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Perceived risk and health risk communication

Erika A. Waters, Amy McQueen, and Linda D. Cameron

The multiple meanings of risk

Risk is a complex concept that has multiple meanings. The term risk can be used as a noun (e.g., ‘Death is a risk of sky diving’), verb (e.g., ‘I’ll risk it’), adjective (e.g., ‘Sky diving is risky’), or probability (e.g., ‘The risk of death while skydiving is ##%’). Risk can refer to multiple topic domains, including financial, health, social, and legal hazards. Perceptions of risk are inherently subjective. Although it is possible to calculate a probability estimate of experiencing a particular outcome, the meaning of that outcome to an individual varies based on a variety of intrapersonal, interpersonal, contextual, and societal factors that include both cognitive and affective/emotional components (Slovic 2000; Pidgeon et al. 2003; Tversky and Kahneman 1974). It is also likely that linguistic features (e.g., word choice) and non-verbal cues (e.g., facial expressions) help shape risk perceptions. These factors and others make it exceptionally challenging to inform people about health risks in a way that persuades them to change their behavior (Weinstein and Klein 1995; Lerman et al. 1997).

In general, people with higher perceived risk of developing a negative health outcome at one point in time are more likely to engage in health-protective behaviors in the future (e.g., Janssen et al. 2011). The size of the effect is highly variable and dependent upon multiple contextual factors, but for volitional and for new behaviors (e.g., not habitual and obtaining a newly available vaccine, respectively), people need to feel some minimal amount of personal risk in order to be motivated to act (see Figure 3.1). Adept communication of health risk information capitalizes on this relationship by changing risk perceptions in the appropriate direction and improving health-related behaviors.

Educating people about the characteristics (i.e., risk factors) that increase or decrease one’s likelihood of experiencing a negative health outcome is one approach to health education, but finer-grained efforts can be more effective. One way to engage in more targeted efforts is to differentiate among the terms absolute, comparative, and relative risk (Ranby et al. 2010). Absolute risk is the likelihood of experiencing an outcome over a specific period of time. Absolute risk can be represented as probability estimates or as verbal qualifiers (e.g., Her absolute risk of developing heart disease within the next ten years is 2 percent; He is at moderate risk of developing colon cancer in the next five years; It is very likely that he will experience side effects after undergoing treatment). Comparative risk is how likely one person is to experience a hazard compared to another person or compared to the average
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Individual differences

Perceived risk

Behavioral motivation, intentions

Health decisions and behaviors

Risk communication formats and strategies

Facilitating and inhibiting factors (not discussed)

Figure 3.1 Broad conceptual framework of perceived risk, health decisions, and behavior

Source: Adapted from common theories of health behavior (e.g., Health Belief Model, Theory of Planned Behavior, Protection Motivation Theory). See Conner and Sparks (1995) for an overview of each of these theories.

This chapter will distill the risk perception and communication literatures into a document that is relevant for researchers and advanced students in linguistics and public health. The chapter emphasizes the challenges inherent in communicating risk and, rather than reiterating established guidelines for communicating probabilistic risk information to individuals, it refers readers to several excellent review articles. This enables the authors to focus on the newest, most innovative, and most promising directions in which the field is moving.

Evaluating comprehension of health risks

For many years, clinicians and researchers approached health risk communication by providing people with probability information. The expectation was that such information would motivate people to engage in appropriate health behaviors. Although such understanding might be helpful under some circumstances, true comprehension involves more than ‘getting the numbers right’ (Fischhoff 1995).

One reason true comprehension is not limited to the accurate estimation of risk probabilities is because risk perceptions often go awry. For example, many women vastly overestimate their risk of developing breast cancer when asked to provide a numerical probability estimate, but providing them with accurate information may only reduce – not eliminate – overestimation. The situation is somewhat different for comparative risk perceptions. With some exceptions, people believe that they are at lower risk of developing health problems than the average person their age and sex. However, not everyone can be at below average risk. This unrealistic optimism (also referred to as optimistic bias) reveals itself in many health hazards and populations (Weinstein 1987). Whether people overestimate their absolute numerical risk, underestimate their comparative risk, or make both errors simultaneously, ‘fixing’ these perceptions is difficult (Weinstein and Klein 1995; Lerman 1995; Lipkus et al. 2000).
One alternative to viewing risk comprehension as ‘getting the number right’ relies on a dichotomous conceptualization of perceived risk. According to this view, true comprehension of one’s risk might be better understood as a ‘gist’ interpretation of a hazard as being risky or not risky. For example, one study examined how medical personnel triaged patients presenting to the emergency room with heart attack symptoms (Reyna and Lloyd 2006). Patients could be discharged, admitted for observation, or admitted to the intensive care unit. The most experienced personnel, cardiologists, drew sharp all-or-none distinctions and typically either discharged patients (i.e., the patient is not at risk) or admitted them to the intensive care unit (i.e., the patient is at risk). Less experienced personnel (i.e., non-cardiologists) were more likely to admit patients to a less intensive setting because they were less able to determine whether someone was or was not likely having a heart attack. They resolved this uncertainty by admitting patients for observation. A different study revealed that adolescents who adopted a gist-based view of risk were less likely to engage in risky behavior than adolescents who evaluated risks using a more quantitative likelihood approach (Mills et al. 2008). Specifically, adolescents who thought about the risks of engaging in sexual behavior probabilistically were more likely to engage in sexual behavior than those who endorsed gist-based statements such as, ‘No risk is better than some risk.’

Another approach to evaluating whether people understand a risk is to define comprehension more broadly (Weinstein 1999). This approach includes several criteria. First, people should understand the nature of the risk, including its name, the approximate absolute and comparative likelihood of experiencing it, and the severity of possible consequences. People should also understand factors that can reduce one’s susceptibility to experiencing harm (e.g., quitting smoking), and the difficulty of avoiding harm (e.g., nicotine is far more addictive than many smokers expect). Although this approach is more complex than inferring comprehension from accurate likelihood estimates, it highlights the fact that risk perception is a multidimensional construct.

Understanding theoretical and conceptual approaches to perceived risk

Health risk communication efforts have met with varying degrees of success. In part, this may be due to a lack of clarity among intervention developers about how laypeople think about health risk information. We briefly describe several theoretical approaches to understanding how people perceive risk.2

The rational choice approach to perceived risk asserts that people make decisions and engage in behaviors based on a rational evaluation of the risks and benefits of engaging (or not engaging) in a particular behavior. Many health communication interventions conceptualize risk in this way (Conner and Sparks 1995), but the approach is incomplete. It does not address habitual or addictive behaviors, and it relies upon a conscious, non-emotional, and rational deliberation and evaluation of outcomes. However, depending on the context, some individuals may not be willing or capable of making detailed calculations. In addition, emotions are integral to risk perceptions.

Another approach to understanding risk perceptions involves heuristics, or mental shortcuts (Tversky and Kahneman 1974). The anchoring and adjustment heuristic states that risk judgments can be influenced by prior information and any adjustment made based on new information is insufficient. Consequently, the revised risk judgment is still either excessively large or small. For example, a woman who knows she is at low risk of having a heart attack (the anchor) might misinterpret chest pain as intestinal discomfort and not call an ambulance (insufficient adjustment). The availability heuristic refers to the tendency that people judge...
events as more frequent when examples of those events are more easily brought to mind. For example, a woman who has several friends with breast cancer may perceive her risk as higher than a woman who does not have any friends with cancer. **Framing effects** occur when people perceive a hazard differently based on whether it is presented as a gain or loss. For example, presenting the consequences of health behaviors as gains (e.g., by eating a healthy diet you may live longer) or losses (e.g., by *not* eating a healthy diet you may develop cancer) may elicit different levels of motivation to change behavior (O’Keefe and Jensen 2007; Latimer et al. 2007). One manifestation of the **representativeness heuristic** involves judging the probability of an event according to the extent to which it resembles a category. For example, a woman who experiences sudden indigestion, weakness, extreme fatigue, and cold sweats might not realize she is having a heart attack because the symptoms do not resemble (i.e., are not representative of) typical heart attack symptoms. Health risk communicators can use these heuristics to design effective campaigns. For instance, the availability heuristic may be overcome by emphasizing that smoking causes not only lung cancer, but also macular degeneration and bladder cancer (Klein and Stefanek 2007).

**Mental models** or representations of health threats are another way to conceptualize risk beliefs. The Common-Sense Model (CSM) (Cameron 2008; Leventhal et al. 2003) proposes that cognitive representations of an illness (e.g., for skin cancer) are structured to include information about the label (e.g., ‘skin cancer’ or ‘melanoma’), physical characteristics they associate with the risk (e.g., pale skin, abnormal moles), causes (e.g., multiple sunburns), a timeline of occurrence (e.g., in late adulthood), consequences (e.g., painful surgery, death), and control (e.g., via sunscreen use). These mental models stimulate fear or worry that motivates action, and they guide the selection of protective actions such as getting a skin exam and using sunscreen. By delineating the attributes of risk representations as is illustrated above, the CSM points to specific informational contents that can be used in communications to alter risk perceptions. For example, a communication aimed at enhancing risk perceptions can provide information about the identity, causes, timeline, consequences, and control measures rather than focusing solely on probability estimates. Unlike abstract probability estimates, when these contents are presented in a coherent ‘common sense’ manner, they are more likely to be encoded and retained in memory.

Despite their absence in many health behavior theories, **affect and emotions** provide information about health threats that is important and distinct from more cognitively oriented conceptualizations of perceived risk (Slovic et al. 2002; Loewenstein et al. 2001). **Feelings of risk** (e.g., ‘If I don’t get screened, I would feel very vulnerable to getting colon cancer sometime in my life’) were more predictive of behavior and intentions than cognitive likelihood estimates (e.g., ‘If I don’t get screened, I think my chances of getting colon cancer sometime in my life are [almost zero – almost certain]’) (Janssen et al. 2011; Brewer et al. 2007). As is evident in the fear appeal literature (e.g., Witte and Allen 2000), **fear and worry** are also important for motivating healthy behaviors (e.g., McCaul et al. 1996). In some cases, worry about the consequences of a behavior may be more effective than perceived risk in motivating people to consider changing their behavior. However, fear appeals that do not inform recipients about how to reduce their risk may be counterproductive and may inhibit behavior change.

The **Social Amplification of Risk Framework** (SARF) (Kasperson et al. 1988; Pidgeon et al. 2003) characterizes perceived risk according to a multilevel framework including psychological, social, and cultural factors. These factors act alone and in concert to amplify or attenuate perceptions of risk and to alter behavior related to a particular hazard. Behavioral responses at the individual or group level can produce ripple effects that may have wider societal and economic consequences. This constellation of effects is referred to as **social**
amplification. Social attenuation occurs when the constellation of ripple effects results in reduced interest by the public. Risk amplification and attenuation may be especially relevant in the current environment, in which the Internet and social networking have important roles in educating and alerting people to health hazards (Chou et al. 2009; Viswanath et al. 2006). Linguists might use SARF to examine how the forms, structures, contents, and contexts of health risk communications affect people’s perceptions within the context of social amplification and attenuation.

**Individual and contextual differences associated with risk perceptions**

As mentioned previously, the goals of many health risk communication interventions include encouraging people to engage in healthy behaviors by altering their perceptions of risk. However, often only modest and temporary changes in risk perceptions have been observed (Lerman 1995). Considering how individual differences and contextual features affect risk perceptions may explain why altering them can be so challenging.

**Individual differences**

Multiple studies have examined sociodemographic correlates of risk perceptions. In general, gender, education, age, and race/ethnicity are associated with perceived risk. However, the effects are not consistent. Being a woman or being younger is often associated with having higher risk perceptions, but some studies show the opposite relationship. The data are also equivocal for educational attainment and race/ethnicity. Several explanations exist for this heterogeneity. For example, each disease has unique characteristics, and these characteristics may be perceived differently by different population segments. The reason most relevant to linguists is that most studies conceptualized perceived risk according to the rational choice approach. However, risk may hold different meanings for different populations (Joseph et al. 2009). For example, one study reported that beliefs about breast cancer risk among African American women were influenced in part by the belief that ‘dwelling’ on a risk might cause it to happen (Salant and Gehlert 2008). Other women in the same study were influenced by past experiences of watching loved ones die of breast cancer due to a lack of treatment. These factors combined to prompt some members of the community to avoid discussing breast cancer risk entirely.

**Numeracy**, or the ability to understand and use numerical information, is another important factor influencing the extent to which health risk communications can change risk perceptions and, consequently, behavior. Low numeracy is prevalent in many countries, including the USA. One study of 500 female US military veterans reported that one-third of the sample believed that 1,000 flips of a fair coin would result in fewer than 300 heads (Schwartz et al. 1997). When provided with numerical information about the degree to which mammography reduces the risk of death from breast cancer, women with low numeracy were less likely than women with high numeracy to correctly calculate the number of women who were ‘saved’ by mammography. In other words, women with low numeracy were less able to use relevant health information to determine the extent to which a medical procedure was beneficial on a population basis. Low numeracy is also associated with higher risk perceptions, less understanding of the risks and benefits of medical tests and treatments, increased susceptibility to improper use of decision heuristics, poorer quality medical decisions, less ability to indicate health preferences, and lower engagement in health behaviors such as cancer screening (for a review, see Nelson et al. 2008).
It should be noted that numeracy is only one component of general health literacy, which has been defined as ‘the ability to read, understand, and apply health-related information in English’ (White 2008: viii). Limited health literacy is also associated with poorer health-related decisions and behavior. However, a full discussion of this issue is beyond the scope of this chapter. (For more information, see the Institute of Medicine 2004; White 2008.)

Contextual features

Numerical risk information can also be problematic because numbers alone lack context. What does having ‘a 12 percent lifetime risk’ mean? Should I attend to the hazard immediately? Can I ignore it in lieu of other concerns? People attempt to answer these questions by adding their own contextual interpretations, such as placing the number into discrete categories like ‘at risk/not at risk’ or ‘low/moderate/high’. However, use of verbal qualifiers to interpret numerical risks can be quite variable. For example, some participants might rate an 8 percent risk as ‘extremely small’, whereas others rate it as ‘extremely large’. Individuals may also interpret a wide range of probabilities, such as 30 percent to 80 percent risk, as reflecting a common discrete category such as ‘moderate risk’ (Cameron et al. 2009).

When people encounter personally relevant yet threatening health risk information, they may engage a variety of defensive strategies in an effort to reduce negative affect (McQueen et al. 2012). This can result in rejection of personal health risk information. Greater defensiveness has been associated with decreased risk estimates, increased beliefs that a risk behavior is normative or common, and increased likelihood of engaging in a risk behavior (Gerrard et al. 1996). In an effort to expand a stage model of defensive information processing, McQueen and colleagues developed and tested measures of four defensive strategies: attention avoidance, blunting, suppression, and counter-arguing (McQueen et al. 2012). In this model, a defensive perception of risk is characterized as denial of vulnerability (i.e., suppression of risk information and implications). Identifying the stage at which individuals stop processing threatening health information may identify future targets for improved health communication interventions. Linguists might find it interesting to explore the characteristics of health risk messages and communication modalities that elicit defensive strategies. This information could then be used to devise communication techniques to avoid triggering defensiveness in message recipients.

Differences between lay and expert views of risk can also influence risk perceptions. For example, information that experts convey with the intention of reassuring the public may inadvertently alarm them (Levy et al. 2008). Conversely, experts may not understand the value of the experiential knowledge laypeople use to construct their personal understanding of a health risk. Successfully bridging the divide between lay and expert views of risk requires that researchers understand how and why lay and expert views differ. Linguists likely have much to contribute to this discussion, particularly with respect to the different meanings laypeople and experts draw from identical pieces of information.

Communication formats and strategies that affect perceived risk

Health risk communicators and medical personnel seek to improve public health by providing individuals with information about the risks and benefits of certain behaviors and/or medical treatments. The ways in which risk is communicated can influence perceived risk and, to a lesser but still important extent, health behavior and medical decisions. The formats
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and strategies used to convey risk information can also obfuscate details and mislead the public. This raises two important questions for risk communicators and clinicians to consider. First, where are the lines dividing educational, persuasive, and coercive risk communications? Second, when, for whom, and under what conditions is it appropriate and ethical to use persuasive techniques? There are seldom easy answers to these questions, but we encourage readers to consider them carefully prior to embarking on their next risk communication effort.

Communicating risk can be daunting; there seems to be an infinite array of possible communication choices. For example, to communicate risk probabilities, one must choose a numeric format (e.g., proportions, percentages, natural frequencies, 1 in N, odds, number needed to treat, relative risk ratio); decide whether to include a visual display and, if so, which one (e.g., bar graph, icon array, pie chart, risk ladder, survival curve); and consider the merits and pitfalls of including verbal descriptors (e.g., unlikely, rare, common) and/or comparative risk information. Numerous studies have attempted to find the best way to communicate risk probability information. The optimal strategy depends on the specific task an individual is asked to perform, but no format will be effective if the information is not relevant and meaningful to the audience. For example, icon arrays may be useful in minimizing some cognitive biases such as denominator neglect, but people with low numeracy and high graph literacy might benefit more than those with low graph literacy (Garcia-Retamero and Galesic 2010).

Several excellent literature reviews describe various aspects of communicating probabilistic risk information (e.g., Lipkus 2007). Readers who need specific advice on communicating probabilities should refer to these comprehensive resources. The following section will focus on health risk communication issues that have received less attention in the literature.

**Uncertainty**

Uncertainty regarding health risk information takes many forms and affects people differently (Han et al. 2011), but less is known about how to communicate it effectively. Probabilistic risk information is inherently uncertain, both in terms of whether an event might occur and whom it might affect. A woman with an 80 percent risk of breast cancer might not become ill, but a woman with a 5 percent risk might. It is therefore unsurprising that many laypeople have trouble accepting the personal relevance of a calculated risk estimate. There is also uncertainty surrounding the precision of an estimate. Although an algorithm might provide point estimates for the risk of heart disease (e.g., 5 percent), those estimates are actually within a larger confidence interval (e.g., 3–7 percent). Another type of uncertainty is represented by conflicting expert opinions, as in the case of the recurring controversy in the USA surrounding the value of annual mammography screening for women 40 to 49 years of age.

Most people understand that uncertainty exists and want to know when and if it applies to them, but their responses to receiving such information are highly variable (Politi and Street 2011). Whereas some people respond by placing more trust in the information source (e.g., physicians), others are mistrustful. In the clinical context, acknowledging the uncertainty surrounding cancer treatment options may produce dissatisfaction with the decision process in some patients. People react differently to uncertain information based on their tolerance of ambiguity, other personality characteristics, and the situation or specific context.

More research is needed to develop formats and strategies that effectively communicate uncertainty. For example, one strategy to convey the sense of randomness inherent in
probabilistic risk estimates utilizes dispersed pictographs in which the affected patients are identified as shaded figures scattered randomly within the display. Evidence regarding the efficacy of this strategy is mixed, with reports of dispersed pictographs having no effect on risk perceptions, increasing risk perceptions, and increasing inaccuracy in providing numerical risk estimates. Providing confidence interval information can heighten absolute risk perceptions if the range is presented as text (e.g., 5–13 percent), but not if the range is presented in the context of a bar graph. Whether confidence interval information is perceived as ‘wishy-washy’ or acceptable may be dependent upon the individual’s level of formal education. There are several strategies that convey uncertainty in a more qualitative manner, such as letter grades and faces, but empirical evidence of their effectiveness is sparse. In a clinical setting, careful conversation can improve communication of uncertainty that results from conflicting expert opinion and insufficient evidence (Politi et al. 2011). Research that identifies specific formats and strategies for discussing uncertainty with patients and the public is critical. Linguists can contribute to this endeavor by examining how subtle differences in the structure and content of language, as well as non-verbal communication like body language, influence laypeople’s responses to uncertain information.

**Mental model consistency**

Another communication strategy that may influence risk perceptions and health behaviors involves the provision of information that enhances the consistency between one’s mental model of the health risk and one’s mental model of the protective behavior. Mental models, or representations, of protective actions are formed through ‘IF–THEN’ contingency rules or links. For example, a common-sense link between a risk and action representations for skin cancer risk may be, ‘IF sunburns cause skin cancer, THEN reducing sun exposure will reduce my risk of skin cancer.’ Motivation to engage in health behaviors and to adhere to treatments may require having a clear representation of the IF–THEN linkages between the health risk and the protective action. That is, individuals may be more motivated to engage in a protective action if they have a coherent understanding of how the action will reduce risk.

Research has demonstrated the efficacy of a communication strategy that provides information designed to enhance comprehension of the links between a disease risk, protective action, and disease control. In one study, women smokers who were at increased risk for cervical cancer received either no information, information on the health benefits of smoking cessation, or risk-action link information about how smoking increases cervical cancer risk (Bishop et al. 2005). The risk-action link information explained how cigarette chemicals pass into the bloodstream and travel through the body to the cervix, and how they attack cells of the cervical lining, making them abnormal so that they can develop into cancer. This brief explanation increased perceived understanding of how smoking cessation reduces cervical cancer risk (i.e., representational coherence), which in turn led to greater intentions to stop smoking relative to the other conditions. In other words, representational coherence mediated the effect of risk-action link information on intentions to stop smoking.

More recently, the efficacy of this communication strategy was tested in the context of genetic testing for disease risk (Cameron et al. 2011). A wide range of genetic tests are now available on the market, and many of these tests are for illnesses for which risk can be reduced through protective actions. Yet individuals often have trouble understanding how a genetically conferred risk for a disease could be reduced through a lifestyle behavior such as eating a low-fat diet (Marteau and Weinman 2006). This lack of understanding may undermine the test’s potential to motivate protective action. In one study (Cameron et al. 2011), adults
received messages about a genetic test for colon cancer risk that either did or did not include risk-action link information about the physiological processes involving the genetic mutation, digestion of high-fat foods, and colon cancer development. Compared to participants who were told only that eating a low-fat diet was important for avoiding colon cancer, participants receiving the risk-action link information reported greater understanding of how a low-fat diet reduces risk, greater beliefs in the efficacy of low-fat diets to reduce risk, and lower appraisals of anticipated risk of developing colon cancer given positive test results. These findings provide further evidence that describing risk-action links may promote risk-related beliefs that motivate protective action. Linguists could have a role in better understanding the development and contents of laypeople’s mental models, as well as the IF–THEN links driving protective behaviors.

Narratives

In contrast to informational and expository communications that present reasons and arguments in favor of a particular course of action, narratives use storytelling and testimonials to depict events and consequences for characters (Kreuter et al. 2007). Narratives that ‘transport’ readers/listeners into another world are more engaging than those that do not (Green and Brock 2000). Engagement and strong identification with a narrative’s characters (message source) are expected to increase empathy and cognitive rehearsal, decrease counter-arguing, and influence attitudes, perceived risk, perceived norms, and behaviors (Hinyard and Kreuter 2007). Narratives may increase perceived risk through the identification with and vicarious learning from the characters and by activating self-referencing thoughts and emotions. For example, taking the perspective of a character who has a skin cancer scare after years of tanning may elicit empathy and self-reflection of one’s own memories of tanning, thereby increasing perceived similarity to the character and perceived vulnerability to skin cancer. The visual images that are evoked and based on meaning from the story are expected to influence story-congruent beliefs, especially for text-based narratives.

Narratives appear to be a promising intervention strategy for addressing health disparities (Houston et al. 2011), but additional research should determine whether the use of narratives may have an undesirable influence on objective judgment and decision-making. More theory-based experimental research is also needed to elucidate the effects of health communications in narrative format (Hinyard and Kreuter 2007). Understanding the processes and mechanisms, including linguistic processes and mechanisms, through which stories influence health-related decisions and behaviors is critical to maximizing their effectiveness and developing appropriate applications for use in practice settings.

Technology and health risk communication

Technological advances make it possible to develop and implement novel health risk communication strategies. The challenge is to use technological tools judiciously and effectively. For example, placing computer kiosks in clinic waiting rooms may be useful in providing tailored health risk materials, but they may not be feasible if each patient needs 20 minutes to complete the preliminary survey materials.

The Internet provides a promising way to increase the reach of health risk information. Internet use is widespread, and cell phones have expanded its availability to many underserved populations (www.pewinternet.org). However, Internet-based health risk communication has many challenges. First, despite increased prevalence of use, there are still population
segments that have limited access to the Internet (e.g., the elderly, those with low incomes). Second, legitimate websites must compete with thousands of other websites that vary in the quality of the information provided. In addition, many websites do not provide the information that users need to evaluate its quality and trustworthiness (e.g., purpose, funding organization), nor are they written in a way that enables users with low literacy to understand. Lastly, although social networking websites like Facebook and Twitter can reach many people, they can also increase the risk of widespread dissemination of misinformation.

Personalized health risk assessment tools provide the opportunity to learn one’s objective likelihood of developing an illness. Many of these tools are brief, available online, and provide information about a variety of illnesses (e.g., cancer, heart attack, diabetes). One content analysis identified over 40 interactive cancer risk calculators that were available online (Waters et al. 2009). Unfortunately, many of these calculators did not convey information using effective risk communication formats or strategies. In addition, the literature evaluating the tools’ effectiveness is sparse. There is some evidence that the tools can educate people about their risk factors, but oftentimes people are reluctant to believe the estimate provided. Their effectiveness in changing behavior may be also limited, unless they are supplemented by additional educational materials or embedded within a larger intervention (Soler et al. 2010).

Advances in computing technology have also led to increased experimentation in risk communication strategies. One approach capitalized on the power of imagery by showing participants simulated but realistic images of a heart and coronary arteries that had been exposed to a long-term healthy diet and physical activity regimen versus eating an unhealthy diet and not engaging in physical activity (Lee et al. 2011). The images changed multiple aspects of participants’ risk representations and increased short-term intentions to eat a healthy diet and engage in physical activity. The images also improved consumption of healthy foods two weeks after the intervention. Another study communicated the idea of probabilistic randomness by using a dynamic, scattered icon array in which different figures ‘blinked’ on and off for a few seconds (Han et al. 2012). Other researchers attempted to convey randomness by asking participants to play a game that required searching for affected cases by clicking identical boxes in an array (Ancker et al. 2011). A very novel approach used virtual reality technology to convey health risk information related to gene-by-environment (GxE) interactions via an elevator metaphor, in which the elevator buttons represented the presence or absence of genetic and lifestyle risk factors (Kaphingst et al. 2009: 388): ‘The interaction between genetic risk and exercise behavior was represented as greater downward movement of the elevator for someone at increased genetic risk than [for] someone at lower genetic risk, reflecting increased protective effects of exercise and greater decrease in disease risk.’

Although each of these technological approaches to communicating risk appears promising, several study authors noted that the complexity and/or novelty of the interventions may have impeded learning. Thus, any novel risk communication format or strategy should be thoroughly pilot-tested and implemented with the awareness that the effects may be unexpected or mixed. There may also be opportunities for researchers and/or students in linguistics to explore how different language features and characteristics act independently and in concert with technological innovations to facilitate or inhibit effective health risk communication.

Conclusions and future research

We hope readers finish this chapter with a better understanding of the importance and complexity of perceived risk and health risk communication. Although public health and
psychology as academic fields have studied risk perception and health risk communication extensively, many questions remain. We hope that researchers and students of linguistics will find ways to use their fresh eyes and unique expertise to help solve some of the most pressing problems in the field. The following is a non-exhaustive list of topics in which additional research is needed and in which linguists may have a pivotal role.

• Conduct more longitudinal work on the relationships among health risk communication, risk perceptions, and health-related behavior and decisions. Specific focus should be placed on the clinical setting, on multiple health behaviors, and in a wide variety of patient populations and health domains (e.g., diabetes, treatment adherence).
• Identify which language and linguistic choices elicit the most beneficial changes in behavior, not only perceived risk.
• Explore the mechanisms driving IF–THEN linkages and narrative communications, and develop strategies that increase their effectiveness in facilitating health protective behaviors.
• Improve our understanding of the role of affect in risk perceptions, including the unique and combined effects of perceived risk and affect on health behaviors.
• Examine how ethnic and cultural differences in the perceived risk affect responsiveness to health risk communication efforts, including how these differences influence behavior.
• Explore how incorporating theoretical approaches from the field of linguistics might improve existing theoretical and conceptual approaches to perceived risk.
• Improve understanding and communication of uncertain risk information (e.g., what are the characteristics of individuals who are likely to respond negatively to uncertain information; what strategies can communicate uncertainty clearly and effectively).

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Related topics
Risk perception; numeracy; technology; theory; health behavior; emotion.

Notes
1 The construct risk perception has many names, including perceived risk, perceived susceptibility, perceived vulnerability, perceived likelihood, and feelings of risk. For simplicity, this chapter will use the terms risk perception and perceived risk.
2 To the best of our knowledge, there are no theories of risk perception or communication that were developed by or for linguists.

Further reading
Behavioral Constructs and Culture for Cancer Screening, edited by M. Kagawa-Singer and K.M. Emmons, Health Education and Behavior (2009) 36 (5 Suppl.). (This supplemental issue critically evaluates the extent to which several constructs described in many theories of health behavior...
References


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