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Cancer Risk Elicitation and Communication: Lessons from the Psychology of Risk Perception

William M. P. Klein, PhD; Michael E. Stefanek, PhD

ABSTRACT Cancer risk perceptions are a key predictor of risk-reduction practices, health behaviors, and processing of cancer information. Nevertheless, patients and the general public (as well as health care providers) exhibit a number of errors and biases in the way they think about risk, such that their risk perceptions and decisions deviate greatly from those prescribed by normative decision models and by experts in risk assessment. For example, people are more likely to engage in screening behaviors such as mammography when faced with loss-based messages than gain-framed messages, and they often ignore the base rate of a given disease when assessing their own risk of obtaining this disease. In this article, we review many of the psychological processes that underlie risk perception and discuss how these processes lead to such deviations. Among these processes are difficulties with use of numerical information (innumeracy), cognitive processes (eg, use of time-saving heuristics), motivational factors (eg, loss and regret aversion), and emotion. We conclude with suggestions for future research in the area, as well as implications for improving the elicitation and communication of personal cancer risk. (*CA Cancer J Clin* 2007;57:147–167.) © American Cancer Society, Inc., 2007.

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INTRODUCTION

How do people think about risk? As health risk information becomes more available via the Internet and other sources, and as people become increasingly engaged in decision making together with their health care providers,^{1,2} meaningful answers to this question are more important than ever. Oncologists, primary care clinicians, and other health care providers continue to be charged with eliciting risk beliefs from their patients, as well as communicating risk information about strategies for cancer prevention, whether or not to engage in genetic testing, and how to treat a diagnosed occurrence of cancer. Early work on risk perception demonstrated what is now a widely accepted phenomenon—that laypeople think about risk in ways that deviate from those of expert risk assessors. For example, Slovic and colleagues^{3,4,5} demonstrated that when considering various environmental risks, people tend to feel most vulnerable to those that are most involuntary and evoke the most dread (eg, nuclear reactors). Consequently, people greatly overestimate the risk of such exposures, yet underestimate the risks of others viewed as voluntary or less dreadful (eg, use of home swimming pools).

Whereas much of this early work focused on environmental risks, recent work has addressed beliefs about personal risks and the various psychological processes that underlie these beliefs. As will be seen throughout this paper, the preponderance of current work suggests that lay risk perception is influenced by a wide variety of cognitive, motivational, and affective factors. These psychological processes often lead to errors and biases in the perception and expression of risk among laypeople, as well as health care providers. The influence of these processes is of utmost importance to understand in the cancer context, given that many decisions (eg, avoiding known risk factors, utilizing screening tests, undergoing *BRCA1/2* testing, and making treatment decisions and end-of-life decisions) are tied inextricably to comprehension and perceptions of personal risk. The goal of this article is to review what is known about the psychology of risk perception and consider implications for eliciting risk beliefs from and communicating risk information to patients in the cancer context.

Importance of Risk Perceptions

Much evidence suggests that risk perceptions are related to health behavior, medical-decision making, and the processing of health information. For example, higher risk perceptions for breast cancer are reliably (though moderately) predictive of mammography screening.⁶ Unfortunately, many studies are cross-sectional, obscuring the relationship, given that behavior may influence risk perceptions and given that other variables (eg, demographics, personality differences) may concomitantly influence both risk perceptions and behavior.⁷ A recent meta-analysis of vaccination behavior shows that prospective studies may reveal a stronger association between risk perceptions and behavior than do cross-sectional studies.⁸ In some domains, the relationship between risk perceptions and behavior is very small; for example, there is almost no relationship between HIV risk perceptions and sexual behavior.⁹ This may result from the fact that health decisions are sometimes made in the “heat of the moment” without sufficient reflection. Moreover, there are likely many moderators of the risk perception-behavior relationship; for example, the relationship between cancer risk perceptions and quitting intentions among smokers may be stronger among those low in cancer worry than among those high in cancer worry (W.M.P.K., L. E. Zajac, BA, M. M. Monin, BA, unpublished data, 2007).

People who feel more at risk spend more time seeking out and processing information that might be used to reduce their risk. In a recent national survey of cancer risk perceptions, individuals who perceived their colon cancer risk to be higher than average were also more likely to have sought cancer information.¹⁰ Interestingly, the nature of that information may influence risk perceptions as well; the same survey showed that people who perceive inconsistency in available messages about cancer-risk reduction felt more at risk and viewed cancer as less preventable.¹¹ This is notable, given the preponderance of cancer-risk messages currently available via multiple information outlets. No research has tested the direct causal effects of ambiguity in cancer messages on risk perceptions and perceived preventability, but these correlational data suggest the need for such research.

Of course, perceiving high personal risk can be anxiety provoking, suggesting that optimistic biases in risk perceptions (ie, perceiving one's risk to be lower than it actually is) might be health promoting.^{12,13} Unfortunately, few studies address how optimistically biased risk perceptions may be related to health outcomes, in large part because it is difficult to assess the accuracy of a risk perception at the level of the individual. It is much easier to show an optimistic bias at the level of the group—ie, if most members of a sample believe that their risk of a normally distributed health event is below average, we can conclude that at least some of them are biased. One approach for assessing accuracy at the level of the individual is to use a risk algorithm to determine a person's risk and then compare a person's subjective-risk estimate with that computation.^{14,15} Another is to track whether an event for which individuals make a prediction actually happens at some point in the future, an approach that is time intensive.¹⁶

The limited number of studies that do assess optimistic biases in risk perception at the level of the individual seem to suggest that these biases are detrimental.¹⁷ For example, smokers who underestimate their lung cancer risk are also more likely to endorse myths supportive of smoking (eg, that there is no increase in risk of lung cancer if one smokes for just a few years) and show lower intentions to quit relative to accurate smokers.¹⁸ People who underestimate their heart disease risk have less knowledge about the causes of heart disease, learn less from educational materials about risk factors, and worry less about getting heart disease.¹⁵ Although correlational, these findings suggest that inaccuracies in risk perceptions can be consequential.

INNUMERACY

In an influential book on innumeracy published in 1988,¹⁹ Jean Paulos highlighted an observation crucial to examining lay risk perception—that people have difficulty coping with and thinking about numerical information. Paulos noted that numeracy often is not valued and is a cause of anxiety. Research suggests that some women may perform poorly on mathematical tasks simply because they fear confirming the

negative cultural stereotype of women's mathematical abilities, a level of anxiety that in turn impedes their performance (independent of actual ability).²⁰

Of course, innumeracy spans both sexes, and many individuals lack the minimal skills needed to make use of numbers embedded in health-related materials. Even among quite highly educated samples, less than half of those tested are able to convert proportions to percentages (eg, 1 in 1,000 to 0.1%).^{21,22} For example, Lipkus et al²² asked 3 samples to imagine that the chance of getting a viral infection was .0005 and to estimate from this information how many of 10,000 individuals would get the infection. The mean ages of the 3 samples were 47.9 years, 53.4 years, and 62.7 years, and the percentages of individuals who had more than a high school education in these samples were 93.6%, 88.4%, and 84.4%. Nevertheless, across the 3 samples, only 48.6% answered this item correctly, and when asked to convert a proportion (20 out of 100) to a percentage, only 70.4% answered correctly. This innumeracy is often accompanied by low health literacy, or the difficulty in making sense of medical information such as prescription instructions.²³ It is notable that mathematics classes at the secondary level prioritize the teaching of probability and statistics lower than less applicable skills such as geometry, and it is rare that the former skills are taught in ways that highlight their relevance to everyday functioning.²⁴

Although innumeracy has been well documented, “therapy” for difficulties with quantitative information has lagged significantly behind. Beyond generic recommendations to remedy our educational system, it seems that teaching strategies for examining quantitative information to determine which numbers are clearly important in risk perception and health literacy is a necessary step. Clearly, some numbers are more important than others in any given quantitative presentation. Teaching that involves determining just what number in an array of quantitative information is the most important forces us to determine why the numbers are important in the first place, what we are trying to learn from the numbers, and what numbers can (and cannot) tell us.

Percentage Scales

Innumeracy can be seen in the idiosyncratic way in which people use the percentage scale. Often “50%” is used in a “non-numeric” fashion, simply suggesting a lack of precision (“might happen, might not happen”), and people often respond with this percentage if they are asked to estimate their own risk and are unsure.²⁵ Percentages between 0% to 1% (which characterize many risks, such as the risk of serious side effects from some medications) are often not endorsed by people using percentage response scales, leading people to overestimate small risks.²⁶ Visually emphasizing this portion of the scale on a questionnaire only serves to reduce all risk estimates—both those in the 0% to 1% range and those at the upper end of the scale (eg, 60% to 90%).²⁷ People often fail to understand that probabilities of events in a set that includes all possibilities (eg, percentage chance of polyp presence plus percentage chance of polyp absence) must add up to 100%,²⁸ that the probabilities of independent events must be multiplied and not added, and that the conditional probability of Event A given Event B does not necessarily equal the probability of Event B given Event A.²⁹ For example, the probability of getting breast cancer given that one has a mutated *BRCA1* or *BRCA2* gene is 60% to 80%,³⁰ but the probability that a woman who develops breast cancer also happens to have a *BRCA* mutation is substantially lower. Similarly, the percentage of smokers who get lung cancer is substantially lower than the percentage of people having lung cancer who smoke.

Frequency

Risk is often elicited or presented as a frequency in fraction form (eg, 8 of 100 patients die from this procedure). People often give undue weight to the numerator relative to the denominator in such a fraction; in the example above, they focus more on the 8 people who die than on the 92 who do not, and thus, increasing the denominator to something larger (while holding the numerator constant) might change their level of worry only nominally. In a telling demonstration, undergraduates were asked to choose between 2 bowls of jelly beans—one with 1 red jelly bean out of 10 and the other with 7 red

jelly beans out of 100—and were told they would win a prize if they randomly selected a red jelly bean out of the bowl they chose.³¹ Many preferred the second bowl (despite the lower probability of winning) because they focused on the 7 ways of winning compared with 1 way of winning in the first bowl. In many cases, participants acknowledged the difference in probability, yet still preferred the second bowl. In another example, when clinicians were asked to consider the release of a psychiatric patient and were told that 20 of 100 similar patients were expected to commit a subsequent act of violence, 41% refused to discharge the patient. However, when instead told that 20% of similar patients were expected to commit such an act, only 21% refused to discharge the patient.³² People are more attuned to frequency than to probability and are, in fact, less susceptible to some of the judgment biases we discuss later when presented with frequencies rather than probabilities.³³

People also may fail to produce and react to frequencies in context. When smokers in one study were asked to estimate how many of 100 smokers would develop lung cancer, the average response was 43 (a gross overestimation, which the author used to argue that tobacco companies should be held blameless for the surge in smoking-related deaths).³⁴ However, it is possible that respondents were simply not paying attention to the many other possible health consequences of smoking. In a follow-up study, a more comprehensive list of consequences was provided to a sample of smokers, and they were asked to indicate how many of 100 smokers would experience each consequence. Another group only estimated the number that would get lung cancer, as in the initial study. The estimate was 48 in the latter group (much like the above study), but went down to 30 in the multiple-consequences group.³⁵ These participants were not asked about their own personal risk, but it is likely that the same pattern would be obtained if they had.

One of the most important types of frequency to a patient is how often 2 events co-occur, such as having an adverse reaction to a medication or getting breast cancer after having a breast injury. Just as people focus on the numerator in single-event frequencies, they focus more on co-occurrences

of 2 events than on any of the other 3 combinations (absence of both events, occurrence of only the first event, or occurrence of only the second event). Consequently, they may perceive an “illusory correlation.”³⁶ Such an illusory correlation is particularly likely to be perceived between events that are vivid, temporally proximal, or salient in some other way.³⁷ Co-presence, rather than co-absence of events (or the presence of one event and absence of another), is generally more vivid and memorable, thereby leading to the discounting of circumstances where events did not co-occur (eg, recalling friends who had breast injuries and did not develop breast cancer).

Underaccumulation

Although people may understand the meaning of a static-risk estimate, such as 10%, they may not necessarily comprehend the exponential accumulation of risk over time. For example, there is a curvilinear relationship (representing an exponential increase) between smoking and lung cancer risk over an extended period of time,³⁸ and yet smokers fail to see this dramatic increase in risk.³⁹ Similarly, although young adults tend to overestimate the risk of contracting HIV after one liaison with a partner who is HIV seropositive, they fail to see how quickly the risk of HIV accumulates after multiple exposures to HIV-seropositive partners.²⁶

Verbal Labels

A potential solution to innumeracy is to use verbal labels in the elicitation and communication of risk. Evidence does indeed support the elicitation portion of this conclusion; people’s verbal estimates (eg, “I feel at risk for influenza.”) are more predictive of health behavior than are their numerical estimates,⁴⁰ and such estimates are more sensitive to intervention.⁴¹

However, it is less clear that verbal labels should be used to communicate risk. For example, the European Commission created verbal labels to denote the chances of experiencing pharmaceutical side effects⁴²; for example, “common” signified a side effect that occurred 1% to 10% of the time. When Berry and colleagues⁴³ asked community volunteers and university students to guess

what these labels represented, the estimates were far higher; “common” was thought to represent a side effect occurring 45% of the time. To the extent that these estimates are meaningful (a complicated question given the difficulty that people have with probability as noted earlier), they lead to the implication that people may fail to take prescribed medication because they greatly overestimate the chances of experiencing side effects. Furthermore, given that there are significant cultural and racial differences in risk perception (for example, one study showed that African American women were less likely than White women to elevate their breast cancer-risk perceptions after having a relative diagnosed with breast cancer⁴⁴) and given that risk is often culturally defined,⁴⁵ it is highly likely that there are cultural (and other) differences in the way such verbal labels are interpreted.

Summary

Many people have a great deal of difficulty using and responding to numerical information, which is a significant problem given that risk is almost always conveyed in numerical terms. They interpret proportion and probability differently than they do equivalent frequency information and have trouble understanding the meaning of conditional probability (eg, chance of having breast cancer given an abnormal screening mammogram). They overestimate how often events co-occur and fail to see that risk accumulates rapidly over time or multiple exposures. Use of verbal or qualitative terms is not a panacea, as the interpretation of those labels can vary greatly from the intended meaning. There are certainly individual differences in numeracy, but even educated individuals can have difficulty with numerical information.^{21,22} Notably, a disproportionate number of studies of these errors are based on data collected from university undergraduates, suggesting the need for replication in more diverse samples.

USE OF HEURISTICS

Given the immense amount of information people face on an everyday basis—numerical or otherwise—it is useful to have heuristics (or “rules of thumb”) to make various types of judgments,

such as frequency (eg, how many people smoke), covariation (eg, how many smokers get lung cancer), similarity (eg, how much is my smoking friend like smokers who have gotten lung cancer), and normativeness (eg, how unusual is a smoker who died from something other than lung cancer). Often heuristics are used properly and judiciously to make these kinds of judgments. However, as would be expected given that their use suggests attention to incomplete information, heuristics can often lead to inaccurate judgments and faulty decisions. We refer the reader to reviews of the heuristics literature,^{37,46} including applications to medical judgment and decision making.⁴⁷ Given the universal importance of heuristics in daily functioning, it is also notable that physicians and other health care providers are as susceptible as anyone else to their misuse.⁴⁸ Here we briefly describe various consequences of these heuristics in the context of cancer.

Availability Heuristic

People often make judgments of frequency or covariation using whatever information is most accessible or most available, thereby relying on the availability heuristic.⁴⁶ To the extent that available information is unrepresentative or incomplete, it will lead to erroneous judgments. For example, vivid events such as plane crashes with multiple fatalities are more cognitively accessible (due in part to disproportionate media coverage) than are more “mundane” events with singular or few fatalities such as automobile deaths, leading to exaggerations of the likelihood of the vivid events. Similarly, celebrities developing cancer—made vivid by repeated media exposure—may increase cancer-risk perception and worry.

This heuristic can become problematic when a patient or layperson attempts to “compute” the association between a potential risk factor and the occurrence of a given disease. As noted earlier, people focus on the co-presence of the risk factor and disease without attending to the 3 other cells necessary for this computation or the odds ratio properly computed from all 4 cells.³⁶ The media often focus on special cases, such as a child who developed autism after being vaccinated, so it is easy to see how people may develop

biased beliefs about how events are associated. The availability heuristic may also be problematic when individuals attempt to estimate the proportion of their peers who engage in a given action or hold a given opinion.⁴⁹ For example, if a man's male friends all discount the potential side effects of a prostate-specific antigen test, he may come to see it as having little risk, not recognizing that a different group of male friends might have a very different opinion.

It is worth noting that people rely as much on the subjective perception of accessibility as they do on accessibility itself when making risk judgments. For example, patients asked to list 8 reasons why they do not feel they should adopt an aggressive therapy might actually feel more inclined to accept the treatment than would individuals asked to list 3 reasons because the former group may find it difficult to come up with 8 reasons and conclude from this search that they are not strongly against this option.⁵⁰

Being aware of the operation of this heuristic could be helpful when communicating cancer-risk feedback. For example, an oncologist might be faced with a patient who is resistant to a given type of treatment because he or she is aware of another person who experienced severe side effects or was not helped by this treatment. It may be prudent to offer other vivid examples of patients who benefited greatly from the treatment, accompanied by statistics indicating how often the side effects actually do occur. Although this is unlikely to fully assuage the patient's concerns, it works against the availability heuristic by widening the sample space.

Representativeness Heuristic

When people make predictions or judgments of similarity, they often rely on the representativeness heuristic in that they judge the extent to which a given outcome is representative of the set of possible outcomes. When doing so, they often focus too much on the subjective "expectedness" of the event and not enough on its actual probability.^{46,47} For example, consider the probability of selecting at random a man with a family history of colon cancer. This probability is clearly higher than the probability of randomly selecting a man with a family history *and* unhealthy eating habits, given that

such men are a subset of all men with a family history. However, a man with a family history and unhealthy eating habits "sounds" more similar to one's mental representation of the typical man with colon cancer, which will lead people to say that the probability of selecting such a man is higher.

Another example of misusing the representativeness heuristic is a lack of attention to base rates.⁵¹ Consider a cancer detection test with false positive and false negative rates of 2%. Imagine further that the prevalence of this type of cancer in the population is 10 in 1,000. If asked to estimate the chances of having this type of cancer given that one has tested positive (the positive predictive value), many laypersons would offer a response of 98%. However, according to Bayes Theorem, this conditional probability must take account of the low base rate. Given that 2% of the 990 people who do not have this cancer will test positive, as will 98% of the 10 people with cancer, most individuals in this population who test positive will not have cancer, making the chances that someone with a positive test result actually has this cancer only 33%. When considering the finding that people confuse conditional probabilities²⁹ (such as equating the above probability with the probability of testing positive if one has cancer, which is much higher), it is essential to be careful when discussing the meaning of test results with patients.

A third manifestation of the representativeness heuristic is a failure to understand regression to the mean. When 2 variables are imperfectly correlated (ie, less than a correlation of 1), and one variable (eg, family history) is used to predict the other (eg, life expectancy), the prediction needs to be conservative, given the imperfect correlation. The statistical phenomenon of regression to the mean is why extreme events (eg, families with multiple cancer diagnoses or athletes with particularly impressive seasons) are usually followed by less extreme events (fewer cancer diagnoses or diminished performance in the following season). Yet people fail to understand the notion of regression.^{46,47} One consequence is that people fail to see that continuing improvement over time may reflect regression to an equilibrium, rather than the effectiveness of a given treatment.

A final application is the use of small or statistically unrepresentative samples to make inferences. Contrary to the “law of large numbers” from statistical theory, Tversky and Kahneman argue that people seem to adhere to a “law of small numbers.”^{46,47} Consistent with the undue influence of vivid information demonstrated in research on the availability heuristic, people often do not pay attention to denominators and fail to appreciate the greater representativeness of large samples. Thus, when told that a certain treatment is 75% effective, they may be insensitive to whether this success rate is based on a small sample of patients (eg, 4) or a much larger sample (eg, hundreds or thousands).

Anchoring Heuristic

If asked to estimate whether their risk of developing colorectal cancer is higher or lower than 70% and then asked to give a point estimate of this risk magnitude, patients are likely to end up giving higher estimates than if the original elicitation asked about whether their risk was higher or lower than 30%.^{46,47,52} The initial “anchor” should have no bearing on the ultimate judgment, yet it does because of insufficient adjustment from that anchor. Naturally, some anchors are meaningful (eg, the base rate of a given cancer), but even randomly chosen anchors that respondents know to be meaningless can produce this bias. In the context of a conversation about personal risk, anchors could result from statements about the risk of other hazards or risk magnitudes that are a part of potentially flawed a priori beliefs about disease. Insufficient adjustment is more likely when cognitive resources are limited,⁵³ as might be the case when receiving risk information in a physician’s office.

Anchors also serve as tentative hypotheses that individuals may then attempt to test. Much work suggests that people are biased toward confirmatory information and away from disconfirmatory information when testing hypotheses,⁵⁴ thereby causing even meaningless anchors to exert unintended effects. This problem highlights the potentially damaging effects that inaccurate initial diagnoses can have. Moreover, this confirmation bias is so powerful that when a given hypothesis is subsequently proven wrong, decision makers continue to believe in it because

of all of the seemingly supportive information they have collected in favor of it.⁵⁵

Heuristics and Persuasion

When faced with any message, people may focus on the content of the message itself or, instead, on heuristic cues such as message length, speaker credibility, and peripheral features such as visual appeal.⁵⁶ To the extent that such features are unrelated to the content, people may fail to process the content adequately. Research in the area of persuasion shows that people are more likely to focus on content than on heuristics when a message is personally relevant (as would be the case when receiving personal-risk information relevant to a cancer decision), yet also shows that distraction, defensiveness, and other processes can encourage heuristic processing.^{56,57} In particular, people may be more persuaded by a risk message when the speaker is viewed as credible, the message is one-sided and contains multiple arguments (even if they are not necessarily all strong), and when it is presented with confidence.⁵⁶ To the extent that a health care provider can achieve these features when discussing risk with a patient, the message may be more impactful.

Summary

Given the vast amount of information people face, it is sensible to use resource-saving heuristics to be able to make judgments and decisions. However, sometimes these heuristics can produce error. The availability heuristic may lead one to overestimate how often an event occurs or how often 2 events co-occur. The representativeness heuristic—used to make similarity judgments such as diagnoses—can result in biases such as base-rate neglect, failure to understand regression, and misunderstanding of the importance of sample size. The anchoring heuristic can bias judgments away from accuracy, even when the anchor is nonsensical, and persuasion heuristics can cause health messages to be differentially persuasive based on features other than the actual content of the message.

As noted earlier, people are more responsive to frequencies than to probabilities, and some work shows that presentation of frequency infor-

mation reduces misuse of the representativeness heuristic.³³ Of course, disproportionate focus on numerators rather than denominators can have negative consequences, so it would be important not to present frequency information in ways that would be misleading. This work suggests, though, that there is hope for developing methods to avoid misuse of these heuristics.

MOTIVATIONAL FACTORS

In addition to the cognitive limitations discussed above, people possess several motives that may influence their risk perceptions. We consider several of those motives below.

Self-enhancement

People clearly do not want to feel vulnerable to diseases such as cancer. Instead, they presumably want to believe that they will have healthy lives unmarred by misfortune and disease. This self-enhancement motive can exert an important influence over the way they think about risk. For example, when asked to estimate their risk of experiencing a variety of diseases relative to that of similar peers, a disproportionate number of respondents in many studies estimate their risk to be lower than average—a statistical implausibility.⁵⁸ The genesis of this bias seems to be an overestimation of others' risk rather than underestimation of one's own risk.^{59,60} Nevertheless, when given accurate information about others' risk, respondents attempt to reduce perceptions of their own risk to maintain the perception that their risk is lower than average.⁶⁰ This bias is particularly likely for health problems that are viewed as controllable, for which there are clear stereotypes of the kinds of individuals who experience this health problem, and for which individuals have no prior experience and are temporally distant from having the health problem.^{61,62} It is also highly resistant to change,⁶³ demonstrating to some degree its motivational underpinnings.

These findings may seem at odds with findings that people often overestimate their risk of experiencing some outcomes. Pessimistic biases for health outcomes such as breast cancer are usually obtained when respondents estimate risk on a percentage scale.^{64,65} These pessimistic biases in risk perception, like optimistic biases, are very

resistant to correction.⁶⁶ However, as noted earlier, estimates may not reflect the same use of the percentage scale relative to risk algorithms because of difficulties using numerical information. Some studies show that women may overestimate their objective breast cancer risk and still believe it is lower than that of their peers.⁶⁵

The goal of self-enhancement is also present when people receive risk information that they find personally threatening. Several studies have shown that such information is met with defensiveness, such as derogation of aspects of the message,⁵⁷ distortion of memory for the contents,⁶⁷ and the alteration of attitudes and perceptions of norms related to the message.⁶⁸ Recent work shows that if people are given the opportunity to reflect on their personal values before or just after receiving threatening risk information, they exhibit less defensiveness,^{69,70} suggesting that this may be an effective strategy for communicating threatening risk information.

Veneer of Rationality

When people make important judgments and decisions, they are motivated to appear rational and dispassionate both to themselves and to others important to them.⁷¹ For example, people often seek information that ultimately has no effect on their decisions.⁷² The collection of additional information helps them to feel as if they have made an informed judgment, a phenomenon observed even among physicians.⁷³ In a related example, if people are faced with 2 comparable options (A and B) and are then given a third choice (C), such that B is a compromise between A and C, they will choose B despite the fact that they had no preference between A and B before C was offered.⁷⁴ This is also the case if C is a worse choice than the other 2, but is closer to B than to A. One interpretation of these effects—which have been demonstrated among physicians making treatment decisions⁷⁵—is that people consider compromises to be representative of a reasoned decision.

Another illustration of this motive is in the way people respond to threatening risk information. Instead of simply dismissing such information, people often work to find specific faults with it so that they are not viewed as being defensive. Paradoxically, the best way to induce

people to focus closely on the content of the message rather than peripheral aspects of the message might be to make the message threatening.⁵⁷ It may be necessary, though, to find ways to reduce defensive processing when presenting threatening messages, such as by providing opportunities for self-affirmation of one's values.^{69,70}

A final application is the exaggerated focus on factors that seem to best support a decision. For example, suppose a patient chooses between a treatment that is highly efficacious, yet causes painful side effects (Treatment A), and a treatment that is only moderately efficacious with less severe side effects (Treatment B). If asked which treatment they would choose, they might choose A because they focus on A's benefits. However, if asked instead which treatment they would reject, they might still choose A because they instead focus on weaknesses when thinking about rejection.⁷⁶

Loss Aversion

The pain of loss is often greater in magnitude than the pleasure of gain. This is a primary assumption of Prospect Theory⁷⁷ and makes sense from an evolutionary standpoint, given that the consequences of loss (eg, death, loss of precious resources) are more impactful than the consequences of gains (eg, procurement of additional resources). Prospect Theory predicts that when people are faced with loss, they are more likely to engage in risky behaviors designed to offset that loss than if they are faced with a gain. In an early demonstration,⁷⁸ participants were presented with a vignette describing a disease afflicting 600 individuals. When faced with a choice between a treatment that would save 200 of the individuals or another which might save all 600, but could potentially save none of them, respondents overwhelmingly preferred the first option (reflecting risk aversion). However, when participants were instead faced with a choice between letting 400 die or taking a chance of saving all 600 (with a concomitant chance of saving none of them), participants generally chose the more risk-seeking second option. Notably, the 2 choice sets are identical in terms of probability and lives saved—the only difference was in how they were framed. When exactly the same information was framed in terms of

loss (400 people dying), participants were more willing to choose the option having an uncertain outcome—the risk-seeking option.

Investigators in risk communication have capitalized on loss aversion by demonstrating that people are more likely to be risk seeking when exposed to risk information framed in terms of losses than when exposed to functionally equivalent messages framed in terms of gains.^{79,80} In one study, the investigators devised risk messages promoting mammography that focused either on losses of not getting tested (eg, neglecting to identify a malignancy) or gains associated with mammography (eg, providing reassurance). Women were more likely to get screened in the loss frame.⁸¹ Getting screened involves assuming a risk—namely, the chance of obtaining an unfavorable test result. Although we might not think of this as a risk comparable to the risk of getting cancer or risk of heart disease, it can be a palpable risk to those who screen.⁸² Given that loss evokes risk taking, it makes sense that the loss frame promoted greater interest in mammography. On the other hand, health behaviors that are not inherently risky (eg, exercise, vitamin use) are more likely to be promoted by gain-framed messages.⁸³

The notion of loss aversion extends to other decision-making processes. For example, people often fail to ignore sunk costs (eg, energy, money, or time already invested in a decision that cannot be reversed) when making decisions, therefore persisting with counterproductive relationships, investments, projects, and other pursuits.⁸⁴ Such persistence can be understood from the perspective of loss aversion; ceasing an endeavor is an explicit acceptance of loss rather than a decision to take the risk of potentially erasing that loss. With some exceptions,⁸⁵ sunk-cost effects have not been systematically investigated in the context of health decisions, but one could imagine such effects emerging in patient decisions about medication protocols that are so far ineffective and health choices that continually produce negative health events.

Counterfactual Thinking and Regret Aversion

When people experience negative outcomes, they often attempt to “mentally undo” the events by imagining how various events leading up to

those outcomes could have been different.⁸⁶ To the extent that a given event is malleable (that is, easy to imagine having turned out differently), it may evoke this kind of thinking, as well as a strong emotional response such as regret. As an example, a nonsmoker who has been diagnosed with lung cancer might be plagued with thoughts such as “if only I had tested my house for radon” or “if only I had worked in a non-smoking restaurant.”

Malleable events are not necessarily those that are less probable, just those that are less psychologically “normal,” as it were. For example, people might feel greater sympathy for a plane crash victim who was killed in his house during the landing than one who was a passenger on the plane because being killed in a plane crash when one is not on the plane feels less “normal.” Consider the earlier example of people worrying more about a treatment that has had side effects in 10 out of 100 patients than one having side effects in 1 out of 10 patients. In this case, the probability is the same, yet being the one unlucky patient in the latter scenario may evoke more sympathy than the 10 patients in the former scenario, given that being a solo is less normal. As a final example, consider that when there are population differences in prevalence of a risk factor, it is more likely that an observer will attempt to explain the disparity in terms of the “deviant” group than they will the “normal” group. In one study, when participants learned there was a gender gap in the frequency of a given disease among elementary school teachers, participants explained the difference by referring to aspects of maleness (in this case, the “deviant” group) versus femaleness (in this case the “normal” group) that might produce this difference, given that people think of the typical elementary school teacher as female. However, when the disease was said to differentially affect male and female college professors, the difference was attributed to aspects of women, because the “normal” group of college professors is perceived as male.⁸⁷

The emotional reactions that follow this so-called “counterfactual thinking” can be profound and have an impact on sympathy, legal judgments, and many beliefs. Moreover, people anticipate engaging in such counterfactual thinking before

an event, knowing full well that such thinking may produce a great deal of regret. A male patient might believe that he would never forgive himself if he refused surgery or radiotherapy for localized prostate cancer that then spread to his bones. Much research shows that people are strongly motivated to avoid regret, to the extent that they will avoid actions that generally produce more regret. Consequently, when assessing the risks associated with a given decision, people often weigh the risk of regretting that decision—a risk that may be as important as any of the other risks.^{40,88}

There are factors that moderate the extent of counterfactual thinking and anticipated regret.⁸⁶ One is whether a given decision is an act of omission (eg, not taking a prescribed medication) or an act of commission (eg, taking the medication). People are more likely to regret (and anticipate regretting) acts of commission, which helps explain in part why parents are sometimes reluctant to vaccinate their children, despite the fact that failing to do so (an act of omission) puts their children at greater risk.⁸⁹ Framing risk information with this in mind might be prudent. As an example, people are more likely to accept defaults—an act of omission. Most parents do vaccinate their children, but notice that this is a default that makes the decision *not* to vaccinate more of an act of commission. These findings suggest that one way to convince a patient to accept a treatment is to make it sound like a default option.

Another moderator is the extent to which events are temporally proximal.⁹⁰ For example, if 2 people play a game in which they each flip a coin and a prize will be awarded if both flip tails or both flip heads, whoever flips the second coin will be viewed as the responsible party for the outcome. Relief pitchers in baseball are derided more for their gaffes in the late innings than are players who make similar gaffes in earlier innings. Likewise, one might expect more assigned responsibility for recent events that may have caused cancer or other health outcomes than for more temporally distal events.

Notably, the phenomenon of anticipated regret can be used effectively in a risk communication by highlighting to participants how they might feel if they failed to engage in a clearly recommended

behavior like screening and then suffered severe consequences.⁹¹ As we discuss later, people not only are motivated to avoid regret, but they also overestimate their future emotional reactions, which in this case might encourage them even more to engage in the recommended behavior. Many cancer patients regret their decisions; one study showed, for example, that 23% of men who chose surgical or chemical castration to treat metastatic prostate cancer regretted their decision.⁹² To offset anticipation of such regret, it may be prudent to stress the benefits of treatment more than the side effects and to discuss the possibility of regret.

Perception of Control

Perceptions of control and self-efficacy are essential to the adoption of health behaviors and execution of health decisions.⁹³ Indeed, such perceptions often explain more variance than any other health belief in tests of various health behavior models, such as the Theory of Planned Behavior.⁹⁴ To the extent that a given health problem or hazard is viewed as uncontrollable, people worry more about it and express more pessimism in their risk judgments.³ On the other hand, seemingly controllable outcomes evoke more optimistic biases regarding future risk.⁶² People also believe they are capable of exerting more control over controllable outcomes than others might,⁹⁵ which could explain why people worry more about flying as a passenger in a plane than about driving a car. In the latter case, the risk of dying in a car accident is multiple orders of magnitude higher than the risk of dying in an airplane disaster, yet people believe they are better than average drivers,⁹⁶ so they do not consider the difference in risk to be personally applicable. Intuitively, it seems important to help people feel as if they have maintained control. Notably, this does not necessarily mean that people desire high levels of choice; some work shows that a preponderance of choice can be stressful and undesirable.⁹⁷

Social Comparison

People do not live and evaluate themselves in a vacuum; on the contrary, they seek and are confronted with others with whom they might

compare their own standing on a dimension. According to Festinger,⁹⁸ people are strongly motivated to evaluate themselves across a wide variety of dimensions, such as abilities, opinions, emotions, and morality. He argues that they first seek out objective information to make a self-evaluation (eg, judging one's ability to drive a car by determining whether one can turn it on, arrive at an intended destination, and so forth). When such information is not available, people then turn to social-comparison information. In reality, it is difficult to find dimensions on which purely objective criteria are available, and some research shows that people are influenced by social-comparison information even when objective information is available.^{99,100} Thus, it stands to reason that people's judgments of personal risk might be greatly influenced by the motivation to compare with others. Indeed, both doctors and patients often find it easier to understand and communicate about comparative or relative risk than about absolute risk.¹⁰¹

Much evidence supports these ideas.¹⁰² Comparative-risk perceptions (ie, risk relative to that of similar others) are often as predictive—and sometimes more predictive—than objective-risk perceptions of health behaviors such as screening.¹⁰³ One study showed that high *comparative*-risk perceptions regarding breast cancer were predictive of greater worry about breast cancer, which in turn was temporally predictive of higher *absolute*-risk perceptions.¹⁰⁴ In vignette studies, people who are asked to imagine that their risk is higher than that of similar peers express more worry and greater interest in risk-reducing behaviors.^{99,100}

Perhaps most convincing are studies in which people are given true comparison information in nonhypothetical settings. Two studies of young women who were overestimating their breast cancer risk showed that the provision of social-comparison information was more effective than any other kind of information at correcting risk perceptions and reducing worry.^{66,105} In another study, people who were off-schedule for colorectal cancer screening received information about how their risk compared with that of others. As a result, they were *less* ambivalent about screening (relative to a non-comparison information control group).¹⁰⁶ Notably, this was true whether the comparison information indicated

their risk was above or below average, suggesting that comparative information does not necessarily have to be favorable to be effective. A recent study suggests that receipt of social comparison information can influence behavior up to 3 months later (S. J. Schmiede, PhD, W.M.P.K., A. B. Bryan, PhD, unpublished data, 2007). Related work suggests that comparisons with risk prototypes might influence risk perceptions. For example, young adults who evaluate the “typical young-adult smoker” favorably are more likely to begin smoking themselves, and once they begin smoking, the risk prototype only becomes more positive.¹⁰⁷

The self-enhancement motive influences the processing of social-comparison information. When faced with threatening comparison information regarding their risk, people engage in a variety of defensive processes designed to reduce the threat. One study showed that when people are shown information suggesting their health behaviors are not better than those of their peers, they distort their memory for how often they engage in these behaviors to restore their sense of being better than average.¹⁰⁸ People often estimate their percentage risk as being lower than that of their similar peers, but when given information showing that they were overestimating others’ risk, respondents decreased estimates of their own risk to preserve the sense that their own risk was lower.⁶⁰ When asked to compare their risk with that of a single other individual, people selectively choose someone who is less well off.¹⁰⁹ These studies show that people are motivated not only to compare their risk and risk factors with those of others, but to arrive at comparisons that are favorable. As a result, risk communications should not only provide social-comparison information, but also take measures to offset potential defensive reactions to that information.

Finally, people can differ greatly in their orientation toward social-comparison information.¹¹⁰ Using a validated measure of these differences, one study showed that a linkage between perceived norms and risk perceptions only exists among those high in social-comparison orientation.¹¹¹ Work such as this highlights an important conclusion to be drawn from all of the research discussed in this paper—that motives vary greatly

both inter- and intraindividually, suggesting that one must tailor risk communications thoughtfully based on the person and context.

Preparedness for Unfavorable Feedback

People do not like to be taken by surprise when they receive personally relevant feedback, risk-related or otherwise. Consequently, when feedback is potentially negative, people often “brace” for the possibility of bad news as a coping mechanism,¹¹² even if the probability of bad news is low. One manifestation of this proactive-coping process is to become more pessimistic as the “moment of truth” comes closer, leading people to go from being unrealistically optimistic to unrealistically pessimistic in their risk estimates.¹¹³ When eliciting risk perceptions from a cancer patient regarding the risk of various therapies, it is essential to understand that this proactive-coping strategy is taking place so as to understand the patient’s risk perceptions in context. Patients may convey excessive pessimism and, at other moments, optimism about the chances of a given treatment outcome, and the temporal proximity of the outcome may easily account for such fluctuation.

Summary

We have discussed a number of different motivational processes that could exert an important influence over how people think about risk. People are motivated to hold self-enhancing views of their risk and also endeavor to appear rational to themselves and others. They are particularly averse to loss, as well as to regret. People also care about having control over their health outcomes and about comparing favorably with their peers. Although these motives may often color risk perceptions in an optimistic direction, people also do not want to be caught by surprise when bad news arrives, making them more pessimistic just before getting risk feedback. Although there is little research addressing how these various motives interact, it is clear from these independent lines of work that failing to acknowledge the role of motivation when communicating risk could be imprudent.

We have certainly not exhausted here all of the possible motives that may influence risk

perception. For example, another line of work shows that people may be motivated to avoid ambiguous risk information, such as conflicting recommendations about cancer-risk factors; such information can increase risk and worry inordinately and also lead to greater beliefs that cancer is unpreventable.¹¹ Another line of work shows that when people reflect on their mortality, they are not only motivated to reduce their mortality risks, but also to engage in behaviors that increase personal meaning and social connection. These motives can come into conflict; for example, using sunblock reduces skin cancer risk, but also prevents the development of tanned skin, which can be related to self-esteem and a sense of social acceptance.¹¹⁴ As more of this work is conducted in the health domain, it will become clearer how it might influence risk communication. In general, more work is needed on how these and other motives can be brought to bear in understanding how people think about risk.

EMOTIONAL INFLUENCES

When people think about risk, they clearly do not do so dispassionately; on the contrary, a range of emotional factors are likely to influence their risk perceptions and their reactions to information about their personal risk. In this section, we consider the role of emotion (or affect, the term used in the psychosocial literature) at various levels. First, we consider incidental affect— affect experienced at the time risk information is encountered, usually due to unrelated reasons— and how it might influence risk perceptions. Next, we consider that risk perceptions themselves may be defined as affective (eg, “feeling” at risk as opposed to believing that one’s risk is low or high) and consider how affectively toned measurements of perceived vulnerability (or “integral” affect) are related to health-decision making. Third, affect is an outcome itself for which people hold risk perceptions (eg, people’s estimates of the chances that they will cope poorly with a negative health outcome), and we consider the accuracy of these risk perceptions. Finally, we address how incidental affect might influence the way in which people process information about their individual risk.

Influence of Incidental Affect on Risk Perceptions

People’s numerical and verbal risk judgments are greatly affected by their emotional state, suggesting that it is important to elicit their risk judgments multiple times to obtain a reliable estimate. One study showed that placing people in a sad mood by having them read about individuals who experienced a health problem (eg, leukemia) led them to provide elevated personal-risk ratings, not only for this health problem but also for a series of unrelated health problems.¹¹⁵ On the contrary, happiness and anger lead to more optimistic risk perceptions.¹¹⁶ The latter finding is notable because it shows that the valence of affect is not sufficient to predict risk judgments; negative affect may increase or decrease risk perceptions depending on the specific emotion experienced.

Anxiety and depression—2 chronic sources of negative affect—also have been associated with elevated perceptions of vulnerability and less optimism overall.⁵⁹ It is thus likely that cancer-treatment decisions will be significantly influenced by such emotional states, given that these states may be associated with vulnerability and pessimism, which in turn inflate risk perceptions. On a related note, interventions designed to correct overestimates of personal risk (as in the case of breast cancer) have been shown to be ineffective if they are not paired with concomitant efforts to reduce cancer anxiety.¹¹⁷

Affective Risk Perceptions

Another way to think about the influence of affect is that risk perceptions themselves are affective rather than cognitive. That is, *feeling* at risk may be more important than *believing* that one is at risk. In a recent prospective study,⁴⁰ respondents on several university campuses estimated their risk of getting the flu on a variety of different scales, including numerical scales (0% to 100% chance), verbal likelihood scales (eg, “very unlikely” to “very likely”), and affective scales (eg, “I feel at risk for the flu”). The investigators then followed up to see who got vaccinated. Although all of the risk-perception measures were positively associated with vaccination, the affective items were most predictive. Interestingly, in keeping with the regret aversion discussed

earlier, the most predictive item concerned people's anticipation of regret if they failed to get vaccinated and then got the flu.

A substantial literature has also addressed the role that worry plays in health behavior. Although there is a great deal of variability in how worry is defined in this literature, one could argue that worry is an affective perception of vulnerability, particularly when measured by such items as "I am worried that I might get cancer." These are the kinds of items used on scales such as the Cancer Worry Scale.¹¹⁸ Research using such items typically reveals a positive association between worry and risk-reducing behavior.^{82,119} These associations are usually linear, suggesting that very high levels of worry are not necessarily debilitating in terms of promoting health behavior. The positive relationship holds when linking worry about cancer to the adoption of cancer screening, but the relationship becomes negative when linking worry about *screening* to use of screening. When people worry about the screening process or the possible negative outcomes (eg, physical discomfort, embarrassment, false positives, radiation exposure), they are less likely to utilize screening tests.⁸²

Slovic et al⁴ argue that people use affect as a source of information when judging whether they are at risk. This "affect heuristic" is demonstrated by the role of dread in risk perception and the distaste for risky endeavors that have high benefit. Indeed, Slovic et al show that people reverse the risk-benefit correlation (which experts consider to be positive—more risky endeavors offer more benefit) and are more likely to do so when affective reactions to the risk are high.¹²⁰ It has been argued that people draw on their affective reactions automatically when judging risk and not to do so would be irrational.¹²¹ Recent work by neuroscientists indeed shows that people construe and act on risk counterproductively if activation of affective areas of the brain such as the amygdala is impaired.¹²²

So do laypeople think about risk affectively or cognitively? The true answer is probably somewhere in between. One possibility is that people hold both cognitive perceptions of vulnerability and affective perceptions of vulnerability, with one influencing the other. Worry and risk perceptions in most of these studies are

only moderately correlated,¹²³ suggesting they do represent somewhat independent psychological processes. Another possibility is that the beliefs are conflated, such that people do not distinguish them. This seems less likely because evidence shows that worry predicts an independent portion of the variance in cancer-screening behavior relative to risk perceptions.¹²⁴ The relative role of beliefs and feelings about objective risk is certainly likely to demand greater interest in future research.

Affective Forecasting

Although people tend to be unrealistically optimistic about their risk of experiencing health problems such as cancer,⁵⁸ they tend to be unrealistically *pessimistic* about their chances of coping effectively with such a problem were they to experience it.¹²⁵ One of the suspected reasons for this bias is that people are relatively poor forecasters of the affect they might experience in response to a negative (or positive) event.¹²⁶ Several studies show that people expect to have strong negative reactions to unwanted life events, such as a cancer diagnosis, and that they expect such reactions to endure for an extended period of time.

In reality, most people who experience severe health conditions are resilient because of the effective use of coping strategies.¹²⁷ For example, women diagnosed with breast cancer often attempt to find benefit or meaning from their condition, making them better appreciate previously mundane aspects of their life experience, and such coping strategies have been shown to be health-promoting.¹²⁸ Nevertheless, people do not anticipate having such coping resources, as they are unaware of their "psychological immune system." This may be due in part to a disproportionate focus by patients on what they will miss (eg, inability to engage in regular activities), as opposed to what they will gain (eg, more time with grandchildren). Such research suggests that cancer patients (and individuals at high risk for cancer) often make medical decisions that are predicated on false assumptions about how they would respond to bad news.

People also have difficulty parsing their current affective state from affective states they might be experiencing in the future.¹²⁹ Addicts in a

noncraving state, for example, may state that they would have little trouble withstanding the temptation to use if they went out with friends several days from now. In so doing, they fail to acknowledge that their affective state when they are with using friends—a state of craving unlike their current affective state—will be overwhelmingly powerful. Similarly, young adults fail to understand the future grip of addiction when deciding to smoke. Another example concerns the completion of living wills. The wills themselves are signed in a relatively cold affective state, unlike the range of emotions a patient may be feeling near the end of life. Thus, people often misrepresent how they will actually feel when faced with an end-of-life decision.¹³⁰

Loewenstein¹³¹ calls this phenomenon a “cold-to-hot” empathy gap. Similarly, a “hot-to-cold” empathy gap exists when people in a strong affective state think about risk and make decisions regarding a future state without taking their current affective state into account. Patients who are devastated by unwelcome news (such as a positive genetic test or the presence of a malignancy) may assess future risk and make decisions regarding the future in ways that fail to acknowledge their current state. Consequently, people may look back on their decisions regretfully; when they do so, they would be exhibiting a cold-to-hot empathy gap. These empathy gaps have been demonstrated for craving, thirst, pain, fear, hunger, and curiosity.¹²⁹ Moreover, they are also found interpersonally, in that people making decisions for others rely too much on their own affective states rather than the more relevant affective states of the individuals for whom they are making the decisions (as in surrogate end-of-life decisions).

Finally, people’s memories for past experiences are often driven by their theories. In one study, women whose implicit theory was that menstruation was painful tended to overestimate how much pain they experienced during a past cycle.¹³¹ If people believe or are led to believe that a given treatment is painful or upsetting in some way, it may be difficult to change this belief even if their actual experience disconfirms it. Again, this bias may influence their perceived risk of experiencing negative outcomes associated with a given treatment.

Affective Influences on Processing of Risk Information

Affect may not only influence or define perceptions of risk, but it also can influence the way in which people respond to feedback about their personal risk. According to Peters and colleagues,¹³² affect may serve 4 primary functions in response to health communications. The first is that it may serve as a source of information, consistent with the affect heuristic described above. The second is that affect may serve as a “spotlight” on certain pieces of information; for example, one study found that when people are angry and are then asked to think about drunk driving, they focus more on aspects of drunk driving that make them angry than they do on aspects of drunk driving that make them fearful.¹³³ The third is that affect can motivate more careful processing of the message. As noted earlier, research in the persuasion literature shows that positive moods like happiness often lead people to process messages less systematically and more heuristically, whereas negative moods encourage more careful processing.¹³⁴ When paired with defensiveness, negative moods might lead people to “pick apart” aspects of a threatening risk message so as to render the message personally irrelevant. Finally, affect can serve as a common currency. Although it may be difficult to compare the complex risks of 2 treatment options such as surgery and radiation therapy, it may be easier to compare the affective reaction one has to each of these choices.

Summary

In addition to the cognitive and motivational processes reviewed earlier, it is essential to acknowledge the role that affect plays in risk perception. People’s incidental affect can influence both their risk perceptions and the way in which they respond to risk feedback. Affect specifically related to the risk in question (eg, worry about breast cancer) can be as important, if not more important, than beliefs about personal likelihood. People seem to have trouble predicting their future affective states and also fail to adequately account for their current affective states when making such predictions. Of course, it would probably come as no surprise to

any practicing physician that individuals often use their hearts more than their minds to make medical decisions, but the current research provides insight into how they do so.

CONCLUSIONS

In this article, we have reviewed a variety of disparate literatures bearing on the way that the general public, patients, and health care providers think and communicate about risk. Many people have trouble working with frequencies, proportions, and probabilities, suggesting that their risk perceptions and the way in which they respond to risk communications such as “your risk of post-operative death from this procedure is 20%” may be idiosyncratic. They fail to understand how risk accumulates over time or multiple exposures, and their use of verbal expressions of risk such as “common” or “likely” deviate greatly from the way experts use these labels. Reliance on generally useful judgmental heuristics such as availability, representativeness, and anchoring often lead to risk judgments that fail to take account of base rates, overestimate (or underestimate) disease frequency and covariation between risk factors and disease occurrence, and neglect the implications of small samples and statistical regression.

People’s risk perceptions and responses to risk feedback are also greatly affected by their motives to hold favorable self-views, appear rational, avoid loss and regret, maintain perceptions of control, compare favorably with others, and be prepared for potential bad news. Both incidental and integral affect influence judgments of risk, and it is clear that risk perceptions themselves are at least partially affective. Despite these affective influences, people often are unable to accurately predict how they will feel in the future when reflecting on their risk of experiencing future outcomes. It is clear that emotions are not only a consequence of decisions involving risk, but also play a key role as they are experienced during the process of assessing risk and making decisions. This body of evidence suggests one must be cognizant of more than just a person’s understanding of illness and risk factors to convey personal risk information or elicit perceptions of risk when pondering important cancer decisions.

Limitations and Directions for Future Research

There is still much to learn about how people think about risk. The application of classic decision science and social psychology to medical-decision making is in its relative infancy. Several studies reviewed here used samples of undergraduates, and others used samples that were largely White, North American, and middle class. Much recent work shows that risk perception and decision-making processes may differ not only cross-culturally,¹³⁵ but also across socioeconomic classes,¹³⁶ suggesting the need to replicate many of the processes reviewed here in a wider variety of samples. It will also be essential to provide more such demonstrations in applied cancer contexts.

Assuming these limitations are addressed, there are still many areas that could use further exploration. The study of decision making itself (medical or otherwise) has only recently begun to consider the role of many of the motivational and emotional factors discussed here. Future work is likely to consider how these factors may moderate some of the conventional cognitive biases, such as misuse of heuristics. In addition, although the focus in this article has been to help clinicians better understand how their patients think about risk, there is certainly scope for considering how laypeople themselves can be trained to understand risk and decision-making processes more effectively. An interesting line of work shows that elementary training in statistics and reasoning reduces susceptibility to some of the decision biases discussed herein,^{137,138} suggesting that the integration of such training into conventional mathematics classes at the secondary-school level might be prudent. Incorporation of judgment and decision-making courses into medical school curricula might also facilitate the communication of risk information, given that medical training does not appear to teach reasoning skills any better than other graduate programs with a less technical focus.¹³⁹ Research on these possibilities is needed.

An important area of future research may derive from the group nature of medical decisions. Providers often make decisions under

uncertainty in concert with other providers and medical experts, as well as with their patients, and patients often involve family members in their medical-decision making.^{1,2} Despite a rich literature on group-decision making, very little of it has been applied to or conducted in natural medical contexts.¹⁴⁰ This literature holds important implications for many of the psychological processes enumerated here. For example, groups are more susceptible to the base-rate fallacy than are individuals.¹⁴¹ Another line of work shows that when groups make decisions under uncertainty (such as when physicians confer on a diagnosis or treatment option), they are more likely to discuss information shared among the members of the group than they are to discuss information known by only one member of the group.¹⁴²

Another important area for future research is an integration of the work on health communication with that on risk perception and decision making. The 2 fields operate largely independently, irrespective of the interest in common issues. Health-communication theories and findings can go a long way toward the development of practices that may counteract some of the biases in risk perception discussed here. For example, theories about how to enable an audience to focus on the content rather than peripheral features of a message⁵⁶ can be used to maximize the effectiveness of a risk message.

We also need to learn more about the comprehension and usefulness of risk information in situations involving multiple risks and benefits. How (and how well) do people evaluate medical “tradeoffs” in which a behavior, food, or drug may decrease the risk of one disease, while increasing another? One study shows that people have difficulty understanding how the use of a drug that has side effects reduces overall risk (ie, risk of disease for which drug is taken plus risk of side effects) and that they may focus too much on the side-effect risk.¹⁴³ There is a need to develop comprehensible and useable formats for such multiple-outcome decisions.

Of all diseases, cancer has received the most attention from researchers in decision making, as exemplified by a special supplemental issue of *Health Psychology* (2005;24:445-548). A

strength of this collaborative work is that research on cancer control has added a great deal to our theoretical understanding of decision processes. For example, research on end-of-life decision making has informed our understanding of how people make surrogate decisions and how people attempt to forecast future affect.¹³⁰ The continuing level of dialogue between decision researchers and cancer control researchers is likely to make extensive contributions to our understanding of the psychology of risk perception.

Implications for Risk Elicitation and Communication

Much of the work described herein has direct implications for how providers elicit risk perceptions from and communicate personal-risk information to patients. Many of these implications have been described in the context of the psychological processes themselves, but we summarize some of them here.

The body of work on innumeracy and misuse of heuristics suggests strongly that people's risk perceptions should not be taken at face value and that, in many cases, these perceptions may appear to greatly overestimate actual risk. That people overestimate risk may not necessarily suggest that they are pessimistic, but rather that they are using the scale differently than an expert might. Moreover, when communicating risk information, it may be useful to use a variety of formats to sidestep the problems with any one format. For example, given that people focus too closely on the numerators of fractions and have trouble seeing the equivalence of probabilities and proportions or frequencies, it would be useful to present percentages (eg, 8%) along with 2 or more frequencies and associated denominators (eg, 8 out of 100 or 80 out of 1000). Of course, the potential for confusion with the presentation of multiple formats *without guidance* should not be underestimated.¹⁴⁴

It also is essential to emphasize the importance of the denominator, given the numerator bias, and the importance of considering all 4 cells of the design when assessing covariation or cause (eg, “think not only of the times you took this medication and it made you irritable,

but also of the times neither or only one of these events happened”). Finally, it is essential to highlight the role of the base rate in making risk judgments—people need to know that a test with 99% accuracy will still yield a lot of false positives if the population prevalence is low. They also need to understand the effects of sample size and sample bias in evaluating the relevance of medical research to their own situations.

Another lesson of the research on risk perception is the role played by the various motives described previously in this paper. Clinicians communicating with patients about their various risks need to acknowledge the presence of these motives. Most people do not want to think of themselves as being at risk. They also want to project an appearance of being rational decision makers, which may lead them to put off decisions involving risk, not necessarily because of the pain of making the decision, but because they want to feel or appear as if they have made the best decision possible. Moreover, people are keenly aware of how they compare with others and may be persuaded by personally tailored risk messages that make reference to a comparable group of similar others (such as others of the same age in a similar family situation).

People also demonstrate a noticeable aversion to regret and loss and make decisions designed to limit the amount of anticipated regret that will be experienced. Some types of decisions evoke higher levels of anticipated regret, such as acts of commission versus omission. If a given treatment option is clearly optimal, the clinician might frame its adoption as a default such that rejecting it is an act of commission (eg, “this is the normative treatment option in such a case, and most patients adopt it”), thereby reducing perceptions of anticipated regret that patients may experience when evaluating the risks of the treatment. Given that people also seem to be averse to ambiguity, it would also seem prudent to emphasize the quality of the scientific evidence supporting this option (assuming it is high). Finally, based on Prospect Theory, it is better to use loss-framed messages when trying to convince patients to engage in behaviors involving risk (eg, screening, which is associated with the possibility of getting bad news)

and gain-framed messages when encouraging preventive behaviors like exercise.

One must acknowledge the role of affective experiences when eliciting risk perceptions from patients and when communicating risk information to them. Patients should clearly be encouraged to reflect on their risk judgments and cancer-related decisions rather than making quick decisions that may be affectively driven. It is also important to understand that people may worry about a given outcome even if they do not feel at risk—that is, affective perceptions of vulnerability (“I feel at risk”) may be different from cognitive perceptions of vulnerability (“I’m at high risk”). Consequently, it should not be surprising that patients will feel high levels of negative affect when making a risk-related cancer decision, even when objective risk is low, an observation punctuated by the finding that people misperceive the correlation between risk and benefit to be negative.⁴ Finally, when communicating risk, it behooves the communicator to acknowledge that incidental affect will influence the way in which the risk information is processed. For example, good moods may actually impair careful processing of the information.

Summary

Experts in the area of risk assessment use epidemiological evidence to estimate risk, and risk communications often use formats that are based on more than a rudimentary understanding of probability. However, the psychology of risk perception deviates greatly from “normative” or “prescriptive” models. People’s use of numerical information, the ways in which they comprehend incoming health information, and the effects of their motives and affect on how they think about risk are all processes that need to be understood and acknowledged to optimize communication between patients and providers about risk. In a time when health awareness and access to health information is greater than it has ever been before, and in a time when patients are continuing to become more involved in decision making in the context of uncertainty, understanding patients’ risk perceptions is a crucial piece of the puzzle in the development of optimal health care.

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