

# The Effect of Risk Communication on Risk Perceptions: the Significance of Individual Differences

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**The purpose of this paper is to address the literature on the relation between risk communication and the initiation of health behavior change. More specifically, we examine the evidence that providing risk information is an effective way to change risk perceptions, as well as the more limited evidence that altering risk perceptions influences risk behavior. The paper discusses significant developments in the research on these issues, describes specific studies that represent trends in this research, and discusses methodologic issues important to the development of the field. Although there are relatively few studies that demonstrate causal links between risk communication and behavior change, recent developments in the field point to the importance of tailoring risk communications to the individual characteristics of targets. Such tailoring has taken a variety of forms, including providing individualized feedback concerning risk status or genetic vulnerability and assessing readiness for behavior change. Future intervention efforts should combine individualized risk status feedback with assessment of individual differences in previous behavior and acceptance of personal vulnerability. [Monogr Natl Cancer Inst 1999;25:94–100]**

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A fundamental assumption underlying efforts to communicate accurate risk information to the public is that individuals will be more capable of making important decisions about precautionary and risk behaviors if they are more knowledgeable about the consequences of those behaviors. The most striking evidence that risk communications can effect a change in behavior is the fact that the prevalence of smoking among adults in the United States dropped by more than  $\frac{1}{3}$  in the 30 years following the Surgeon General's report on the dangers of smoking (1). More recently, dissemination of information about sexual transmission of the human immunodeficiency virus (HIV) was followed by a dramatic decrease in unprotected sex among gay men (2–4). Examples such as these offer support for the appealing hypothesis that risk communications can be effective in changing perceptions of risk and, in so doing, can motivate people to initiate effective precautionary behavior.

As intuitive as this motivational hypothesis appears, however, we know relatively little about the causal links between risk communication and behavior change. There is limited evidence that providing risk information is an effective way to change risk perceptions, and even less evidence that altering risk perceptions motivates new health behavior. The purpose of this paper is to examine the literature on these important links. We will not attempt to present an exhaustive review of this literature; rather, we will examine significant developments in the research and describe, in some detail, specific studies that represent these trends. The paper is organized around the following set of questions: 1) Do risk perceptions motivate the initiation of new precautionary behavior or changes in risk behavior? 2) What are the barriers to acknowledging risk? 3) Can risk communications

change risk perceptions? 4) Finally, what research needs to be done to increase our understanding of the relation between risk information and behavior change?

## RELATION BETWEEN RISK PERCEPTIONS AND PRECAUTIONARY BEHAVIOR

Virtually all theories of health behavior include the hypothesis that perceived vulnerability is the major motivational force behind precautionary behavior (5). Furthermore, a number of reviews (6–8) of the empirical literature have supported this motivational hypothesis by providing empirical evidence that perceptions of vulnerability are positively related to a wide variety of preventive behaviors in adolescents and adults. Unfortunately, these reviews have generally included both prospective and cross-sectional studies, leading to confusing and often contradictory conclusions.

Most cross-sectional studies of the relation between perceived vulnerability and precautionary behavior have been based on the assumption that feelings of vulnerability motivate individuals to engage in precautionary behavior. As several researchers (9–11) have asserted, however, this is often an erroneous assumption. For example, the motivational hypothesis posits that the perception that one is vulnerable to sunburns will lead to the use of sunscreen and protective clothing. However, once an individual has taken these precautions, his or her perceived vulnerability should decrease, the result being a negative correlation between precautionary behavior and current estimates of vulnerability. In other words, in many cases, perceptions of vulnerability should be interpreted as reflections of the amount of precautionary or risk behavior a person has already engaged in, rather than as the motivation for that behavior.<sup>1</sup> We did not include cross-sectional studies in this review because interpretation is difficult.

A number of studies have tested the motivational hypothesis by tracking the association between perceptions of vulnerability and subsequent precautionary behavior. In an early review of this literature, Janz and Becker (7) concluded that the majority of these studies supported the motivational hypothesis—the more vulnerable people feel, the more likely they are to *subsequently* engage in precautionary behaviors (e.g., inoculation for swine flu, screening for blood pressure, or use of clinic preventive services). Subsequent reexamination of these studies, however, led to a somewhat different conclusion. More specifically, Montgomery et al. (12) suggested that the role of perceived vulnerability is qualitatively different when the behavior in question is simple (e.g., getting an immunization), as opposed to

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threatening, taxing, or socially complex (e.g., monthly breast self-examination or regular condom use). In fact, when these authors examined the subset of studies by Janz and Becker that investigated negative events with extreme threat, complex precautionary behavior, or both, they found that only 25% of these studies reported a significant relation between perceptions of vulnerability and precautionary behavior.

This conclusion was further supported by the Chicago Multi-Center AIDS Cohort Study (MACS) of HIV preventive behavior (13). This study assessed risk perceptions and risk behavior in 637 gay men at two different points in time, 6 months apart. These authors found that perceived vulnerability at time 1 was related to risk behavior at time 2; however, this effect was explained by the correlation between time 1 perceived risk and time 1 risk behavior. In their words, "the apparent link between perceived risk and longitudinal changes in behavior is actually explained by the covariability of a sense of risk and behavior at [time] 1" (14). Secondary analysis of data from the Los Angeles MACS study (15) revealed the same pattern (Aspinwall LG: personal communication, 1994 Feb 22). It would appear then that longitudinal studies of the relation between perceptions of vulnerability and precautionary behavior have also failed to provide convincing support for the motivational hypothesis.

How can this be the case? Is it possible that the rapid and profound reductions in smoking and unprotected sex that followed widespread dissemination of research documenting the health risks associated with these behaviors were not associated with corresponding increases in vulnerability estimates? One answer to this question has to do with the nature of the research that has examined it. In particular, we suggest that methodologic shortcomings in the extant research are at least partly responsible for the lack of clear findings in prospective examinations of the hypothesis. We will discuss two of these problems.

Although warnings about the inappropriateness of interpreting cross-sectional data as support for the motivational hypothesis have been articulated repeatedly in the literature (7,9–11), two other methodologic issues have received far less attention. The first of these issues is the problem of initial covariation of perceived vulnerability and behavior—the problem noted by Joseph et al. in their analysis of the MACS data (13,14). More than a decade after the observation by Joseph et al., there are few longitudinal studies of the relationship between perceptions of risk and subsequent precautionary behavior. Even fewer studies exist in which the authors control for prior precautionary behavior and, by doing so, test the relation between risk perceptions and change in behavior. Without controlling for time 1 behavior, significant correlations between risk perceptions at time 1 and behavior at time 2 could be interpreted as causal when they are, in fact, the result of initial covariation between perceived risk and behavior at time 1 (as was the case in Joseph et al.). This is a common source of misinterpretation of prospective risk data (9–11). Ideally, because the relation between perceived vulnerability and behavior is reciprocal (*see below*), both constructs should be assessed at time 1 and time 2 to determine whether change in behavior covaries with change in risk perceptions.

The second methodologic issue has to do with the match between the risk question and the participants' experience with the behavior and their stage of behavior change (9–11). If the participant is engaging in a precautionary behavior, such as breast self-examination, and intends to continue this practice, the appropriate risk question is different than if he or she is not

practicing the precautionary behavior. More specifically, a simple question about the likelihood of dying of a disease, breast cancer for example, can confound perceptions of risk and intentions to continue self-examinations: "Even if I develop breast cancer, I won't die from it because I intend to be vigilant about early detection." Likewise, different questions are required if the participant is engaging in a risk behavior, trying to quit a risk behavior, or has already quit. For example, an adamant nonsmoker would probably answer the question "What is the likelihood that you will suffer from a smoking-related disease?" with "none" because he or she does not intend to start smoking. To separate the effects of risk perceptions from those of intentions and past behavior, it is often necessary to ask a hypothetical or "conditional" risk question, i.e., one that is contingent on performance of the behavior: "What would be the likelihood that you would suffer from a smoking-related disease if you were to start smoking?" For smokers who are preparing to quit smoking, it is appropriate to ask, "What would be the likelihood that you would suffer from a smoking-related disease if you were to continue smoking?" and "What would be the likelihood . . . if you were to stop smoking?" (16). Until there are more studies that incorporate these features and thereby take experience, prior changes in behavior, and intentions into account, it is premature to draw definitive conclusions from the existing prospective literature on the motivational hypothesis.

## DEFENSIVE RESPONSES TO HEALTH COMMUNICATIONS

Another reason why longitudinal studies about risk perceptions and precautionary behavior have failed to provide convincing support for the motivational hypothesis has to do with the way people respond to health communications. Specifically, many people tend to react to risk information in a defensive manner. This is especially true if the message suggests or implies that their current or past behavior has been unwise or unhealthy.

### Risk Awareness

People often think that they are less vulnerable to future negative events than are similar others—others whose level of risk, objectively, is comparable. This optimistic perspective has been termed an "illusion of invulnerability," or simply an optimistic bias (17,18). There is evidence, however, that this optimism is at least tempered by reality. In other words, although people may see themselves as less vulnerable than a peer or the average person, their estimates do reflect a reasonable awareness of their personal risk status (11). For example, adult smokers are aware that their risks of smoking-related disease are greater than are those of nonsmokers (19), and college students' risk perceptions have been shown to correlate with their actual probability of experiencing a variety of health hazards (20,21). Adolescents also understand the relationship between smoking and vulnerability to smoking-related diseases, and they can apply this knowledge to themselves. More specifically, increases in adolescents' smoking over time are accompanied by corresponding increases in personal vulnerability to lung disease (22). In short, people, including young people, may not be accurate in an exact sense when estimating the likelihood that their behavior will lead to a specific negative consequence. They do, however, appear to have an idea of the relative risks associated with their behavior.

## Defensive Cognitions

In spite of these reality constraints on perceptions of vulnerability, optimistic biases are quite common, and people engage in a variety of cognitive strategies that protect these biases. For example, early research on reactions to medical diagnoses by Croyle et al. (23–25) revealed that people tend to respond to threatening health information with a predictable set of defensive “adjustments” in their thinking, i.e., when learning that they are at risk, people often engage in an active process of distorting and discounting the risk information. More recent research (22) has revealed that adolescents exhibit this same kind of defensiveness following increases in their smoking. In one study, smoking and cognitions associated with smoking were tracked over a 3-year period in a sample of 477 adolescents. Results indicated that adolescents who increased their smoking engaged in two types of defensive (cognitive) strategies: (a) They *normalized* the behavior by increasing their estimates of the prevalence of smoking among their peers, and (b) they *avoided thinking* about the potential negative consequences of smoking. Likewise, members of smoking cessation groups who relapse demonstrate a similar kind of defensiveness by decreasing their risk estimates to the health risks associated with smoking (16,26). Furthermore, this defensiveness appears to be associated with subsequent increases in smoking (22).

Thus, people are not passive, unbiased recipients of information about their health. Although most people do not engage in delusional thinking or complete denial of the potential consequences of their behavior, they do possess an impressive array of self-protective strategies that can act as buffers against the unwanted implications posed by risk information. In other words, first-order denial of risk is uncommon, but avoiding thinking about the risk and minimizing its significance appear to be common reactions to risk communications. Furthermore, people with certain characteristics are more likely to engage in these strategies than others. In fact, several personality constructs have been shown to predict reactions to risk communications. For example, individuals characterized by a general tendency to seek threatening information rather than to avoid it (high monitors) respond to risk communications with excessive anxiety that results in avoidance coping and may ultimately be maladaptive in terms of behavior change [(27,28); see Salovey et al. (29) for a review of personality factors related to reactions to risk information].

A series of studies (30–32) has explored the relation between defensiveness and awareness that one’s precautionary behavior is less than optimal. This research has demonstrated that people engage in defensive strategies primarily when their risk behavior is made salient. Furthermore, people with high self-esteem find the implication that they are engaging in inappropriate or unwise behavior to be more aversive than do those with low self-esteem. Thus, they are more likely to become defensive in response to risk messages that make their shortcomings salient. In contrast, people with low self-esteem are not as surprised to learn that their health behavior is less than optimal and respond to such information with less defensiveness (31–33).

## Self-Esteem and Defensiveness

The important question here is whether these individual differences in defensiveness affect health; in other words, does it interfere with salutary behavior? To answer this question, we examined changes in risk estimates among adult participants in

smoking cessation groups conducted by the American Lung Association (16). Perceptions of vulnerability to smoking-related diseases, commitment to quitting, and self-concept were assessed before, during, and after participation in the clinics. The measure of vulnerability used in this study was conditional—“If you were to continue smoking [start smoking again], what would be the likelihood that you would develop . . .” (followed by a series of smoking-related diseases, each answered on a 0%–100% scale). No differences were seen in the risk perceptions of high and low self-esteem participants at the beginning of the study, and no changes in the risk perceptions of the abstainers or of the low esteem relapsers between the quit date and the 6-month follow-up. Consistent with our other studies of self-esteem and risk information, however, many of the high esteem relapsers adjusted their perceptions of vulnerability after they resumed smoking—they (significantly) decreased their risk estimates between the quit date and the follow-up. In addition, there was a significant correlation between these changes in risk estimates and commitment to future smoking cessation attempts. More specifically, the relapsers who demonstrated the most defensiveness (i.e., decreases in risk estimates) reported lower levels of commitment to future attempts to quit. Thus, it appears that the defensive cognitive strategies exhibited by high esteem individuals may soothe their egos but may also inhibit adaptive behavior change.

To summarize, the evidence on defensive reactions to risk communications is mixed. On the one hand, it appears that people are *relatively* accurate regarding risk and tend not to delude themselves about either the probability of negative consequences or the potential severity of those consequences. On the other hand, some people, namely those with high self-esteem who have engaged in risky behavior, are particularly facile at minimizing their vulnerability when their risk behavior is made salient to them, and this process may have adverse behavioral consequences. Thus, it appears that, for risk information to have maximum effect on risk perceptions or risk behavior, it must be presented in a manner that reduces defensiveness and reactance.

So far, then, we have come to somewhat disheartening conclusions regarding two of the questions we posed at the beginning of the paper. First, there is insufficient empirical evidence from longitudinal studies to support the hypothesis that perceptions of vulnerability motivate precautionary behavior. Second, it would appear that a percentage of the population is capable of at least minimizing (if not ignoring) risk information. To address the more general question about whether risk information can have an effect on risk perceptions, we turn to experimental studies of the effects of generic (nontailored) risk communications.

## CAN GENERIC (NONTAILORED) RISK COMMUNICATIONS ALTER RISK PERCEPTIONS?

A number of studies have addressed this question by examining the effects of providing people with nonspecific information about health risks with which they are relatively *unfamiliar*. For example, Weinstein and his colleagues (34,35) distributed a brochure about the risks associated with radon exposure in communities that had significant radon problems but had not been targeted for media coverage of the problem. They demonstrated that informing homeowners that there was a “substantial probability” of finding high radon levels in homes in their communities significantly increased the homeowners’ perceptions of the likelihood that their own homes had unhealthy radon levels.

Mahler et al. (36) provided a demonstration of the effect of relatively *familiar* risk information, i.e., information about the risk of skin cancer associated with exposure to the sun, on perceptions of vulnerability. In this study, participants were shown one of two 10-minute slide shows depicting the proper use of sunscreen. One of the slide shows emphasized the use of sunscreen to prevent skin cancer, and the other focused on the use of sunscreen to prevent age spots and wrinkling. The participants who watched either of these slide shows had higher postintervention risk estimates than did those in a no-information control group.

A different strategy has been used to change risk estimates among young women who are engaging in another relatively familiar risk behavior—unprotected sex. In these studies (30–32), women who were engaging in unprotected sexual intercourse were asked to think about the number of times they had failed to use appropriate protection. This review of previous behavior, which was intended to serve as a reminder that that behavior had been risky, did, in fact, increase the women's estimates of the likelihood that they would contract a sexually transmitted disease or have an unplanned pregnancy. Thus, simply reminding people that their behavior has been risky can increase risk estimates. It should be noted, however, that, in two of these three studies, self-esteem moderated the effect of review on risk estimates, such that the review had a greater effect on the risk estimates of low than high esteem women.

In summary, there is evidence that risk communications that are not tailored to individual differences in risk factors can affect risk perceptions. Furthermore, it appears that these communications can be in the form of information about new risks or reminders of risks about which people are already knowledgeable. The research on individual differences in defensive reactions to such information (e.g., differences in monitoring and blunting and in self-esteem), however, indicates that these nontailored communications are more effective for some people than for others. Concern about such individual differences in reactions to risk information has resulted in recent research exploring the efficacy of risk information that is tailored to the individual. These studies have generally focused on matching the message to either recipients' readiness for behavior change or their risk status.

### **MATCHING COMMUNICATIONS TO READINESS FOR BEHAVIOR CHANGE**

Theoretical models that describe health behavior change in terms of discrete stages rather than continua have a long history in health psychology. For example, the Transtheoretical Model of Behavior Change suggests that people go through five distinct stages in the process of quitting a risk behavior or adopting a precautionary behavior. The model suggests that the kinds of interventions that are successful in changing behavior vary from stage to stage (37). Similarly, the Precaution Adoption Process Model outlines different kinds of information that are useful in moving people from one stage of precaution adoption to the next (38). Until recently, however, little research had been directed toward investigating the efficacy of tailoring risk communications to the recipient's stage.

An example of the potential of this approach can be found in an experimental test by Weinstein et al. (39) of the effectiveness of risk communications about radon exposure. The study focused on two (stage) transitions relevant to home radon testing:

1) the transition from being undecided about testing one's home (stage 3 in the Precaution Adoption Process Model) to deciding to test (stage 5) and 2) the transition from deciding to test to actually ordering a test (stage 6 in the model). The hypothesis was that risk communications designed solely to increase risk estimates would be effective in getting undecided people to decide to test their homes but were not what was needed to move people who had already decided to buy a test to the next stage, i.e., they would not increase the likelihood that people at stage 5 would move to stage 6. Likewise, it was hypothesized that a message that stressed the ease of testing would have no effect on the attitudes, beliefs, and behaviors of those who had not yet decided to test (movement from stage 3 to stage 5) but would facilitate action among those who had already decided to test (movement from stage 5 to stage 6).

The results were as expected: Risk information was very influential in getting people to decide to buy radon home test kits, but it had no effect on people who had already decided to purchase the kits. Similarly, information on how to conduct the test was successful in getting people to buy and use the kits but only if they had previously decided to conduct the test. Thus, this simple experiment demonstrated that risk information has different effects at different stages of precaution adoption and, therefore, lends support to the utility of stage models in developing tailored risk communications.

### **USE OF BIOSTATISTICAL MODELS TO TAILOR RISK INFORMATION**

A different kind of tailoring has been designed to take advantage of increasingly accurate biostatistical models of risk projection. These studies typically provide participants with feedback from an individualized health risk appraisal that is designed to estimate their morbidity and mortality risk for various diseases on the basis of their medical history, health habits, and diagnostic assessments, such as blood pressure and cholesterol levels. For example, Avis et al. (40) employed this approach to provide individuals with information regarding their risk of heart attack and to determine whether such information could alter optimistic bias. In this study, the participants were asked to rate their own likelihood of having a heart attack or stroke within the next 10 years compared with others of their age and sex. After answering this question, participants completed a health risk appraisal that included weight, cholesterol level, blood pressure, and self-reports of family history of heart disease, smoking behavior, physical activity, and recent life stress. The results of this study were disappointing in that the vast majority of participants (>70%) did not change their risk perceptions during the 7–12 weeks between the health risk appraisal and the follow-up assessment. Although the above-average-risk participants were more likely to decrease their optimistic bias than were the average and below-average risk participants (21% responded to the information by decreasing their optimistic bias), 12% of those who received high-risk feedback actually increased their optimistic bias.

In a similar but more comprehensive study of the use of biostatistical data to alter perceptions of vulnerability, Kreuter and Strecher (41) asked adult patients in a primary care setting to report their likelihood of having a heart attack, stroke, or fatal motor vehicle crash or of getting cancer "compared to that of others your age and gender" and then to complete a computer-administered health risk appraisal. The appraisal elicited self-

reports of age, height, weight, body frame, diabetes, blood pressure, cholesterol level, smoking, and alcohol consumption. In addition, women were asked about their family history of breast cancer, age at menarche, age at parity, and history of hysterectomy, mammograms, and Pap smears. On completion of the appraisal, patients were provided with feedback regarding their actuarial risk of 10-year mortality as a result of heart attack, stroke, cancer, and automobile accidents. Six months later, the patients responded to the question about their vulnerability again to assess whether the feedback had an effect on optimistic and pessimistic biases. The results of this study were mixed—risk appraisal feedback reduced optimistic bias for stroke and reduced pessimistic bias for cancer. It did not, however, affect risk estimates for heart attack or motor vehicle crashes or reduce optimistic bias for cancer or pessimistic bias for stroke.<sup>2</sup>

Although these two studies (40,41) failed to provide clear evidence that health risk appraisals can affect risk perceptions, both of them employed limited measures of perceived vulnerability. More specifically, both studies employed a measure of comparative risk that assessed participants' perceptions that they were more or less vulnerable than the average person. Thus, these studies were designed to measure the effect of risk appraisals on optimistic bias and pessimistic bias rather than risk estimates, and these biases have been shown to be exceptionally resistant to change (42).

### USE OF GENETIC BIOMARKERS IN TAILORING RISK COMMUNICATIONS

The current generation of research on the effect of risk communication is evolving in conjunction with the rapid development of our ability to assess risk accurately with various physiologic measures and biomarkers. A provocative example of this approach is provided by the examination by Lerman et al. (43) of the effectiveness of individualized genetic biomarker feedback in changing risk estimates and behavior in adult smokers. This study incorporated biomarker feedback about exposure and genetic susceptibility into a quit smoking intervention. One group of smokers (consultation treatment) received a standardized 60-minute individual smoking cessation consultation that included development of a quitting plan, a menu of quitting strategies, and advice on gaining support from friends and family for the quit effort. The second group (exposure feedback treatment) received the same consultation plus feedback about their personal carbon monoxide level and comparison of their level with typical levels for nonsmokers and ex-smokers. The third group (susceptibility feedback treatment) received the consultation, exposure feedback, and feedback regarding their individual susceptibility to exposure (i.e., CYP2D6 genotyping). For example, smokers whose genotype indicated that they metabolized tobacco carcinogens extensively were told that, because of their genetic make-up, they had a higher risk of developing lung cancer than did other smokers who did not have the same genetic make-up. The results of this study indicated that the susceptibility feedback had a dramatic effect on risk estimates—the exposure plus susceptibility feedback treatment resulted in a sixfold increase in risk estimates relative to the consultation treatment. Thus, this study suggests that biomarkers and other physiologic feedback may be useful tools in providing individualized feedback that can affect risk perceptions and risk behaviors.

Is risk communication an effective way to change risk per-

ceptions? A number of studies have demonstrated that, in spite of optimistic bias and natural defensiveness, providing people with risk information and reminders of their risk behavior can alter their estimates of both familiar and novel risks. These effects have been demonstrated for diverse risks ranging from home radon, unplanned pregnancy and sexually transmitted diseases, and skin damage from the sun, to osteoporosis, colorectal cancer, and the dangers of smoking (30–32,35,43–45). Thus, there is convincing evidence that a variety of approaches to risk communication can be effective in altering risk perceptions. What we do not know for sure as of yet, however, is whether risk information that is tailored to individual differences in risk characteristics and readiness to change is more effective in changing risk perceptions than is nontailored information or whether tailoring can be useful in overcoming defensive responses to risk communications. Although the assumption that tailoring risk information will produce stronger effects is appealing, currently there are insufficient data to either support or refute this assumption.

### WHEN DOES CHANGING RISK PERCEPTIONS INFLUENCE BEHAVIOR?

We suggest that asking the simple question of whether changing risk perceptions influences behavior ignores much of what we have learned about the complexity of risk and precautionary behavior over the past 20 years. In particular, it ignores evidence that, because people go through stages of behavior change and precaution adoption, risk information is more relevant at some stages than it is at others. It also ignores the finding that there are individual differences in responses to risk information and, more specifically, that some people respond defensively to this information. Finally, it ignores the finding that complex and multiterminated precautionary behaviors, like breast self-examination and smoking cessation, are less likely to be affected by risk information than are simple behaviors (e.g., getting flu shots). Therefore, we suggest that the appropriate question is not whether risk information is effective in altering risk behavior but rather, "What are the conditions under which risk information is most effective in moving people toward behavior change?"

Consistent with this framing of the question, the Precaution Adoption Process Model suggests that changes in intention will occur only when a change in behavior is perceived to be effective and the problem is perceived to be severe enough to warrant action. In other words, risk information will lead to intention to alter behavior only when it is accompanied by perceptions that the problem is severe and that the behavior change will be efficacious. Efforts to demonstrate this effect under other circumstances are most likely doomed to failure.

Our search of the literature revealed only two studies (one published and the other in preparation) that demonstrate that risk perceptions mediate the effect of risk information on intention to change behavior. First, Fong GT et al. (manuscript in preparation) report that genetic counseling is effective in altering risk estimates of ovarian cancer among women patients at an ovarian cancer clinic and that these changes in risk estimates mediate the relation between actual risk and intentions to have future screening. In this study, both the severity of the cancer and the efficacy of early detection through screening were important components of the counseling session. Similarly, Mahler et al. (36) provided participants with information about the probability and severity of skin damage from ultraviolet rays and about the efficacy of

sunscreen use. The information was effective in altering estimates of vulnerability to skin damage, and these perceptions did mediate changes in intention to use sunscreen. Furthermore, these authors were able to follow a subset of their participants and found that their interventions were successful in decreasing the amount of sun exposure in these people, as indicated by melanin skin content 6 weeks later. Although the small number of participants in the follow-up sample did not permit definitive conclusions about the mediation of behavior change by change in risk perceptions, these data are consistent with this interpretation.

The study by Lerman et al. (43) described earlier leads to similar conclusions, although these authors did not directly address the role of change in perceived risk as a mediator. They did examine the effects of their intervention by stage of behavior change and concluded that smokers in either biomarker feedback group who were in the preparation stage at the beginning of the study (as defined by the Transtheoretical Model of Behavior Change) were more likely to decrease their cigarette smoking during the 2-month follow-up period than were those in the consultation group.

All three of these studies [(43,36); and Fong GT et al.: manuscript in preparation] meet the conditions specified in the Precaution Adoption Process Model in that the interventions included components that addressed the *severity* of the risk and the *efficacy* of behavior change. There is, however, surprisingly little research on *how* perceptions of vulnerability and severity interact with perceptions of the efficacy of behavior change to motivate the adoption of precautionary behavior. Given that most people view cancer as extremely severe, these studies suggest that future research examine the efficacy of risk communications that are personalized with regard to individual differences in personal risk factors, ability, or willingness to acknowledge vulnerability and with readiness to change behavior when the disease outcomes are perceived to be severe.

## FUTURE DIRECTIONS FOR RESEARCH

Although there are gaps in our knowledge about the effects of risk communication on risk behavior that need to be filled, there are also exciting developments in the field. The next generation of research can achieve more methodologic precision than the last generation, while taking advantage of new developments in tailoring feedback. More specifically, we propose the following four future research directions:

1) To avoid misinterpretation of results because of covariation of prior perceptions of risk and risk behavior, tests of the effect of cancer risk communications on risk perceptions and precautionary behavior should include (a) risk communication interventions compared with no-information control groups, (b) preintervention and postintervention assessment of risk perceptions and risk behavior, and (c) appropriate statistical analyses to detect the role of risk perceptions as a mediator of changes in behavior, controlling for the covariation of perceived vulnerability and prior behavior.

2) Cancer risk communications do not just provide information about new risks. In many cases, they primarily serve as reminders that one's current or past behavior has been unwise. In these cases, people are not passive recipients of risk information but, instead, can be extremely adept at a variety of cognitive strategies to protect themselves from information they do not want to hear. Consequently, we need research that furthers un-

derstanding of defensive reactions to risk communications. We also need research on interventions that reduce this defensiveness and minimize the psychologic reactance that often occurs when a risk communication reminds individuals (especially those individuals with high self-esteem, low monitoring, and high blunting) that their recent behavior has been potentially unhealthy or risky.

3) Much of the literature on risk communication focuses on specific diseases (e.g., breast cancer), or even specific precautionary behaviors (e.g., breast self-examination). This kind of research furthers our knowledge about the effectiveness of various risk communication strategies in altering specific behaviors. It does little, however, to build a body of knowledge that is applicable across diseases and behaviors. If the vast majority of risk researchers focus exclusively on the diseases or risk behaviors that are of interest to them, the result will be a failure to examine questions that are applicable to a variety of diseases and behaviors. For example: Does altering behavior that has short-term versus long-term consequences require different risk communication strategies? Do preventive and screening behaviors require different strategies? We suggest that there is a need for research that compares the effect of various risk communication strategies across different types of diseases and precautionary behaviors and that this research should be designed to explore these differences and advance theory relevant to risk communication across different kinds of behaviors.

4) Finally, we suggest that the exciting new research on tailoring feedback to individual risk characteristics should be expanded to include tailoring on additional individual difference variables. For example, risk appraisals that typically include assessment of health habits, such as exercise and smoking, could be expanded to include assessments of defensiveness about current behaviors (e.g., inflated perceptions of prevalence, minimized perceptions of susceptibility, or misattributions of responsibility), as well as readiness to change specific behaviors. Likewise, interventions that provide feedback on genetic susceptibility to lung cancer could be structured to include measurement of perceived severity and perceived efficacy of smoking cessation to guide counseling strategies for individual participants. Such steps would go a long way toward integrating the theoretical and empirical progress of the past 20 years of research on risk and precautionary behavior, behavior change, risk perception, and risk communication.

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## NOTES

<sup>1</sup>It should also be noted that many screening behaviors (e.g., breast cancer screening) should not affect perceptions of future vulnerability.

<sup>2</sup>The advisability of altering perceptions that one is more vulnerable than the average person (i.e., pessimistic bias), and thereby possibly increasing risk behavior, and the question of whether accurate risk perceptions are necessary for behavior change are both important issues, but they are beyond the scope of this paper.