Chapter 18
Risk Perceptions and Risk Attitudes in the United States and Europe
Elke U. Weber and Jessica S. Ancker

This is a preprint of a chapter whose final and definitive form has been published in *The Reality of Precaution: Comparing Approaches to Risk Regulation in the United States and Europe*, ed. J. B. Wiener, M. D. Rogers, P. H. Sand, and J. K. Hammitt, by Taylor & Francis, December 2010, available through Taylor and Francis. Many Taylor & Francis and Routledge books are now available as eBooks through the Taylor & Francis eBookstore.

Chapter 18
Risk Perceptions and Risk Attitudes in the United States and Europe
Elke U. Weber and Jessica S. Ancker

Deleted: [tx]

Public policies related to health and safety risks in Europe and the United States show different patterns of precaution, yet in complex ways that make simple explanations elusive (Wiener and Rogers 2002). Among the factors identified as possible explanations for these differences in precautionary concern are cultural differences in risk perception and preferences. In this chapter, we review the literature of behavioral decision theory and cross-cultural research that compares risk perceptions and preferences in different countries. We show that there are cross-cultural differences in the perception of risks and thus in people's apparent willingness to take such risks. But we also find that this phenomenon has not yet been systematically explored and that much research on the topic remains to be done.

The Precautionary Principle

Public policy and public health researchers generally quantify health and safety risks as the relative frequency of known instances of morbidity, mortality, or other adverse impacts. However, conclusive evidence of adverse impacts is lacking for many potential risks, especially those that are novel, uncertain, or require extrapolating from known to unknown situations (e.g., from animal experiments to human health). In such situations, waiting for deaths or cases of disease to accrue before making decisions may be politically and morally unacceptable. In light of this problem, advocates of the precautionary principle favor anticipatory regulation of possible risks. The precautionary principle arises primarily in the public policy arena (Wiener and Rogers 2002), but has also been discussed in other areas, including medical decisionmaking and public health (Cranor 2004; Resnik 2004; Weed 2004). The precautionary principle has been

formulated in a number of ways, ranging from very weak (e.g., “regulation is permissible in the absence of complete evidence”) to strong (e.g., “potentially risky activities should be prohibited until they can be proven to pose minimal risk”). It has been adopted in a highly issue-specific fashion in both the United States and the European Union. Wiener and Rogers (2002) and Sunstein (Chapter 19 of this volume) have argued convincingly that the patterns of precaution are so complex that neither the EU nor the United States can be described globally either as precautionary or risk-averse. For example, European countries have taken a precautionary stance on regulating genetically modified foods, whereas American policies on teenage drinking or new drug approvals can be seen as precautionary (Wiener and Rogers 2002). Sunstein (Chapter 19) revives an argument by proponents of risk-risk analysis (Lave 1981; Keeney 1997; Graham and Wiener 1995), namely that it is in fact logically impossible to be globally precautionary with respect to all risks, because taking measures to prevent one hazard may increase the chances of another. For example, banning DDT to prevent ecosystem damage may result in increased malaria rates as mosquito populations rebound (Sunstein Chapter 19). The only way to think of one’s actions as precautionary is thus to take a myopic view of the problem or issue at hand. Cognitive myopia has, of course, been observed in many areas, from investment decisionmaking (Benartzi and Thaler 1999) to the consideration of consequences of multiple, related decisions (Lave 1981; Keeney 1997; Read et al. 1999).

Decomposing Risk-Taking into Risk Perception and Risk Attitude

Because the precautionary principle focuses on preventing possible losses, including losses that have not yet happened, invocation of the precautionary principle would seem to be a sign of risk-aversion at the individual or societal level.

In popular thought, risk attitude (defined as propensity for risk-aversion or risk-taking) is typically thought of as a personality trait. In this view, some individuals are risk-seekers across a broad range of situations and contexts, while others prefer safer options. This view, however, is undermined by a wealth of research on framing and domain effects. Framing effects refer to the finding that people's risk-taking and thus apparent risk attitudes are strongly affected by whether outcomes are framed in terms of losses ("10 out of 100 patients will die") or gains ("90 out of 100 patients will survive"). Explanations of framing effects draw on prospect theory (Kahneman and Tversky 1979), which posits different utility functions for gains and losses. Namely, a concave function for gains predicts risk-averse choices, and a convex function for losses predicts risk-seeking choices. Furthermore, risk-taking behavior varies across content domains. An individual's apparent risk-taking in the context of gambling does not predict risk-taking in other domains such as health, recreation, financial investing, business decisions, social choices, and ethical decisions (MacCrimmon and Wehrung 1986; Weber et al. 2002).

Together, these results suggest that risk attitudes inferred from choice (or, equivalently, from the shape of utility functions describing choice) are not stable personality attributes (Weber 2001a). A promising alternative model of risk-taking, adopted from finance, describes risk-taking as a function of three variables: (1) the perceived return of available choice options, (2) the perceived riskiness of those options, and (3) the decisionmaker's attitude toward perceived risk—that is, his or her willingness to trade perceived risk for possible return, or *perceived-risk attitude* (Brachinger and Weber 1997; Weber and Milliman 1997). When individual or group differences in risk-taking are examined closely, they are typically the result of differences in perceived risk and not of differences in willingness to take on perceived risk. For example, the characteristic that distinguishes entrepreneurs from other business people is not a more positive

attitude towards risk, but an overly optimistic perception of the risks involved (Brockhaus 1982; Cooper et al. 1988). Although there are individual differences in perceived-risk attitude, they are far smaller than individual and group differences in perceived risk, making perceived-risk attitude a credible candidate for a stable personality trait (Weber and Milliman 1997; Weber 2001a).

Culture and Risk Perception

The fact that individual and situational differences in apparent risk-taking are mediated by differences in the perception of the relative risks of choice options raises the possibility that national differences in preference for precautionary policies might be caused by national or cultural differences in the perceived risks of precautionary and other policies. Before discussing cross-cultural differences in risk perception and perceived-risk attitudes, we provide a brief overview of some developments in the psychological study of risk perception. As discussed in this section, perceptions of risk have been studied within three different research paradigms: measurement-theoretical, psychometric, and cultural theory.

Measurement-theoretical Paradigm

Normative models of risk-taking—from finance (Markowitz 1959) to biology (Caraco 1980)—characterize the riskiness of a risky choice option as the variance of possible outcomes, i.e., the square of the average deviation of outcomes around the mean (Weber et al. 2004). Sure options thus carry no risk, while a widening distribution of possible outcomes increases risk. The perception of risk, however, has long been known to differ from the variance of outcomes. For example, the possibility of outcomes below the mean affects perceived risk far more than the

possibility of outcomes above the mean (Weber and Bottom 1989; Weber and Bottom 1990). One model that attempts to capture such asymmetry of the effects of outcomes above and below the mean is Luce and Weber's conjoint expected risk (CER) model (Luce and Weber 1986). In this model, the perceived risk of a choice option is a linear combination of the probabilities of neutral, positive, and negative outcomes, and of the conditional expected values of positive outcomes and negative outcomes, raised to power functions. Model parameters allow for different weights of these different contributors to perceived risk, providing a way of explaining individual and group differences in risk perception.

In a study of business students and security analysts in Hong Kong, Taiwan, the Netherlands, and the United States, Bontempo, Bottom, and Weber (1997) fit the CER model to judgments of the riskiness of monetary lotteries. The *probability* of a loss had a larger effect on perceived risk for the two Western samples, but the *magnitude* of losses had a larger effect on the two culturally Chinese samples. Cross-cultural differences in risk perception were greater than differences due to profession, suggesting that cultural upbringing and environment are more important in shaping financial risk perceptions than professional training and experience.

Psychometric Paradigm

Another research approach, the psychometric paradigm, arose to explain lay perceptions of the risks of technological and health hazards (Fischhoff 1978; Slovic et al. 1986; Slovic 1987; Peters and Slovic 1996), which were found to differ from the risk estimates of experts who generally based their assessments on the relative frequency of negative outcomes such as death or disability, e.g., the list of mortality risks in Slovic (1997, 281). The primary question underlying this research agenda was why some hazards with low probability of negative outcomes (such as

airplane travel) were perceived as riskier than others that carried a much higher probability (such as car travel). The psychometric paradigm decomposes risk perception into a set of psychological risk dimensions that can be reduced to two factors: dread and risk of the unknown. The dread of an event is heightened when a hazard has severe consequences (even if rare), provoking a gut-level "dread" reaction, and effects that are perceived as catastrophic and sudden (rather than gradual or chronic). The risk of the unknown is heightened by characteristics such as novelty, delayed impact, or undetectability (i.e., exposure to carbon monoxide is frightening in part because the gas cannot be seen or smelled). Additional variables that may also contribute to the two psychological risk factors include the origin of the hazard (manmade versus natural), voluntariness of the exposure to the risk, and real or perceived controversy in the scientific community. As a result, when lay judgments are compared to expert judgments, lay people tend to overweight risk associated with infrequent, catastrophic, and involuntary events, and underweight risk associated with frequent, familiar, and voluntary events. As Slovic has said, the public's perception of risk is "much richer" than that of the expert (Slovic 1997).

Psychometric researchers have thus sought to persuade health and environmental risk assessment experts to define risk not simply as the probability of adverse consequences, but to add some measure of the uncertainty of outcomes, as has long been accepted in financial definitions of risk (Markowitz 1959), in addition to other psychological dimensions. While the psychometric model has extensively documented the ways in which risk perception departs from probability, probabilities do contribute to risk perception, increasing for example the vividness and salience (and thus the availability) of the risk. Availability has been identified as one of the heuristics that is generally used to estimate the frequency of an event (Tversky and Kahneman 1974), including the frequency of adverse consequences as a measure of risk.

Holtgrave and Weber (1993) found that subjects' judgments of financial and health and safety risks were best explained by a hybrid model that integrated the "dread" risk dimension with probabilities and utilities drawn from a simplified version of the conjoint expected risk model. The hybrid model provides additional evidence that risk perception (even about monetary risks) has emotional elements that are not captured by purely consequentialist models (Loewenstein 2001).

The two-factor structure of the psychometric paradigm of risk perception has been validated in studies using respondents from a variety of different countries, including Canada (Slovic et al. 1991), France (Bastide et al. 1989; Slovic et al. 2000), Hong Kong (Keown 1989), Hungary (Englander et al. 1986), Japan (Kleinhesselink and Rosa 1994), Norway (Teigen et al. 1988), the Soviet Union (Mechitov and Rebrik 1989), and Sweden (Slovic et al. 1989). Renn and Rohrmann (2000) provide a review. Only minor deviations from the standard two-factor risk dimension pattern emerged, with Americans, for example, rating high-tech hazards and risks high on the unknown axis as the most serious, whereas Hungarians rated everyday and familiar hazards such as driving cars as posing higher risks (Englander et al. 1986). Specific hazards in these studies often fell into different parts of the two-dimensional risk space in ways that were sometimes attributable to historical effects. For example, in a study conducted shortly after a Hong Kong public awareness campaign about heroin, Hong Kong students rated illicit drugs as more hazardous than did Americans (Keown 1989). Japanese students considered nuclear hazards to be old and well-known, unlike American students—a difference attributed to Japan's unique experience as the target of nuclear weapons at the end of World War II (Kleinhesselink and Rosa 1994).

Because of its success at capturing differences in perceptions of risk within a society, the psychometric paradigm has also been invoked to examine apparent differences in perceived risk across societies. For example, Wiener and Rogers (2002) invoke the psychometric paradigm of risk to suggest that Europeans' distrust of genetically modified foods may stem from their perception of such items as "unnatural." However, additional information would have to be provided to explain why American consumers do not share the European perception distrust of genetically engineered products as "unnatural." Sunstein (in Chapter 19) suggests that the availability heuristic and the dynamics of social groups in combination with differences in national history may explain cultural differences in risk behavior. For example, the vividness of a severe acute respiratory syndrome (SARS) outbreak in Toronto and of the 9/11 terrorist attacks in the United States can help explain why Canadians have been more concerned with SARS than with terrorism, whereas American citizens show the opposite pattern of concern (Chapter 19).

Cultural Theory

Both the measurement-theoretical and the psychometric paradigms were originally developed to explain individual differences in decisionmaking and risk perception, especially differences between lay and expert risk judgments. By contrast, a body of work originating in anthropology and sociology suggests that risk is not decided at an individual level, but instead is culturally constructed (Douglas and Wildavsky 1982; Douglas 1992). In the cultural theory model, a risk is an event that threatens values held to be important at the cultural or societal level. Such societal values serve as a frame through which members of a culture tend to view current events and future possibilities. "A risk is not only the probability of an event, but also the probable magnitude of its outcome, and everything depends on the value that is set on the outcome. The

evaluation is a political, aesthetic, and moral matter" (Douglas 1992, 31). In this view, providing information about probabilities fails to change risk judgments "not because the public does not understand the sums, but because many other objectives which it cares about have been left out of the risk calculation" (ibid., 40). Risk perception reflects what a society or community fears and seeks to blame for individual or group misfortune (ibid.).

The cultural theory of risk has been operationalized through an instrument that categorizes individuals according to their preferred cultural worldview or "orienting disposition" (Dake 1991). Cultures and individuals that value both rigid societal structures and strong social group loyalties are termed *hierarchists*. Those who value neither societal rigidity nor group solidarity are *individualists*. *Egalitarians* view group solidarity as valuable while disapproving of rigid social hierarchies. *Fatalists* feel trapped in a social hierarchy without feeling strong social bonds, whereas *hermits* renounce social connections altogether. (Most researchers restrict their attention to the first three categories, as fatalists and hermits are rare, and when fatalists are identified, they tend to behave like hierarchists.)

The orienting disposition categorization predicts differences in risk preferences (Dake 1991; Weber 2001b). Members of hierarchical cultures tend to appear risk-tolerant toward industrial and technological risks because they trust the competency of the technocratic elites who handle risky decisions; social deviance is feared more than technological hazards because social change, unlike technological change, threatens the social order. Individualists are likely to see economic risk as opportunity, being willing to chance poor outcomes in order to reap the benefits of possible good ones. By contrast, egalitarians are distrustful of technological risks that may threaten equality by disproportionately harming the poor or the environment (Douglas and Wildavsky 1982; Dake 1991).

Palmer (1996) used the orienting dispositions questionnaire to identify hierarchists, individualists, and egalitarians from a multiethnic population of southern Californian students. Respondents also rated the riskiness of a set of monetary and health/safety hazards, and their responses were assessed through the CER model. As predicted, Palmer found that the risk judgments of people with different worldviews were described by different components of the CER model. Hierarchists were predicted to be comfortable with risk-benefit methods of determining acceptable levels of risk for technologies (Thompson et al. 1990). In agreement with this prediction, Palmer found that hierarchists' risk judgments reflected all predictor variables of the CER model, where gains offset possible losses, and outcome levels as well as probabilities were considered. Egalitarians, by contrast, were predicted to be suspicious of technology and to view nature as a fragile shared resource in need of protection (Thompson et al. 1990). In agreement with this prediction, egalitarians viewed risk in terms of possible harms and provided risk judgments that reflected only the loss/harm predictor variables of the CER model. Finally, individualists have been described as viewing risk as opportunity, as long as the risk does not interfere with market mechanisms (Thompson et al. 1990). In agreement with this prediction, individualists provided the lowest risk judgments for almost all of the risky investments and activities.

Specifics of the cultural theory of risk have been debated. For example, Dake's categories have been criticized as "polemical abstractions" too rigid to adequately capture the complex and dynamic experience of either cultural dispositions or risk perception in the real world (Wilkinson 2001), and for being flawed by problematic data collection and statistical analyses (Rippl 2002; Sjöberg 2002). The adequacy of the Dake instrument as a measurement of culture has been called into question (Marris et al. 1998; Rippl 2002). Although ad-hoc models have been

proposed as alternatives to the cultural theory, no overarching theoretical framework appears to have emerged. Sjöberg (2002), for example, argues that in the case of perceived risk of nuclear waste, both the psychometric model and cultural theory should be jettisoned in favor of a regression model combining attitude toward nuclear power, risk attitude as a trait, attitude toward nature (the "tampering with nature" factor), perception of moral aspects of risk, and several attributes of the nuclear and radiation risk itself. Rohrmann (2000) suggests that globalization of the economy and media means that professional or political groups may have more in common with similar groups in other countries than with others of their own country, i.e., that social group differences may have larger effects than other cultural distinctions.

Risk Perception: Integrating Individual, Cultural, and National Factors

Among the factors shown to influence risk perception, several are likely to be cultural-specific. Two examples are sex and race (Slovic 1997; Slovic et al. 2000). For example, in the United States, the subset of white males with good educations, high incomes, and conservative political tastes tend to perceive risks to be markedly smaller and more manageable than do other men, women, or members of minority races (Slovic 1997). This "white male effect"—also confirmed by other researchers; see Weber et al. 2002—may be attributable to the high status of white men in America, which tends to give them more real as well as perceived control over hazards. Such gender and race effects are likely to vary across nations as culture establishes the relative equality or inequality between the sexes and various racial groups.

A related factor identified by Slovic as affecting risk perception is the degree of trust in institutions (particularly those performing risk management), which can vary across cultures as well as from individual to individual (Slovic 1997; Renn and Rohrmann 2000). Impaired trust in

social institutions implies suspicion about their willingness or ability to protect citizens, which could thus enhance the negative affective response to potential hazards. In studies in Europe (Sweden, Spain, the United Kingdom, and France), Viklund (2003) has confirmed that trust significantly predicted perceived risk within countries and across countries, but that the relationship was fairly weak. Public trust may be enhanced or attenuated by a country's mass media (Sjöberg et al. 2000).

A large study of sexual behavior in Estonia, Georgia, Hungary, Poland, and Russia contrasted individual perceptions of HIV risk in different countries (Realo and Goodwin 2003). Participants were given a "collectivism scale" to assess the extent of their orientation toward their families as a source of authority and strength ("familism") (Realo and Goodwin 2003). Across countries and occupations, high familism scores were associated with more conservative sexual behavior and with lower perceived vulnerability to HIV, but neither national origin nor profession had significant effects (Realo and Goodwin 2003). This study can be interpreted to suggest that any national differences in risk perception are attributable to differences in familial attitude. However, because individual sexual history was so strongly correlated with familism and is also strongly correlated with both objective and subjective HIV risk, other effects of nationality may simply have been overwhelmed. It also seems possible that the Eastern European countries targeted in this series of studies were not different enough to produce large cultural effects, despite the authors' argument to the contrary (Realo and Goodwin 2003).

Culture and Risk Preference

In contrast to risk perception (the perceived importance or magnitude of a risk as assessed by self-reports), risk preference is conceptualized as the willingness to take risks and can be measured by behavior. In a variety of financial gamble experiments, Weber and Hsee (1998; 1999) have repeatedly found that respondents from the People's Republic of China are less risk-averse in their financial choices than are U.S. respondents. The finding contradicts cultural stereotypes and, in one case, the predictions of the participants themselves (Weber and Hsee 1999). The difference in apparent risk preference between American and Chinese business students was attributed to differences in risk perception (Weber and Hsee 1999): Chinese participants tended to perceive financial risks as smaller than Americans did. The authors' cushion hypothesis attributes this phenomenon to the collectivism of Chinese culture: individuals who lose money are confident that they can turn to familial and social networks to "cushion" the blow. By contrast, members of America's individualist culture expect to shoulder the impact of adverse financial events themselves. The situation-specific element of risk-taking (that is, the perceived risk) resembles other theorists' formulation of risk perception as the severity of the *consequences* of a risk (Douglas and Wildavsky 1982; Sjöberg 2002). Another study in the People's Republic of China, the United States, Germany, and Poland involved willingness to pay for financial investment options and perceived riskiness of these options (Weber and Hsee 1998). The Chinese respondents considered the risks to be the lowest and paid the highest prices. Americans considered risks to be highest and were willing to pay the least. The cross-national differences in willingness to pay were completely accounted for by differences in risk perception. That is, there were no national differences in perceived-risk attitude or people's willingness to take on risks after controlling for the difference in the perceived magnitude of the risks. Risk perceptions and risk preferences of German respondents were closer to those of Chinese

respondents than those of American respondents, even though Germany's socioeconomic and political system is more similar to that of the United States. Consistent with attributing observed national differences to the cushion hypothesis, however, German culture has socially-collectivist elements (such as strong family and group ties and extensive social safety nets) that resemble China's (Weber and Hsee 1998).

Additional support for the cushion hypothesis that attributes cross-cultural differences in risk preferences to differences in social networks was found by Hsee and Weber (1999). They found that Chinese had larger social networks than Americans, and that when social network measures were added to a regression model of risk preferences, the nationality variable was no longer significant. This suggests that social networks could be the means through which culture affects risk preference. The cushion hypothesis moreover predicts that risk preferences should differ with the type of risk. A member of a collectivist culture could expect that his or her social network would cushion the impact of losses on dimensions where interpersonal transfer is possible (e.g., money), but not of losses where no such transfer is possible (e.g., honor, academic grades, life expectancy). Hsee and Weber confirmed this prediction in an experiment in which Chinese and American participants were asked to make a financial decision (to invest money in a safe savings account or in risky stocks), an academic one (whether to write a term paper on a safe topic or a provocative one), and a medical one (whether to take a pain reliever with a known moderate effect or another one with an effect that could vary from high to low). The Chinese were significantly more risk-seeking than the Americans only in the financial choice (Hsee and Weber 1999). This work also calls attention to the domain-specificity of risk perception. Risk attitude does not appear to be a global trait; people express different thresholds for financial risks,

health and safety risks, recreational risks, ethical risks, and social risks such as angering colleagues or friends (Weber et al. 2002).

Proverbs reflect cultural attitudes toward risk-taking (Weber et al. 1998). In a content analysis of proverbs from Chinese and American proverbial expressions, Weber et al. (1998) found that American and Chinese raters agreed that Chinese proverbs were more likely to promote risk-taking than were American ones. Because the Chinese proverbs are in many cases centuries old, this finding suggests the more risk-seeking behavior reported in the studies described above may have a long-standing cultural origin rather than reflecting merely current economic or political conditions. A larger proportion of American proverbs were judged to be applicable to financial-risk decisions than to social-risk decisions, whereas Chinese proverbs were judged to be roughly equally applicable to the two domains. The proverbs produced by these two cultures may reflect the fact that a collectivist culture considers social concerns to be as important as materialistic ones, whereas an individualist culture privileges material concerns.

Conclusions

Numerous cross-national and cross-cultural differences in risk perception have been identified, and it is these differences in the perception of risk—rather than attitudes towards (perceived) risk, proper—that seems to be responsible for cultural differences in risk-taking. A variety of explanations has been provided for observed cultural differences in risk perception: differences in the evaluation of specific risks on the psychological risk dimensions identified by the psychometric paradigm (including differences in perceived control as the result of power differentials or differences in institutional trust), as well as differences in objective circumstances (the cushion of collectivist risk diversification). The adoption of precautionary measures by

governments may reflect, in part, the responses of policymakers to the vicissitudes of public perceptions of risk. Further research is necessary to explain how these identified cultural differences can contribute to the understanding of differences in patterns of precaution between Europe and the United States.

Acknowledgments

Preparation of this chapter was facilitated by funding provided by the National Science Foundation under Grant No. SES-0345840. Any opinions, findings, and conclusions or recommendations expressed here are those of the authors and do not necessarily reflect the view of the National Science Foundation.

References

Bastide, S., J. P. Moatti, J.-P. Pages, and F. Fagnani. 1989. Risk Perception and Social Acceptability of Technologies: The French Case. *Risk Analysis* 9: 215–223.

Benartzi, S., and R. Thaler. 1999. Risk Aversion or Myopia? Choices in Repeated Gambles and Retirement Investments. *Management Science* 45: 364–381.

Bontempo, R. N., W. P. Bottom, and E. U. Weber. 1997. Cross-cultural Differences in Risk Perception: A Model-based Approach. *Risk Analysis* 17: 479–488.

Brachinger, H. W., and M. Weber. 1997. Risk as a Primitive: A Survey of Measures of Perceived Risk. *OR Spectrum* 19: 235–250.

Brockhaus, R. 1982. The Psychology of the Entrepreneur. In *The Encyclopedia of Entrepreneurship*, ed. C. Kent, D. L. Sexton, and K. Vesper. Englewood Cliffs, NJ: Prentice Hall.

Caraco, T. 1980. On Foraging Time Allocation in a Stochastic Environment. *Ecology* 61: 119–128.

Cooper, A., C. Woo, and W. Dunkelberg. 1988. Entrepreneur's Perceived Chances for Success. *Journal of Business Venturing* 3: 97–108.

Cranor, C. F. 2004. Toward Understanding Aspects of the Precautionary Principle. *Journal of Medicine and Philosophy* 29(3): 259–279.

Dake, K. 1991. Orienting Dispositions in the Perception of Risk: An Analysis of Contemporary Worldviews and Cultural Biases. *Journal of Cross-Cultural Psychology* 22(1): 61–82.

Douglas, M. 1992. *Risk and Blame: Essays in Cultural Theory*. London: Routledge.

Douglas, M., and A. Wildavsky. 1982. *Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers*. Berkeley: University of California Press.

Englander, T., K. Farago, P. Slovic, and B. Fischhoff. 1986. A Comparative Analysis of Risk Perception in Hungary and the United States. *International Journal of Social Psychology* 1: 55–66.

Fischhoff, B., P. Slovic, S. Lichtenstein, S. Read, and B. Combs. 1978. How Safe Is Safe Enough? A Psychometric Study of Attitudes Towards Technological Risks and Benefits. *Policy Sciences* 9: 127–152.

Graham, John D., and Jonathan B. Wiener, ed. 1995. *Risk vs. Risk: Tradeoffs in Protecting Health and the Environment.* Cambridge MA: Harvard University Press.

Holtgrave, D., and E. U. Weber. 1993. Dimensions of Risk Perception for Financial and Health and Safety Risks. *Risk Analysis* 13: 553–558.

Hsee, C. K., and E. U. Weber. 1999. Cross-national Differences in Risk Preference and Lay Predictions. *Journal of Behavioral Decision Making* 12: 165–179.

Kahneman, D., and A. Tversky. 1979. Prospect Theory: An Analysis of Decision under Risk. *Econometrica* 47: 263–291.

Keeney, R. 1997. Estimating Fatalities by the Economic Costs of Regulations. *Journal of Risk and Uncertainty* 14: 5–23.

Keown, C. F. 1989. Risk Perceptions of Hong Kongese versus Americans. *Risk Analysis* 9: 401–405.

Kleinhesselink, R. R., and E. A. Rosa. 1994. Cognitive Representation of Risk Perceptions: A Comparison of Japan and the United States. *Journal of Cross-Cultural Psychology* 22: 11–28.

Lave, L. 1981. *The Strategy of Social Regulation: Decision Frameworks for Policy*. Washington, DC: Brookings Institution.

Loewenstein, G., E. U. Weber, and C. K. Hsee. 2001. Risk as Feelings. *Psychological Bulletin* 127(2): 267–286.

Luce, R. D., and E. U. Weber. 1986. An Axiomatic Theory of Conjoint Expected Risk. *Journal of Mathematical Psychology* 30: 188–205.

MacCrimmon, K. R., and D. A. Wehrung. 1986. *Taking Risks: The Management of Uncertainty*. New York: Free Press.

Markowitz, H. M. 1959. *Portfolio Selection*. New York: Wiley.

Marris, C., I. H. Langford, and T. O'Riordan. 1998. A Quantitative Test of the Cultural Theory of Risk Perceptions: Comparison with the Psychometric Model. *Risk Analysis* 18(5): 635–647.

Mechitov, A. I., and S. B. Rebrik, ed. 1989. Studies of Risk and Safety Perception in the USSR. *Contemporary Issues in Decision Making*. Amsterdam: North Holland.

Palmer, C. G. S. 1996. Risk Perception: An Empirical Study of the Relationship between Worldview and the Risk Construct. *Risk Analysis* 16: 717–724.

Peters, E., and P. Slovic. 1996. The Role of Affect and Worldview as Orienting Dispositions in the Perception and Acceptance of Nuclear Power. *Journal of Applied Social Psychology* 26: 1427–1453.

Read, D., G. Loewenstein, and M. Rabin. 1999. Choice Bracketing. *Journal of Risk and Uncertainty* 19: 171–197.

Realo, A., and R. Goodwin. 2003. Family-related Allocentrism and HIV Risk Behavior in Central and Eastern Europe. *Journal of Cross-Cultural Psychology* 34(6): 690–701.

Renn, O., and B. Rohrmann, ed. 2000. *Cross-cultural Risk Perception: A Survey of Empirical Studies.* Boston: Kluwer Academic.

Resnik, D. B. 2004. The Precautionary Principle and Medical Decisionmaking. *Journal of Medicine and Philosophy* 29(3): 281–299.

Rippl, S. 2002. Cultural Theory and Risk Perception: A Proposal for a Better Measurement. *Journal of Risk Research* 5(2): 147–165.

Rohrmann, B. 2000. Cross-cultural Studies on the Perception and Evaluation of Hazards. In *Cross-cultural Risk Perception: A Survey of Empirical Studies*, ed. O. Renn and B. Rohrmann. Boston: Kluwer Academic, 103–144.

Sjöberg, L. 2002. Are Received Risk Perception Models Alive and Well? *Risk Analysis* 22(4): 665–669.

Sjöberg, L., D. Kolarova, A. A. Rucai, and M.L. Bernstrom. 2000. Risk perception in Bulgaria and Romania. In *Cross-cultural Risk Perception: A Survey of Empirical Studies*, ed. O. Renn and B. Rohrmann. Boston: Kluwer Academic, 146–183.

Slovic, P. 1987. Perception of Risk. *Science* 236: 280–285.

Slovic, P., ed. 1997. Trust, Emotion, Sex, Politics, and Science: Surveying the Risk-assessment Battlefield. In *Environment, Ethics, and Behavior: The Psychology of Environmental Valuation and Degradation*, ed. M. H. Bazerman, D. M. Messick, A. E. Tenbrunsel, and K. A. Wade-Benzoni. San Francisco: New Lexington Press, 277–313.

Slovic, P., B. Fischhoff, and S. Lichtenstein. 1986. The Psychometric Study of Risk Perception. In *Risk Evaluation and Management*, ed. V. T. Covello, J. Menkes, and J. Mumpower. New York: Plenum Press.

Slovic, P., J. Flynn, C. K. Mertz, M. Poumadere, and C. Mays. 2000. Nuclear Power and the Public: A Comparative Study of Risk Perception in France and the United States. In *Cross-cultural Risk Perception: A Survey of Empirical Studies*, ed. O. Renn and B. Rohrmann. Boston: Kluwer Academic, 56–102.

Slovic, P., N. Kraus, H. Lappe, H. Letzel, and T. Malmfors. 1989. Risk Perception of Prescription Drugs: Report on a Survey in Sweden.In *The Perception and Management of Drug Safety Risks*, ed. B. Horrisberger and R. Dinkel. Berlin: Springer, 91–111.

Slovic, P., N. Kraus, H. Lappe, and M. Major. 1991. Risk Perception of Prescription Drugs: Report on a Survey in Canada. *Canadian Journal of Public Health* 82: S15–S20.

Teigen, K. H., W. Brun, and P. Slovic. 1988. Societal Risk as Seen by a Norwegian Public. *Journal of Behavioral Decision Making.* 1: 111–130.

Thompson, M., R. Ellis, and A. Wildavsky. 1990. *Cultural Theory*. Boulder, CO: Westview Press.

Tversky, A., and D. Kahneman. 1974. Judgment under Uncertainty: Heuristics and Biases. *Science* 185: 1124–1130.

Viklund, M. J. 2003. Trust and Risk Perception in Western Europe: A Cross-national Study. *Risk Analysis* 23(4): 727–738.

Weber, E. U. 2001a. Personality and Risk Taking. In *International Encyclopedia of the Social and Behavioral Sciences*, ed. N. Smelser and P. Baltes. Oxford: Elsevier, 11274–11276.

———. 2001b. Risk: Empirical Studies on Decision and Choice. In *International Encyclopedia of the Social and Behavioral Sciences*, ed. N. Smelser and P. Baltes. Oxford: Elsevier, 13347–13351.

Weber, E. U., A. R. Blais, and N. E. Betz. 2002. A Domain-specific Risk-attitude Scale: Measuring Risk Perceptions and Risk Behaviors. *Journal of Behavioral Decision Making* 15: 1–28.

Weber, E. U., and W. P. Bottom. 1989. Axiomatic Measures of Perceived Risk: Some Tests and Extensions. *Journal of Behavioral Decision Making* 2: 113–131.

———. 1990. An Empirical Evaluation of the Transitivity, Monotonicity, Accounting, and Conjoint Axioms for Perceived Risk. *Organizational Behavior and Human Decision Processes* 45: 253–276.

Weber, E. U., and C. K. Hsee. 1998. Cross-cultural Differences in Risk Perception, But Cross-cultural Similarities in Attitude towards Perceived Risk. *Management Science* 44: 1205–1217.

———. 1999. Models and Mosaics: Investigating Cross-cultural Differences in Risk Perception and Risk Preference. *Psychonomic Bulletin Review* 6(4): 611–617.

Weber, E. U., C. K. Hsee, and J. Sokolowska. 1998. What Folklore Tells Us about Risk and Risk Taking: A Cross-cultural Comparison of American, German, and Chinese Proverbs. *Organizational Behavior and Human Decision Processes* 75: 170–186.

Weber, E. U., and R. Milliman. 1997. Perceived Risk Attitudes: Relating Risk Perception to Risky Choice. *Management Science* 43: 122–143.

Weber, E. U., S. Shafir, and A. R. Blais. 2004. Predicting Risk Sensitivity in Humans and Lower Animals: Risk as Variance or Coefficient of Variation. *Psychological Review* 111(2): 430–445.

Weed, D. L. 2004. Precaution, Prevention, and Public Health Ethics. *Journal of Medicine and Philosophy* 29(3): 313–332.

Wiener, J. B., and M. D. Rogers. 2002. Comparing Precaution in the United States and Europe. *Journal of Risk Research* 5(4): 317–349.

Wilkinson, I. 2001. Social Theories of Risk Perception: At Once Indispensable and Insufficient. *Current Sociology* 49(1): 1–22.