Relative Risk	Percent of Respondents	Cumulative Percentage
0.00-0.99	5.7%	5.7%
1.0	11.6%	17.2%
0.01-1.99	17.3%	34.5%
1.00-2.99	16.0%	50.5%
3.00-3.99	6.4%	56.9%
4.00-4.99	4.8%	61.7%
5.00-5.99	5.7%	67.4%
6.00-6.99	2.2%	69.6%
7.00-7.99	2.5%	72.1%
8.00-8.99	1.9%	74.0%
9.00-9.99	0.9%	74.8%
10.00-10.99	4.8%	79.6%
11.00-11.99	0.2%	79.8%
12.00-12.99	0.8%	80.6%
13.00-13.99	0.6%	81.2%
14.00-14.99	0.3%	81.4%
15.00-15.99	1.2%	82.7%
16.00-16.99	1.0%	83.7%
17.00-17.99	0.3%	83.9%
18.00-18.99	0.4%	84.4%
19.00-19.99	0.0%	84.4%
20.00-29.99	3.4%	87.8%
30.00-49.00	2.4%	90.2%
50.00-79.00	3.3%	93.5%
80.00-1000.00	6.5%	100.0%
Total	100.0%	
Mean	29.7	
Median	2.8	
N	1,905	

Table 5:

Logistic Regression Predicting Smoking Status Using Measures of Perceived Risk

Predictor	Coefficients	
Perceived Risk Difference	-.04+	-.05*
Perceived Relative Risk	-.69*	-.36**
Perceived Relative Risk Squared	.16+	.04*
Perceived Relative Risk Cubed	-.01	
N	1898	1898

+ p<.10

* p<.05

** p<.01

Figure 1:

The Proportion of People at Various Levels of Perceived Relative Risk Who Had Quit Smoking



Figure 1:

The Proportion of People at Various Levels of Perceived Relative Risk Who Had Quit Smoking

