

## CONSUMER PERCEPTIONS OF FOOD SAFETY

**Lynn Frewer, Janneke de Jonge and Ellen van Kleef**

*Wageningen University, The Netherlands*

**Keywords:** risk, benefit, trust, confidence, individual differences, risk uncertainty, risk variability, affect, risk management, risk communication.

### Contents

1. Introduction
  2. Consumer perceptions of risk
  3. Risk and benefit
    - 3.1. Risk and Benefit Associated with New Food Technologies
    - 3.2. The Negative Correlation Between Perceived Risk and Benefit
    - 3.3. Habit
    - 3.4. Risk Uncertainty and Variability
  4. Trust in food and actors in the food chain
  5. Individual differences
  6. Conclusion
- Glossary  
Bibliography  
Biographical Sketches

### Summary

Understanding consumer responses to various food safety issues is of crucial importance if effective food safety policy and risk communication are to be developed and implemented. This chapter presents an overview of research into consumer perceptions of food safety, and the role of consumer risk psychology in determining risk-related behaviors and best practice in risk communication. Many empirical investigations of consumer perceptions about the safety of food have focused on perceived risk associated with food, food-related hazards, and food technologies. In addition, consumer trust in different actors and institutions responsible for guaranteeing food safety, as well as trust in the information provided by different information sources that communicate about food-related risks, is considered to be important for consumer confidence in the safety of food, as well as consumer evaluation of the efficacy of food risk management practices. In particular, as food chains become global, there is a need to understand cross-cultural differences in consumer risk perceptions and trust in food, and how these influence consumer behaviors. It has become increasingly evident that consumers are making decisions about the acceptability of specific foods and production technologies based on a complex interaction of perceptions of risk and benefit associated with specific food choices. Theoretical advances in the area of social psychology are relevant to the development of effective risk-benefit communication strategies that address communication of risk under conditions of uncertainty, as well as communication specifically targeted at vulnerable groups within the population. Research is urgently needed to further our understanding of the fundamental

mechanisms which determine individual responses to existing and emerging food issues, particularly under circumstances where habit, emotion, and information processing heuristics may have an effect on consumer decision-making. Risk communication and intervention activities aimed at health promotion should be developed that take these issues explicitly into account.

## **1. Introduction**

Existing and emerging food risks have been recognized by international organizations, as well as many governments worldwide, as a major problem both in modern (intensive) and in low-input food production systems. Many of these organizations are also responsible for communicating food risks and other safety matters to interested stakeholders, including consumers. Substantial effort and resources have been invested in global, national and regional initiatives (e.g., research, regulation) to improve food safety standards. The series of food safety crises since the 1990's, including Bovine Spongiform Encephalopathy (BSE), dioxin contamination in different food chains, the debate about the effects of acrylamide, and the identification of emerging pathogens such as *E. coli* O157 have evoked broad public concern about the safety of the food and feed chain. One consequence has been the decline in consumer confidence in regulatory activities associated with consumer protection in the agri-food sector.

Consumer 'rankings' of the severity of different risks appear to differ from those provided by individuals with 'technical' skills and knowledge about a specific hazard domain, including that of food risk. For example, experts often wonder why consumers accept relatively high risks from unhealthy food choices, while at the same time they do not tolerate risks that experts may find relatively low, such as contracting Creutzfeldt Jakob Disease (vCJD) from eating beef that has been produced in a country where BSE occurred. Considering that public evaluations of risk and acceptability differ from expert risk judgments, consumer reactions to food-related hazards or new food technologies can not be predicted by relying on technical risk assessments made by experts. Therefore, understanding consumer responses to various food safety issues is of crucial importance if effective food safety policy and risk communication is to be developed and implemented. That is, the behavior of consumers in relation to food safety issues can only be properly predicted if there is systematic understanding of the way in which consumers perceive risks, and benefits, associated with different food safety issues.

As a result of the increasing globalization of the food supply, food safety problems are spreading rapidly beyond single locations to create global problems, and it is at this level that the issues of existing emerging food risks must be discussed. At the present time, an emerging risk which has potential for negative effects is Avian Influenza which, whilst not technically a food risk, may have severe consequences on the efficiency of food production, animal welfare, human health, as well as consumption of poultry and poultry products. In 2006, a Special Eurobarometer study was carried out to examine consumer opinions regarding Avian Influenza. Although the majority of European citizens were not very worried about the health risks posed through the consumption of poultry, eggs and egg-based products, approximately 1 respondent in 5 declared that he/she has reduced her consumption of poultry meat, and 1 out of 8

respondents reported that they had reduced their consumption of eggs and egg-based products. This demonstrates that consumers appear to be risk adverse in terms of their consumption behavior even under conditions where they appear relatively unconcerned about the potential impact of a particular potential hazard.

In the light of cross-national food safety issues, there is an urgent need to understand cross-cultural differences and similarities in risk perception, and how these influence consumer behaviors. In addition, there is a need to develop insights into best practice in risk management and communication targeted *across* and *within* cultures.

Many empirical investigations of consumer perceptions about the safety of food have focused on perceived risk associated with food, food-related hazards, and food technologies. In early studies focused on understanding lay peoples' risk perception, different dimensions of risk were identified. In particular, it was found that factors that are not included in technical risk estimates may influence peoples' perception of risk, such as the extent to which a risk is perceived to be *unnatural*, *dreaded*, or to which an individual perceives exposure to be *involuntary*. These psychological dimensions are excellent predictors of people's responses to potential risks associated with hazards across different hazard domains, including that of food hazards.

Another concept that has been extensively studied in relation to consumer perceptions of food safety, and food risk management in general, is the concept of trust. Consumer trust in different actors and institutions responsible for guaranteeing and controlling food safety, as well as trust in the information provided by different information sources that communicate about food safety or food-related risks, is considered to be important for consumer confidence in the safety of food, as well as consumer evaluation of the efficacy of food risk management practices.

Consumer perceptions of risk and their trust in regulators, and risk information, have been identified as important underlying determinants of consumer acceptance of new food technologies, as well as factors that influence consumer behavior in the context of food safety incidents. That is, the impact of consumer risk perceptions on product consumption and choice, such as brand choice, retail choice, and preferences for distinct product types (e.g., organic products) has attracted considerable attention. For example, research into consumer perceptions of meat indicated that consumers' self-reported meat consumption was related to their perceptions regarding the potential presence of hormones or harmful substances in meat products, and the safety of meat.

In addition to studies focusing on consumer perceptions of food-related hazards in relation to food safety incidents and new food technologies, research in the food area has focused on lifestyle hazards such as inappropriate dietary choices, or microbiological risk associated with food contamination.

Increasingly, individual differences in consumer responses to food hazards, and communication about the associated risks, have been taken into account. For example, risk perceptions, food safety related behaviors, consumer responses to food safety scares, and consumer use of information are dependent on consistent personality characteristics as well as other background variables.

The aims of this chapter are:

- to provide an overview of research into consumer perceptions of food safety, and
- to provide an overview of the role of consumer risk psychology in determining risk-related behaviors and best practice in risk communication

## 2. Consumer Perceptions of Risk

By means of psychometric scaling methods, researchers in the late 1970s initiated research which identified those factors which drive consumers' responses to a variety of hazards associated with lifestyle choices and technological innovation. Slovic and colleagues conducted the influential research that revealed that the public judge risks on different and more criteria than the two classical factors of risk, i.e. level of probability and degree of possible harm. From this research, it was found that the main drivers of public perceptions of risk are the degree to which a hazard is unknown, and the degree of dread experienced by the individual evaluating a particular hazard. The application of the 'psychometric paradigm' to increase understanding of the factors that determine risk perception, inspired many researchers to carry out more detailed research into specific risk issues, such as food-related hazards.

Although the psychometric approach has been utilized to study risk perceptions in a number of countries, the results and implications have been criticized on the basis that the results have not been cross-culturally validated in less developed countries. Other researchers have put forward the criticism that *aggregated* data were the unit of analysis, which did not allow investigation of individual differences. Thus the model neglects potentially important individual differences in risk perception, particularly when considering how to effectively communicate about different hazards, which may also be prone to population level variability in terms of their impact on consumer health and wellbeing. However, many studies have shown that risk perceptions vary between individuals. In order to investigate the dimensionality of public risk perceptions taking into account potential individual differences, research has investigated individual perceptions of hazards across the risk dimensions distinguished by Fischhoff and colleagues in the 1970s. The same two dimensions underlying public risk perceptions (i.e., unknown risk and dread risk) were obtained as in psychometric studies that used aggregated data. However, it was found that the *extent* to which hazards were perceived to be unknown and dreaded was dependent upon individual perceptions.

With respect to individuals' perception of risk, a relevant psychological phenomenon is that of *optimistic bias* or *unreal optimism*. Optimistic bias refers to an individual's judgment that negative events are less likely to happen to the person making the judgment in comparison to the risks experienced by an average member of society. This is because people personally believe that they are at low personal risk from the hazard and 'bad things happen to other people'. Optimistic bias has been observed for a range of food related hazards, but tends to be more pronounced for that which can be

described as ‘lifestyle’ related as opposed to ‘technological’ in origin. For example, in the case of saturated fat consumption, people justify their lower than average personal risk ratings by attributing higher perceived personal control over risk exposure to the hazard, together with increased perceived personal knowledge about the effects of saturated fat consumption on health. As a consequence, it may be difficult to motivate consumers to reduce their fat intake since they perceive that information is directed towards more vulnerable and less knowledgeable members of society.

### **3. Risk and Benefit**

#### **3.1. Risk and Benefit Associated with New Food Technologies**

Many studies have been conducted on consumer attitudes to emerging food technologies, such as genetically modified foods, food irradiation, or highly technological food processing practices. In the area of food technology, it seems likely that consumer responses are contingent on perceptions of both risk and benefit associated with specific applications. The higher the perceived risk associated with a particular technology or hazard, the less favorable were found to be consumers’ attitudes. For example, research has focused on the trade-offs consumers make between perceived risks and benefits regarding genetic modification applied to mitigating allergies. The attitude of allergic and non-allergic respondents towards applications of genetic modification for allergy prevention was examined for one food application (apple) and two non-food applications (birch, grass). Allergic patients perceived greater ‘benefits’ associated with the birch application compared to non-patients, and the perceived benefits of genetic modification for allergy prevention increased with an increasing impact of allergic complaints on quality of life. However, no differences were found between patients and non-patients for the food application, possibly because the severity of apple allergy is rather low. Thus it appears that the *personal relevance* of a particular benefit associated with a technology application will influence whether a particular consumer perceives the application of a technology to be acceptable.

Research into consumer attitudes to emerging food technologies has further demonstrated that consumer attitudes towards these technologies, and the products of these technologies, do not only include evaluations of the potential personal benefits and health effects, but also take account of moral concerns and beliefs such as *ethical and moral* considerations, and *values* such as *concern about the integrity of nature* played a part in societal and consumer acceptance. The public perception that institutions and industries were pushing the introduction of genetically modified foods in order to protect their own vested interests rather than to support societal benefits did little to alleviate societal concerns. In the future, emerging technologies applied to food production (e.g., nanotechnology), or convergence between different technologies in the agri-food sector (e.g., information and communication technologies, biotechnologies, cognitive sciences and nanotechnologies), may give rise to other public concerns under conditions of increased complexities and uncertainties regarding both risks and benefits associated with food production processes and food products produced by such processes. In response to public concerns, institutions may adopt a precautionary

approach in terms of regulation. An example is that taken by the European Commission to restrict the use of GM crops under conditions of uncertainty about negative environmental consequences, and restrictions in imports of food products that are produced using genetic modification.

### **3.2. The Negative Correlation Between Perceived Risk and Benefit**

There is some evidence that perceived risk and benefit associated with different activities or technologies are negatively correlated. That is, high levels of perceived risk are related to low levels of perceived benefit, and *vice versa*. However, it has been argued that in the *real world*, high levels of risk are only acceptable when they are offset by high perceived levels of benefit. Several theories have been developed and tested to explain the negative relationship between perceived risk and benefit. It has been hypothesized that consumer perceptions of risk and benefit are dependent upon consumer trust in institutions and the industry. For example, when trust in scientists, authorities, and industry was controlled in the analysis, the inverse relationship between perceived risk and perceived benefit associated with different hazards decreased. Although it has been proposed that perceived risk is reduced when the public trust expert knowledge, regulators and risk managers in being able to control risks, other studies indicated that other dimensions of trust, such as care for public welfare of different actors, might overrule perceived competence in influencing risk perceptions and attitudes. In addition, research has indicated that prior attitudes toward hazards or technologies might influence whom the public trusts. For example, if people have a strongly held attitude about a potentially hazardous activity, such as genetic modification of food products, they are more likely to trust a source that provides a message congruent to their attitude, and to distrust a source that provides a dissonant message). This means that trust does not necessarily influence risk perceptions and acceptance of technologies, but that overall attitudes might also steer more specific perceptions of risk and trust. Closely related to this, other researchers have suggested that affective responses to a hazard, or emotion generated by a particular hazard topic, guides perceptions of risk and benefit. Affective responses to an event or object can serve as a mental shortcut when making assessments of risk and benefit. The use of affect in cognitive information processing might be more efficient in terms of mental resource allocation, and easier to use, in comparison to analytic reasoning about benefits and risks, and might particularly be helpful when mental resources are limited. It has been empirically demonstrated that affect comes prior to, and influences, judgments of risk and benefit. The results of the study indicated that, when the opportunity for analytic deliberation was limited, and people had to rely on quick affective judgments, the inverse relationship between risk and benefit perceptions increased. So, under conditions of time pressure, 'low risk, high benefit' evaluations of activities and technologies were more frequently made, in comparison to conditions where time constraints did not apply. In addition, it was found that when people were provided with information about *either* the degree of risk or benefit, subsequent evaluations of both risk and benefit were influenced. That is, information indicating high benefit increased subsequent judgments of benefit, but also reduced perceptions of risk associated with the activity or technology under consideration. The results showed that risks and

benefits are not evaluated independently from each other, and that people make affectively congruent judgments of risk and benefit. The tendency for overall affect to serve as a cue for making judgments has also been called the *affect heuristic*. In addition, others proposed a similar concept, namely the *risk-as-feelings* hypothesis, which postulates that feelings, such as worry, fear, dread, or anxiety influence responses to risky situations. It has also been argued that perceived risk and benefit might be inversely correlated, because people have a need for consistency in beliefs, and as such tend to avoid cognitive dissonance, or conflict between different beliefs held simultaneously. That is, it is cognitively difficult for consumers to perceive high risks and high benefits associated with the *same* hazard simultaneously. Finally, the inverse relationship between risk and benefit judgments might be explained by people producing 'net riskiness' and 'net benefit' judgments, because they do not evaluate risks and benefits independently from each other. This means that when net risk is high, net benefit is low, and *vice versa*.

-  
-  
-

TO ACCESS ALL THE 21 PAGES OF THIS CHAPTER,  
Visit: <http://www.eolss.net/Eolss-sampleAllChapter.aspx>

### Bibliography

Aarts, H., and Dijksterhuis, A. (2000). Habits as knowledge structures: Automaticity in goal-directed behavior. *Journal of Personality and Social Psychology*, 78(1), 53-63. [In three experimental studies it is shown that habits are a form of goal-directed automatic behavior].

Alhakami, A. S., and Slovic, P. (1994). A psychological study of the inverse relationship between perceived risk and perceived benefit. *Risk Analysis*, 14(6), 1085-1096. [This studies the inverse relationship between perceived risk and benefit].

Anderson, E. S., Winett, R. A., and Wojcik, J. R. (2000). Social-cognitive determinants of nutrition behavior among supermarket food shoppers: A structural equation analysis. *Health Psychology*, 19(5), 479-486. [This study examines the impact of several social-cognitive factors on nutrition behavior].

Barnett, J., and Breakwell, G. M. (2001). Risk perception and experience: Hazard personality profiles and individual differences. *Risk Analysis*, 21(1), 171-177. [This investigates how experience with voluntary and involuntary activities influences individual risk perceptions].

Baron, J., Hershey, J. C., and Kunreuther, H. (2000). Determinants of priority for risk reduction: The role of worry. *Risk Analysis*, 20, 413-427. [This examines the determinants of desire for risk reduction among experts and non-experts].

Berg, L. (2004). Trust in food in the age of mad cow disease: A comparative study of consumers' evaluation of food safety in Belgium, Britain and Norway. *Appetite*, 42, 21-32. [This study investigates how countries that experienced a food safety scandal differ from those who did not regarding consumer's trust in food].

Berg, L., Kjaernes, U., Ganskau, E., Minina, V., Voltchkova, L., Halkier, B., Holm, L. (2005). Trust in food safety in Russia, Denmark and Norway. *European Societies*, 7(1), 103-129. [This examines cross-

national differences in trust in food and the extent to which this depends on trust in national food control authorities and trust in market mechanisms].

Bouyer, M., Bagdassarian, S., Chaabanne, S., and Mullet, E. (2001). Personality correlates of risk perception. *Risk Analysis*, 21(3), 457-465. [This investigates individuals' anxiety and worldviews in relation to their perceived risk of different types of hazards].

Bredahl, L. (2001). Determinants of consumer attitudes and purchase intentions with regard to genetically modified foods - results of a cross-national survey. *Journal of Consumer Policy*, 24, 23-61. [This study focuses on the factors that influence consumer attitudes and purchase intentions of genetically modified foods].

Bronfman, N. C., and Cifuentes, L. A. (2003). Risk perception in a developing country: the case of Chile. *Risk Analysis*, 23, 1271-1285. [This is an investigation of public risk perceptions in Chile using the psychometric paradigm].

Brug, J., Lechner, L., and De Vries, H. (1995). Psychosocial determinants of fruit and vegetable consumption. *Appetite*, 25(3), 285-296. [This study examines the influence of attitudes, social influence, and self efficacy on consumption of fruit and vegetables].

Burger, J., Gaines, K. E., and Gochfield, M. (2001). Ethnic differences in risk from Mercury among Savannah river fishermen. *Risk Analysis*, 21(3), 533-544. [This is an examination of ethnic differences in risk from mercury exposure based on site-specific consumption patterns of fish].

Burger, J., and Waishwell, L. (2001). Are we reaching the target audience? Evaluation of a fish fact sheet. *The Science of the Total Environment*, 277, 77-86. [On the basis of interviews with fishermen, it is investigated how risk communication concerning the consumption of wild-caught fish from contaminated waters is perceived by the target audience].

Burton, M., and Young, T. (1996). The impact of BSE on the demand for beef and other meats in Great Britain. *Applied Economics*, 28, 687-693. [This studies meat demand over time taking into account an index of media coverage on BSE].

Da Costa, M. C., Deliza, R., Rosenthal, A., Hedderley, D., and Frewer, L. J. (2001). Non-conventional technologies and impact on consumer behaviour. *Trends in Food Science and Technology*, 11, 188-193. [This is a conjoint study on public acceptance of a genetically modified product, of which the production method had the potential to reduce negative environmental impact].

De Jonge, J., Frewer, L., Van Trijp, H., Renes, R. J., De Wit, W., and Timmers, J. (2004). Monitoring consumer confidence in food safety: An exploratory study. *British Food Journal*, 106, 837-849. [This describes the development of a monitor of consumer confidence in the safety of food, and investigates public perceptions of food safety in the Netherlands].

De Jonge, J., Van Trijp, H., Goddard, E., and Frewer, L. (submitted-a). Consumer confidence in the safety of food in Canada and the Netherlands: the validation of a generic framework. [This is a validation of a framework of the determinants of consumer confidence in the safety of food on the basis of a systematic comparison of consumer perceptions of food safety in Canada and the Netherlands].

De Jonge, J., Van Trijp, H., Renes, R. J., and Frewer, L. (accepted subject to revision). Understanding consumer confidence in the safety of food: Its two-dimensional structure and determinants. *Risk Analysis*. [This is an investigation of the determinants of consumer confidence in the safety of food, and the extent to which these differentially influence the optimism and pessimism dimension of confidence].

De Jonge, J., Van Trijp, H. C. M., Van der Lans, I. A., Renes, R.-J., and Frewer, L. J. (submitted-b). How trust in institutions and organisations builds general consumer confidence in the safety of food. [Two studies describe the development of a scale of general consumer confidence in the safety of food, and the extent to which trust in actors in the food chain and regulators, taking into account different dimensions of trust, was related to general consumer confidence].

Dibsdall, L., Lambert, N., and Frewer, L. J. (2002). Using interpretative phenomenology to understand the food related experiences and beliefs of a select group of low-income UK women. *Journal of Nutrition Education and Behavior*, 34(6), 298-209. [This is a qualitative approach to exploring barriers to healthy eating in socially excluded groups].



Dosman, D. M., Adamowicz, W. L., and Hrudehy, S. E. (2001). Socioeconomic determinants of health- and food safety-related risk perceptions. *Risk Analysis*, 21(2), 307-317. [An analysis of the significance of socioeconomic determinants of risk perceptions concerning health and food safety].

Eiser, J. R., Miles, S., and Frewer, L. J. (2002). Trust, perceived risk, and attitudes toward food technologies. *Journal of Applied Social Psychology*, 32(11), 2423-2433. [A re-analysis of 3 studies (on food technology) to compare whether (a) both trust and perceived risk are independently and directly associated with acceptance, or (b) the relationship between trust and acceptance is mediated by perceived risk].

Fife-Schaw, C., and Rowe, G. (1996). Public perceptions of everyday food hazards: A psychometric study. *Risk Analysis*, 16(4), 487-500. [A study of public perceptions of food-related hazards by employing the psychometric approach].

Finucane, M. L., Alhakami, A., Slovic, P., and Johnson, S. M. (2000). The affect heuristic in judgments of risks and benefits. *Journal of Behavioral Decision Making*, 13(1), 1-17. [A study of judgments of risks and benefits, which suggests that people seem prone to using an 'affect heuristic' which improves judgmental efficiency by deriving both risk and benefit evaluations from affective reactions to the stimulus item].

Fischer, A. R. H., and De Vries, P. W. (submitted). Everyday behaviour and everyday risk: An exploration how people respond to frequently encountered risks by acting on experience and feelings. [This paper describes the development of a model for consumer behavior under everyday risks on the basis of insights from behavior regulation and risk perception theory].

Fischer, A. R. H., and Frewer, L. J. (in press). Public acceptance of new technologies in food products and production. In R. Flynn and P. Bellaby (Eds.), *Risk and the public acceptability of new technologies*. Hampshire, UK: Pelgrave Publishers. [Provides an overview of factors which determine whether new food technologies are accepted by the public].

Fischer, A., and Frewer, L. J. (submitted-a). The "psychological" structure of food behavior. [An analysis of how people think about food related behaviors].

Fischer, A. R. H., and Frewer, L. J. (submitted-b). Food safety practices in the domestic kitchen: Demographic, personality and experiential determinants. [An analysis of what determines differences between people in terms of their food safety practices].

Fischer, A. R. H., Frewer, L. J., and Nauta, M. J. (2006). Toward Improving Food Safety in the Domestic Environment: A Multi-Item Rasch Scale for the Measurement of the Safety Efficacy of Domestic Food-Handling Practices. *Risk Analysis*, 26(5), 1323-1338. [Consumer survey conducted to develop a measure of food safety behavior which can be used to assess the effectiveness of different intervention strategies across different groups of consumers].

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., and Combs, B. (1978). How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. *Policy Sciences*, 9, 127-152. [An analysis of consumer elicited judgments of perceived risk, acceptable risk, and perceived benefit for 30 activities and technologies].

Frewer, L. J., Howard, C., Hedderley, D., and Shepherd, R. (1996). What determines trust in information about food-related risks? Underlying psychological constructs. *Risk Analysis*, 16(4), 473-485. [An examination of the constructs underlying trust and distrust in different sources providing food-related risk information].

Frewer, L. J., Howard, C., and Shepherd, R. (1997). Public concerns about general and specific applications of genetic engineering: risk, benefit and ethics. *Science, Technology and Human Values*, 22, 98-124. [A consumer study on what terminology people use to distinguish between different applications of genetic engineering drawn from food-related, agricultural, and medical applications].

Frewer, L. J., Howard, C., and Shepherd, R. (1998). Understanding public attitudes to technology. *Journal of Risk Research*, 1, 221-237. [A paper demonstrating the inverse relationship between perceived risk and perceived benefit associated with different technologies].

Frewer, L. J., Hunt, S., Kuznesof, S., Brennon, M., Ness, M., and Ritson, R. (2003a). The views of

scientific experts on how the public conceptualise uncertainty. *Journal of Risk Research*, 6, 75-85. [An analysis of how scientific experts think the public will react to uncertainty information].

Frewer, L., Lassen, J., Kettlitz, B., Scholderer, J., Beekman, V., and Berdal, K. G. (2004). Societal aspects of genetically modified foods. *Food and Chemical Toxicology*, 42(7), 1181-1193. [Provides an overview of factors which contributed to the negative view of European consumers regarding genetically modified foods].

Frewer, L. J., and Miles, S. (2003). Temporal stability of the psychological determinants of trust: Implications for communication about food risks. *Health, Risk and Society*, 5(3), 259-271. [A paper which tracks changes in consumer trust associated with food safety with time].

Frewer, L. J., Miles, S., Brennan, M., Kuznesof, S., Ness, M., and Ritson, C. (2002a). Public preferences for informed choice under conditions of risk uncertainty. *Public Understanding of Science*, 11, 363-372. [An analysis of how consumers make food choice decisions under conditions of uncertainty].

Frewer, L. J., Miles, S., and Marsh, R. (2002b). The GM foods controversy. A test of the social amplification of risk model. *Risk Analysis*, 22, 4, 713-723. [An empirical analysis of the social amplification of risk framework based on attitude data before, during, and after the increased reporting of the risks of genetically modified food in the United Kingdom].

Frewer, L., Scholderer, J., and Bredahl, L. (2003b). Communicating about the risks and benefits of genetically modified foods: The mediating role of trust. *Risk Analysis*, 23(6), 1117-1133. [An examination of trust in a consumer attitude experiment involving consumers from Denmark, Germany, Italy and the United Kingdom].

Frewer, L. J., Shepherd, R., and Sparks, P. (1994). The interrelationship between perceived knowledge, control and risk associated with a range of food related hazards targeted at the self, other people and society. *Journal of Food Safety*, 14, 19-40. [An investigation of the relationship between perceived risk, perceived control, and perceived knowledge for a range of food related hazards].

Gordon, J. (2003). Risk communication and foodborne illness: Message sponsorship and attempts to stimulate perceptions of risk. *Risk Analysis*, 23(6), 1287-1296. [A content analysis of nationally distributed food-safety messages].

Griffith, C. J., and Worsfold, D. (1994). Application of HACCP to food preparation practices in domestic kitchens. *Food control*, 5, 200-204. [A description of potential applications of HACCP to improve food preparation practices in the domestic kitchen].

Griffith, C. J., Worsfold, D., and Mitchell, R. (1998). Food preparation, risk communication and the consumer. *Food control*, 9(4), 225-232. [This is an investigation of domestic food handling practices in the context of the risk of food poisoning].

Henson, S., and Northen, J. (2000). Consumer assessment of the safety of beef at the point of purchase: A pan-European study. *Journal of Agricultural Economics*, 51(1), 90-105. [This study examines how safety assessments of beef are made].

Hites, R. A., Foran, J. A., Carpenter, D. O., Hamilton, M. C., Knuth, B. A., and Schwager, S. J. (2004). Global assessment of organic contaminants in farmed salmon. *Science*, 303, 226-229. [A risk analysis indicating that consumption of farmed Atlantic salmon may pose health risks that detract from the beneficial effects of fish consumption].

Houghton, J. R., Van Kleef, E., Rowe, G., and Frewer, L. J. (2006) Consumer perceptions of the effectiveness of food risk management practices: A cross-cultural study. *Health, Risk and Society*, 8(2), 165-183. [Research exploring public attitudes regarding the effectiveness of current food risk management practices in four European countries (Denmark, Germany, Greece and the UK)].

Houts, S., and Warland, R. (1989). Rotter's Social Learning Theory of Personality and Dietary Behavior. *Journal of Nutrition Education*, 21(4), 172-179. [This paper examines how locus of control influences dietary behavior].

Huber, O., Wider, R., and Huber, O. (1997). Active information search and complete information presentation in naturalistic risky decision tasks. *Acta Psychologica*, 95, 15-29. [Analysis of the role of human information processing associated with risk].

Jensen, K. K., and Sandoe, P. (2002). Food safety and ethics: The interplay between science and values. *Journal of Agricultural and Environmental Ethics*, 15, 245-253. [This is a discussion about the role of ethics in food production].

Johnson, B. B., and Slovic, P. (1995). Presenting uncertainty in health risk assessment: Initial studies of its effects on risk perception and trust. *Risk Analysis*, 15, 485-494. [This paper presents three experiments on how people perceive uncertainty information].

Johnson, B. B., and Slovic, P. (1998). Lay views on uncertainty in environmental health risk assessments. *Journal of Risk Research*, 1, 261-279. [This is a study on how American laypeople think about uncertainty in risk assessment].

Judge, T. A., Locke, E. A., Durham, C. C., and Kluger, A. N. (1998). Dispositional effects on job and life satisfaction: The role of core evaluations. *Journal of Applied Psychology*, 83(1), 17-34. [A study on the influence of core self-evaluations on job and life satisfaction].

Kahneman, D., Slovic, P., and Tversky, A. (1982) (Eds). *Judgement and Uncertainty. Heuristics and Biases*. New York, Cambridge University Press. [An overview of factors that determine how people process information].

Kinsey, J. D. (2001). The new food economy: Consumers, farms, pharms, and science. *American Journal of Agricultural Economics*, 83, 1113-1130. [A discussion of the transformative impact of new technologies (particularly information and communication technologies) on agriculture and consumer food choices].

Kirk, S. F. L., Greenwood, D., Cade, J. E., and Pearman, A. D. (2002). Public perception of a range of potential food risks in the United Kingdom. *Appetite*, 38(3), 189-197. [A longitudinal psychometric study on consumer perceptions of food-related risks].

Kornelis, M., De Jonge, J., Frewer, L., and Dagevos, H. (in press). Consumer selection of food-safety information sources. *Risk Analysis*. [This paper applies cluster analysis to investigate individual differences in intended use of food-safety information sources].

Kunreuther, H., Novemsky, N., and Kahneman, D. (2001). Making low probabilities useful. *Journal of Risk and Uncertainty*, 23, 103-120. [A study on how people process information on low probability-high consequence negative events and how to get individuals to be sensitive to the likelihood of these types of accidents or disasters].

Levidow, L. (2001). Precautionary uncertainty: Regulating GM crops in Europe. *Social Studies of Science*, 31(6), 842-874. [This paper discusses scientific uncertainty, public policy, and the application of the precautionary approach].

Levidow, L., and Marris, C. (2001). Science and governance in Europe: Lessons from the case of agricultural biotechnology. *Science and Public Policy*, 28(5), 345-360. [This is an analysis of the policy debate on science and governance with a special focus on agricultural biotechnology in Europe].

Loewenstein, G. F., Weber, E. U., Hsee, C. K., and Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, 127(2), 267-286. [This paper proposes the risk-as-feelings hypothesis that highlights the role of affect experienced at the moment of decision making].

McComas, K. A. (2006). Defining moments in risk communication research: 1996-2005. *Journal of Health Communication*, 11, 75-91. [This article reviews risk communication research that appeared in the published literature between 1996 and 2005].

Miles, S., Brennan, M., Kuznesof, S., Ness, M., Ritson, C., and Frewer, L. J. (2004). Public worry about specific food safety issues. *British Food Journal*, 106(1), 9-22. [Public perceptions of food safety are investigated distinguishing between technological and lifestyle food issues].

Miles, S., and Frewer, L. J. (2001). Investigating specific concerns about different food hazards. *Food Quality and Preference*, 12, 47-61. [This paper used semi-structured interviews to identify public concerns with regard to five specific food hazards].

Miles, S., and Scaife, V. (2003). Optimistic bias and food. *Nutrition Research Reviews*, 16, 3-19. [This is a review of the literature on optimistic bias focusing on the food domain].

Mitchell, V.-W. (1998). A role for consumer risk perceptions in grocery retailing. *British Food Journal*, 100(4), 171-183. [This is a review on public risk perception and risk reduction strategies in the context of buying food in grocery stores].

Morgan, M. G., and Henrion, M. (1990). *Uncertainty. A guide to dealing with uncertainty in quantitative risk and policy analysis*. Cambridge: Cambridge University Press. [This is a discussion of the implications of uncertainty associated with risk in terms of policy development].

Mozaffarian, D. (2006). Fish intake, contaminants, and human health. Evaluating the risks and benefits. *Journal of the American Medical Association*, 299(15), 1885-1899. [This is a literature review on the risk/benefit evaluation of fish consumption].

Parry, S. M., Miles, S., Tridente, A., Palmer, S. R., and South and East Wales Infectious Disease Group (2004). Differences in perception of risk between people who have and have not experienced *salmonella* food poisoning. *Risk Analysis*, 24(1), 289-299. [This study examines perceived risk, knowledge, and control regarding food poisoning, looking at cases and controls].

Pennings, J. M. E., Wansink, B., and Meulenberg, M. T. G. (2002). A note on modeling consumer reactions to a crisis: The case of the mad cow disease. *International Journal of Research in Marketing*, 19, 91-100. [This study investigates how risk perceptions and risk attitudes influence consumer responses to a crisis].

Poortinga, W., and Pidgeon, N. F. (2005). Trust in risk regulation: Cause or consequence of the acceptability of GM food? *Risk Analysis*, 25(1), 199-209. [This study examines the relationship between trust in risk regulation and consumer acceptability of risk].

Rozin, P., and Vollmecke, T. A. (1986). Food likes and dislikes. *Annual Review of Nutrition*, 6, 433-456. [This is an overview of factors which determine food preferences].

Saba, A., and Messina, F. (2003). Attitudes towards organic foods and risk/benefit perception associated with pesticides. *Food Quality and Preference*, 14, 637-645. [This study examines consumer attitudes toward consuming organic products, and how public trust is related to perceived risks and benefit associated with pesticide residues on food].

Schenk, M. F., Fischer, A. R. H., Frewer, L. J., Gilissen, L. J. W. J., Jacobsen, E., and Smulders, M. J. M. (submitted). Attitude towards GM applications for prevention of hay fever and food allergy by allergic patients and non-patients. [This study analyses how consumers make trade offs between perceived risks and benefits associated with novel foods].

Setbon, M., Raude, J., Fischler, C., and Flahault, A. (2005). Risk perception of the "Mad Cow Disease" in France: Determinants and consequences. *Risk Analysis*, 25(4), 813-826. [The results of two consecutive survey studies on consumer risk perceptions regarding mad cow disease are presented].

Siegrist, M. (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Analysis*, 20(2), 195-203. [In this study a model of consumer acceptance of gene technology is tested].

Siegrist, M., and Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis*, 20(5), 713-719. [This paper investigates the role of prior knowledge about a range of activities and technologies for evaluations of risk, benefit, and trust in risk management authorities].

Siegrist, M., Cvetkovich, G., and Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis*, 20(3), 353-361. [This paper explores the interrelationships between value similarity, social trust and perceived risks and benefits in the context of three different hazards].

Siegrist, M., Keller, C., and Kiers, H. A. L. (2005). A new look at the psychometric paradigm of perception of hazards. *Risk Analysis* 25(1), 211-222. [This is an analysis of the dimensionality of public risk perceptions, taking into account individual differences].

Slovic, P. (1987). Perception of risk. *Science*, 236, 280-285. [This paper gives an overview of the results of psychometric studies on public perceptions of risk, how negative events can have a signaling function, and public acceptance of technologies].

Slovic, P. (1992). Perception of risk: Reflections on the psychometric paradigm. In S. Krimsky and D.

Golding (Eds.), *Social theories of risk* (pp. 117-152). Westport: Praeger. [This is a discussion and overview of public perceptions of risk].

Slovic, P. (1993). Perceived risk, trust, and democracy. *Risk Analysis*, 13(6), 675-682. [This paper is on risk management, risk perception research and public distrust in risk analysis].

Slovic, P. (1999). Perceived risk, trust, and democracy. In G. Cvetkovich and R. E. Löfstedt (Eds.), *Social trust and the management of risk* (pp. 42-52). London: Earthscan. [Considerations on risk management, risk perception research and public distrust in risk analysis].

Slovic, P., Finucane, M., Peters, E., and MacGregor, D. G. (2002). The affect heuristic. In T. Gilovich, D. Griffin and D. Kahneman (Eds.), *Heuristics and biases: The psychology of intuitive judgment* (pp. 397-420). New York: Cambridge University Press. [This provides a theoretical framework about the role of affect in guiding human decision-making].

Slovic, P., Finucane, M., Peters, E., and MacGregor, D. G. (2004). Risk as analysis and risk as feelings: Some thoughts about affect, reason, risk, and rationality. *Risk Analysis*, 24(2), 311-322. [This paper addresses two fundamental ways in which human beings comprehend risk].

Slovic, P., Fischhoff, B., and Lichtenstein, S. (1982). Facts versus fears: Understanding perceived risk. In D. Kahneman, P. Slovic and A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 463-489). New York: Cambridge University Press. [This gives an overview of studies on lay perceptions of risk].

Sparks, P., and Shepherd, R. (1994). Public perceptions of the potential hazards associated with food production and food consumption: An experimental study. *Risk Analysis*, 14(5), 799-806. [This is a study on consumer perceptions of the risk characteristics of potential hazards associated with various aspects of food production and food consumption, providing evidence of the existence of unrealistic optimism].

Special Eurobarometer 257 (2006). Avian Influenza. Retrieved at [http://ec.europa.eu/public\\_opinion/archives/ebs/ebs\\_252\\_en.pdf](http://ec.europa.eu/public_opinion/archives/ebs/ebs_252_en.pdf) (November 2006). [This provides an analysis of public opinions about Avian Influenza among Europeans].

Spence, A., and Townsend, E. (2006). Implicit attitudes towards genetically modified (GM) foods: A comparison of context-free and context-dependent evaluations. *Appetite*, 46, 67-74. [An investigation in which implicit attitudes towards GM foods are compared with explicit attitudes].

Steptoe, A., Perkins-Porras, L., Rink, E., Hilton, S., and Cappuccio, F. P. (2004). Psychological and social predictors of changes in fruit and vegetable consumption over 12 months following behavioral and nutrition education counseling. *Health Psychology*, 23(6), 574-581. [This is an analysis of determinants of the effectiveness of interventions designed to promote healthy eating].

Thompson, K. M., and Graham, J. D. (1996). Going beyond the single number. Using probabilistic risk assessment to improve risk management. *Human and Ecological Risk Assessment*, 2, 1008-1034. [This paper discusses the role of probabilistic risk assessment in risk management].

Tuorila, H., Lähteenmäki, L., Pohjalainen, L., and Lotti, L. (2001). Food neophobia among the Finns and related responses to familiar and unfamiliar foods. *Food Quality and Preference*, 12, 29-37. [This study examines food neophobia among Finnish respondents by letting them rate the familiarity of 20 foods and the willingness to try them].

Van Dijk, H., Van Kleef, E., and Frewer, L. J. (in preparation). Consumer responses to communication about food risk management. [This is a consumer information experiment which aims to understand the impact of different types of communication regarding three food hazards on consumer perceptions of food risk management quality].

Van Kleef, E., Frewer, L. J., Chrysoschoidis, G., Houghton, J. R., Korzen-Bohr, S., Krystallis, T., Lassen, J., Pfenning, U., and Rowe, G. (2006). Perceptions of food risk management among key stakeholders: Results from a cross-European study. *Appetite* 47(1), 46-63. [This is an examination of similarities and differences in perceptions of, and attitudes toward, food risk management practices held by consumers and experts with an interest in food safety].

Van Kleef, E., Houghton, J. R., Krystallis, A., Pfenning, U., Rowe, G., Van Dijk, H., and Frewer, L. J. (submitted). Consumers evaluations of food risk management quality in Europe. [This study investigates

the factors driving consumer evaluation of food risk management quality based on survey data in five European countries].

Verbeke, W. (2001). Beliefs, attitude and behaviour towards fresh meat revisited after the Belgian dioxin crisis. *Food Quality and Preference*, 12, 489-498. [This paper assesses shifts and persistence in consumer perceptions of and attitude toward meat].

Verbeke, W., Sioen, I., Pieniak, Z., Van Camp, J., and De Henauw, S. (2005). Consumer perception versus scientific evidence about health benefits and safety risks from fish consumption. *Public Health Nutrition*, 8(4), 422-429. [This study provides an examination of the gap between consumer perception and scientific evidence related to health benefits and safety risks from fish consumption].

Verbeke, W., and Van Kenhove, P. (2002). Impact of emotional stability and attitude on consumption decisions under risk: The coca-cola crisis in Belgium. *Journal of Health Communication*, 7(5), 455-472. [This paper examines public reactions to the Coca-Cola crisis in Belgium in 1999].

Verbeke, W., and Viaene, J. (1999). Beliefs, attitude and behaviour towards fresh meat consumption in Belgium: Empirical evidence from a consumer survey. *Food Quality and Preference*, 10, 437-445. [This paper assesses consumer perceptions of fresh beef, pork, and poultry meat].

Verplanken, B., and Orbell, S. (2003). Reflections on past behavior: A self-report index of habit strength. *Journal of Applied Social Psychology*, 33, 1313-1330. [This paper describes the development of a 12-item index of habit strength].

Weinstein, N. D. (1989). Optimistic biases about personal risks. *Science*, 246(4935), 1232-1233. [An overview is provided on optimistic biases about personal risks and why these occur].

Weinstein, N. D. (1987). Unrealistic optimism about susceptibility to health problems: conclusions from a community-wide sample. *Journal of Behaviour Medicine*, 10, 481-500. [This is an analysis of why people believe risks will not affect them personally].

Williams, P. R. D., and Hammitt, J. K. (2001). Perceived risks of conventional and organic produce: Pesticides, pathogens, and natural toxins. *Risk Analysis*, 21(2), 319-330. [This study investigates consumer risk perceptions of conventional and organic produce, and the factors by which risk perceptions are influenced].

Yeung, R. M., and Morris, J. (2001). Food safety risk: Consumer perception and purchase behaviour. *British Food Journal*, 103(3), 170-187. [The development of a conceptual framework to identify the factors that influence consumer perceptions of food safety related risk and the impact of perceived risk on purchase behavior].

### **Biographical Sketches**

**Lynn Frewer** was born in London in 1960. She has a BSc in psychology from the University of Bristol, UK (1981), an MSc in Ergonomics from University College London, UK (1982) and a PhD in applied psychopharmacology from the University of Leeds, UK (1987).

After completing her doctoral studies she obtained a lectureship at the University of Port Moresby in Papua New Guinea. Subsequently she held research posts at the institute of Psychiatry in London and the Institute of food research in Norwich, where she headed the Consumer Science Group. She is currently Professor of Food Safety and Consumer Behaviour at the University of Wageningen in the Netherlands. She has published over 90 referred journal articles and three books in the area of food safety and consumer behaviour, as well as science and society issues associated with risk analysis in the agrifood sector.

Professor Frewer is a chartered member of the British Psychological Society.

**Janneke de Jonge** was born in Boxmeer (The Netherlands) in 1978. She obtained a Master of Science degree in business economics with a specialization in marketing research in 2002 from Tilburg University, The Netherlands.

In 2003, she started her PhD research examining consumer confidence in the safety of food within the

Marketing and Consumer Behaviour group of Wageningen University. She defended her dissertation called 'A monitor for consumer confidence in the safety of food' in 2008. Since 2007, she has been involved in the EU-funded research projects Safefoods and Sigma Chain. In August 2008 she was appointed as an assistant professor at the Marketing and Consumer Behaviour group of Wageningen University.

Dr. de Jonge is a member of the Society of Risk Analysis (SRA) and the Dutch Association of Social Psychological Researchers.

**Ellen van Kleef** was born in 1972 in Echteld (The Netherlands). Ellen van Kleef obtained a Master of Science degree in Human Nutrition in 1997 at Wageningen University, the Netherlands. After working for a short period of time at Unilever Research Vlaardingen (1998), she began her doctoral dissertation research at Wageningen University in 1999. She defended her dissertation called 'Consumer research in the early stages of new product development. Issues and applications in the food domain' in 2006. From 2004 till 2008, she was a postdoctoral researcher at the EU-funded research project SAFE FOODS (Promoting food safety through a new integrated risk analysis approach for foods). Currently, she is an assistant professor in the Marketing and Consumer Behaviour Group of Wageningen University. Her research interests are food risk perception and consumer behaviour, and experimental consumer research for both food policy and new product development purposes.