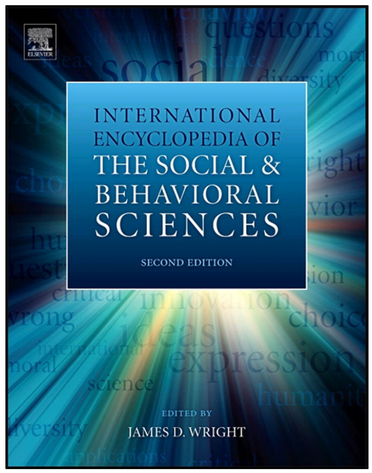

From Renner, B., Gamp, M., Schmälzle, R., Schupp, H.T., 2015. Health Risk Perception. In: James D. Wright (editor-in-chief), International Encyclopedia of the Social & Behavioral Sciences, 2nd edition, Vol 10. Oxford: Elsevier. pp. 702–709.
ISBN: 9780080970868

Health Risk Perception

Britta Renner, Martina Gamp, Ralf Schmälzle, and Harald T Schupp, University of Konstanz, Konstanz, Germany

Abstract

Perceptions of health-related risks are a prerequisite for taking protective action, adopting a healthier lifestyle, attending health screenings, and adhering to medical care. It seems inherently plausible that the greater the perceived risk for one's own health is the greater the motivation for protective action. Accordingly, it is important to understand how people perceive health risks, how accurate these perceptions are, and how information about one's own health risk is received. This article focuses on general and personal risk perceptions, discusses the role of intuition in personal risk perception, and presents findings regarding reactions to individualized feedback about risk.

Introduction: Why Study Risk Perception?

Risk perception, i.e., how individuals think and feel about the risks they face, is an important determinant of protective behavior. For instance, responses to the A/H1N1 virus or 'swine flu' outbreak in 2009 showed that the success of public health intervention programs is largely dependent on individual risk perception. Although many governments launched large-scale vaccination campaigns, vaccine uptake in the general population was very low. In Germany, for example, only 6.8% of the general population followed the recommendation to be vaccinated, even though vaccination is the most effective intervention for preventing influenza and A/H1N1 (Renner and Reuter, 2012).

Accordingly, it seems inherently plausible that people not only need to be aware of an existing health risk ('Many people are becoming infected with a new type of influenza.'), but they also need to feel personally at risk ('I might catch the new influenza myself.') in order to take protective action. It is thus critical to understand (1) how people construe and evaluate health risks in general (general risk perception), (2) how they gauge their own personal risk (personal risk perception), and (3) how they react to information indicating that they are personally at risk.

General Risk Perception

Risk Assessment and the Numbers of Risk

Risk is commonly defined as a multiplicative combination of the probability of a hazardous event occurring (e.g., smoking) and the severity of the resulting negative consequences (e.g., lung cancer). This definition of risk, as 'probability × severity,' implies that greater probability and greater severity result in greater overall risk (Slovic, 2000).

Numerically determining the probability of adverse events and possible adverse consequences is one of the main challenges for scientific *risk assessment* (Slovic, 2000). Risks to health can be assessed on the basis of different metrics, such as morbidity and mortality rates (number of cases of disease or deaths per year). For example, there were 2 426 264 deaths in the United States in 2006. While heart diseases led to 631 636 deaths in the United States in 2006 (26%), accidents were responsible for 121 599 deaths (5%) (Heron et al., 2009). Thus, heart diseases posed a five times greater risk in comparison to accidents. Moreover, the magnitude of risk can be framed in many numeric formats, such as natural frequencies (e.g., 5 out of 100), percentages (e.g., a 5% chance of contraction), or probabilities (e.g., 0.05), and in many different visual formats (e.g., bar charts, pie graphs, or icons displaying the number of individuals affected). All of these numeric formats are equally valid representations of 'the numbers of risk' in the realm of risk assessment.

In contrast to 'risk assessment,' 'risk perception' considers how people, in particular laypeople, construe risk. Wright et al. (2002) examined risk judgments made by experts (life insurance underwriters) and laypeople (business students) for 31 hazards (smoking, asthma, etc.) and compared them to the actual risk level (annual fatalities). The correlation between risk judgments and factual risk for fatalities was $r = 0.66$ for the experts and $r = 0.73$ for the laypeople. Thus, both laypeople and experts were capable of ordering the hazards by the absolute risk level in the metric of annual fatalities. However, the accuracy of lay perceptions commonly decreases when it comes to estimating more complex numbers of risk, and systematic deviations between risk assessment and lay risk perception occur (see for further discussion Gigerenzer et al., 2008; Renner and Schupp, 2011).

How well risk statistics are understood depends on numeracy, i.e., the ability to process basic numerical and probability concepts (Reyna et al., 2009). As expected, highly numerate adults are more likely to extract and use appropriate numerical principles and thereby have more complete and complex information than less numerate individuals. Furthermore, the issue of which type of numeric and visual formats facilitates accurate perceptions of risks has been addressed by many studies (Gigerenzer et al., 2008). One of the most striking effects emerged from the comparison of relative and absolute numeric risk formats. Relative risk formats describe risk in conditional probabilities, percentages, or ratios without defining the baseline or absolute risk level. Thus, a risk factor may be described as conferring '50% more risk' than another, even when the absolute increase is only from 2 to 3%. Without information on the baseline risk level, people tend to overestimate not only the impact of risk factors but also the impact of precautionary measures. Furthermore, conveying risk in

 http://dx.doi.org/10.1016/B978-0-08-097086-8.14138-8

International Encyclopedia of the Social & Behavioral Sciences, Second Edition, 2015, 702–709

natural frequencies (e.g., 5 out of 1000 instead of 0.5%) facilitated the understanding of risk within laypeople (cf also Ferguson and Starmer, 2013; Gigerenzer et al., 2008). Thus, the pessimistic view that the public is not capable of understanding the numbers of risk may at least partly be the result of using suboptimal formats when communicating risk. Sensible risk communication should ideally present an array of risk information, i.e., absolute and relative risk information, mortality rates, and survival rates, as well as natural frequencies, in order to increase risk literacy in laypeople and experts over time.

How People Construe Risk: The Multidimensionality of General Risk Perception

Risk assessment can be seen as an objective approach to determining risk, which commonly considers two core components: the severity of the negative consequences and the probability of an occurrence of a hazardous event. However, numerous studies suggest that risk perception in the layperson is more complex, and that it is influenced by risk characteristics other than 'probability' and 'severity.' The issue has been most thoroughly examined with respect to the psychometric paradigm, which provides a systematic attempt to determine the characteristics associated with risk.

The Psychometric Paradigm

A pioneering study by Fischhoff et al. (1978) examined risk perceptions of various hazards, which were evaluated in terms of several risk attributes. Factor analysis was used to condense ratings of risk attributes into two orthogonal dimensions of 'dread' and 'unknown risk.' The factor 'dread' captures aspects such as perceived control over exposure to the risk, the degree of catastrophic consequences, or global ramifications. The factor 'unknown risk' refers to the degree to which a risk is predictable, observable, and understood. The psychometric paradigm plays a prominent role in risk perception research and numerous studies have confirmed the two factors, 'dread' and 'unknown risk' (see Sjöberg et al., 2004, for a review). Overall, despite noted shortcomings (e.g., Sjöberg et al., 2004), this work constitutes a landmark in risk perception research by showing that characteristics beyond the 'probability' by 'severity' calculus influence public perception and attitudes toward risk.

Intuition and Feelings in Risk Perception

The factor 'dread,' identified by research using the psychometric paradigm, clearly alludes to emotional characteristics. However, emotions were seldom discussed explicitly in earlier theories of risk perception. This has now changed and emotion has become a key area of risk perception research. For instance, Loewenstein et al. (2001) propose that emotional feelings can affect risk perceptions independently from numerical cognitions (probability, severity) or other attributes of risks (e.g., controllability, catastrophic potential). Similarly, Slovic and Peters (2006) distinguish between an intuitive mode of risk perception based on feelings and the rational, deliberative analysis of risk. Both approaches share the notion that feelings of risk stem from rapid and largely automatic routines that reflect an association-based, parallel mode of thinking, which is often referred to as 'intuition.' In contrast, the so-called 'rational' mode of risk analysis is presumed to depend on resource-dependent, effortful, and serial processes (see also Pachur et al., 2012).

One challenge for examining intuitive risk perception is that rapid and largely automatic processing is hard to capture. Neuroimaging methods, such as functional magnetic resonance imaging (fMRI) and event-related potentials (ERPs), allow measuring of rapid, introspectively opaque, and affectively charged processes and may accordingly be useful in examining the intuitive processes involved in risk perception. A series of ERP studies on HIV risk perception (e.g., Renner et al., 2012; Schmälzle et al., 2011, 2012) provides an example of this novel approach. Previous research using focus groups and retrospective interviews with HIV-positive people had revealed that people have spontaneous impressions of risk – i.e., they often reported that they were convinced that their partners were safe. These impressions about a potential partner's HIV risk may make people prone to rely on 'illusory control strategies,' such as selecting 'safe-looking' partners. To uncover the mechanisms behind these intuitive HIV risk perceptions, neural responses were measured while participants spontaneously evaluated the HIV risk of unacquainted individuals depicted in photographs. Demonstrating the fast and frugal risk perception mode, ERPs reliably differentiated between individuals perceived as risky and safe early in the processing stream (e.g., Schmälzle et al., 2011). The early onset of this electrocortical differentiation (<300 ms) precedes systematic reasoning about health risks and supports the notion of intuitive as opposed to analytic processing. Furthermore, the late positive potential (LPP), a specific ERP component that has been linked to affective evaluation processes, was also associated with HIV risk perception. In particular, individuals perceived as risky elicited larger LPPs compared to individuals perceived as safe (see **Figure 1**; Schmälzle et al., 2011). These findings were corroborated by fMRI measurements, which revealed that individuals perceived as risky activated regions of the saliency network, i.e., the anterior insulae and medial frontal cortex, which are also engaged by threatening and negative-affect-related stimuli (Häcker et al., 2014). Based on these findings, when people report that they 'just know' the risk posed by a certain individual, their feeling of risk may reflect the implicit assessment of personal characteristics related to a HIV risk stereotype. Extrapolating from this line of research, the integration of experimental methods, i.e., self-reports, behavioral observation, and psychophysiology, seems highly promising for uncovering the intuitive sensing of health risks.

Personal Risk Perceptions

At first glance, it seems obvious that perceiving a health threat is a prerequisite for the motivation to change a risk behavior. However, from a psychological perspective, the process is far more complex: people not only need to know about the existence of a health risk (general risk perception; e.g., 'Many people are becoming infected with a new type of influenza.'), but they need to feel personally at risk (personal risk

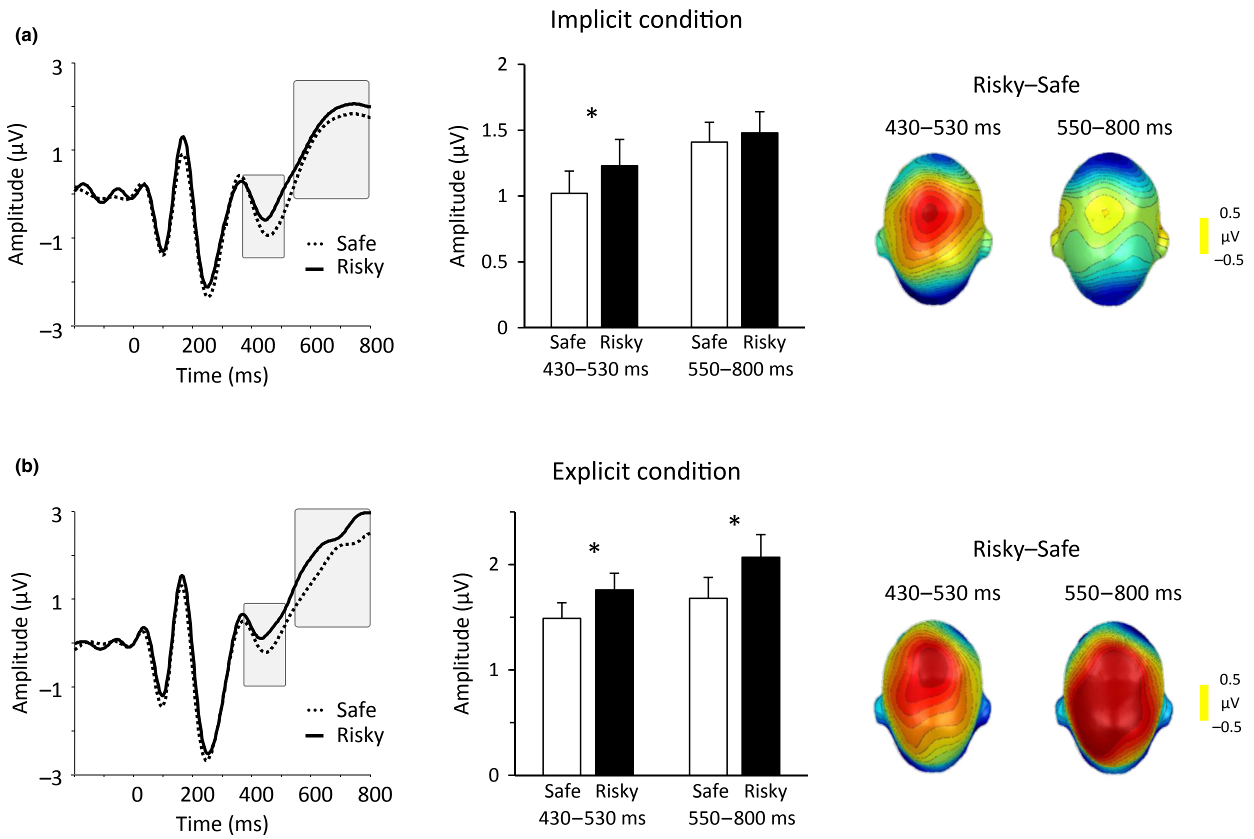

Figure 1 Neural signature of (a) implicit and (b) explicit HIV risk perceptions. Reproduced from Schmälzle, R., Schupp, H.T., Barth, A., Renner, B., 2011. Implicit and explicit processes in risk perception: neural antecedents of perceived HIV risk. Frontiers in Human Neuroscience 5, 43. doi:10.3389/fnhum.2011.00043.

perception, e.g., 'I might catch the new influenza myself.') in order to take protective action. In general, two different types of personal risk perceptions are distinguished: (1) absolute personal risk perceptions and (2) comparative personal risk perceptions (Renner and Schupp, 2011; Shepperd et al., 2013; see also Table 1).

Absolute Personal Risk Perceptions

One of the most common ways of assessing people's perception of their own health risks is to ask them to estimate their personal absolute risk in numerical form ('My risk of catching the new influenza this winter is 70%.'). Comparing personal absolute risk perception with epidemiological or actual risk estimates shows that they often greatly deviate. Similar to general risk perceptions, the likelihood of contracting a disease is often drastically overestimated. Lipkus et al. (2001), for example, asked adult women between the ages of 45 and 54 years to estimate their lifetime breast cancer risk. In addition, they measured the actual breast cancer risk using the Gail score, which calculates breast cancer risk on the basis of seven risk factors (e.g., age, race, age at menarche, age at first live birth, number of first-degree relatives with breast cancer). On average, compared to their actual lifetime risk (8%), the women greatly overestimated their lifetime breast cancer risk (34%), indicating an unrealistic pessimistic bias in absolute personal risk perception at the group level (see Table 1).

Comparative Personal Risk Perceptions

Although people often overestimate their personal absolute risk, they are often convinced that their risk is lower than that of other people. The same women who overestimated their personal absolute breast cancer risk in the study by Lipkus et al. (2001) were convinced that their comparative risk was below average (see Table 1). Numerous studies have shown that when people are asked to rate their chances of experiencing certain illnesses, and other problems, most of them report their risk is below average (see Shepperd et al., 2013). However, if people believe on average that their risk is below average, they are systematically underestimating their personal risk. This bias in comparative personal risk perception has been labeled *unrealistic optimism* or *optimistic bias* (Perloff and Fetzer, 1986; Weinstein, 1980). Unrealistic optimism has been demonstrated for men and women across age-groups and education levels (see Renner and Schupp, 2011; Weinstein, 2003).

It is important to note that the 'classical unrealistic optimism' only indicates a bias in comparative personal risk perceptions at the level of the group (see Table 1). A woman who says that her breast cancer risk is 'below average' might

Table 1 Types of personal risk perceptions and examples for optimistic/pessimistic biases

Type of risk perception	*Type of actual risk standard* *Individual-based* *(e.g., individual health risk assessment (HRA) such as an individual Gail score or CVD Framingham Risk Score)*	*Group-based* *(e.g., annual disease incidence)*
Absolute personal risk perception (absolute unrealistic pessimistic/optimistic bias)	1. Pessimistic A woman believes her breast cancer risk is 34% but the objective risk estimate (e.g., Gail score) indicates that her risk is 8%. 2. Optimistic A woman believes her breast cancer risk is 2% but the objective risk estimate (e.g., Gail score) indicates that her risk is 8%.	1. Pessimistic A representative group of women believes their breast cancer risk is on average 34% but the annual incidence rate is 8%. 2. Optimistic A representative group of women believes their breast cancer risk is on average 2% but the annual incidence rate is 8%.
Comparative personal risk perception (comparative unrealistic pessimistic/optimistic bias)	1. Pessimistic A woman believes her breast cancer risk is higher than the risk of an average woman of her age (average peer) but the objective risk estimate (e.g., Gail score) indicates that her risk is lower than the average peer risk. 2. Optimistic A woman believes her breast cancer risk is lower than the risk of an average woman of her age (average peer) but the objective risk estimate (e.g., Gail score) indicates that her risk is higher than the average peer risk.	1. Pessimistic A representative group of women believes on average their breast cancer risk is higher than the risk of an average woman of their age (average peer). 2. Optimistic A representative group of women believes on average their breast cancer risk is lower than the risk of an average woman of their age (average peer). ='classical unrealistic optimism'

Reproduced from Renner, B., Schupp, H., 2011. The perception of health risks. In: Friedman, H.S. (Ed.), Oxford Handbook of Health Psychology. Oxford University Press, New York, pp. 637–665 and Shepperd, J.A., Klein, W.M.P., Waters, E.A., Weinstein, N.D., 2013. Taking stock of unrealistic optimism. Perspectives on Psychological Science 8 (4), 395–411. doi:10.1177/1745691613485247.

give a somewhat optimistic risk rating, but if she has a low risk factor profile, her optimistic rating may actually be a realistic perception of her risk status (cf Weinstein, 2003). To assess the optimistic bias at the individual level, objective risk measures are required such as 'health risk appraisals' that estimate a person's actual risk based on characteristics such as medical history, blood pressure, smoking habits, and epidemiological data (e.g., CVD Framingham Risk Score at http://cvdrisk.nhlbi.nih.gov).

Why do people feel less at risk than others? Research has posited various explanations for this intriguing phenomenon, involving both motivational and cognitive processes. Motivational accounts postulate that the optimistic bias is fueled by the motivation either to self-enhance or protect, and maintain a positive view of one's health. However, a purely motivational account cannot sufficiently explain this phenomenon. If people predominantly bias comparative risk perceptions because they want to maintain a positive self-view, serious diseases should provoke an increased degree of optimistic bias because they are particularly threatening to the self. Contrary to the idea that biased comparative risk perceptions are a defense against feelings of threat and anxiety, unrealistic optimism is generally no greater for serious, life-threatening hazards than for more mundane problems (Harris et al., 2008).

Interestingly, some hazards appear to be associated with a strong and reliable comparative optimistic bias (e.g., STDs, alcohol problems), whereas other hazards commonly elicit only a weak or no bias (e.g., colds, cancer). A seminal study by Neil Weinstein (1980) observed that unrealistic optimism was pronounced when the hazard was perceived as controllable and associated with a vivid victim stereotype. People find it easier to picture stereotypical victims of controllable events (Hahn and Renner, 1998; Perloff and Fetzer, 1986; Thornton et al., 2002). For example, lung cancer is perceived as a controllable and behavior-dependent disease, and people can easily picture a typical victim (Hahn and Renner, 1998). This may explain why lung cancer typically elicits a pronounced unrealistic optimism, whereas cancer in general does not. The less similar a person believes he or she is to the high-risk stereotype, the safer the person will perceive him- or herself to be (Perloff and Fetzer, 1986; see Renner and Schupp, 2011).

One intriguing conclusion from this research is that public health education campaigns may often facilitate, instead of reducing, unrealistic optimistic risk perceptions. The guiding principles proposed by campaigns for health risk reduction usually include vivid presentations of risk factors and show high-risk persons. This may foster risk stereotypes that are perceived as dissimilar and thereby may lead to an underestimation of personal risk if individuals think that many risk factors do not apply to them. Consequently, risk communication that only provides information about general risk may make people aware of a risk ('Smoking causes coronary heart disease.') but also lead to an underestimation of self-risk ('It is unlikely that this will happen to me.') by creating high-risk stereotypes. Accordingly, providing information about an individual's personal risk status should be less ambiguous and more effective for facilitating realistic personal risk perception and protective behavior.

Reactions toward Personalized Risk Feedback

In recent years, health risk assessment tools have been developed to assess individual risk for particular diseases. For example, the National Institute of Health in the United States offers an online tool for estimating the 10-year risk of having a heart attack (http://cvdrisk.nhlbi.nih.gov/). The increasing availability of such services over the Internet and the rise of over-the-counter testing kits underscore the need for a better understanding of how individuals react to such feedback. In an agenda-setting study, Jemmott et al. (1986) devised an experimental paradigm that enables the study of reactions toward personalized health risk feedback. Participants who were led to believe that they suffered from a hypothetical thioamine acetylase (TAA) deficiency perceived their test result as less accurate and rated TAA deficiency as a less-serious health threat when compared to the non-TAA group (for a review, see Croyle et al., 1997). The reduced acceptance of negative health risk information compared to positive one is a very robust phenomenon, evident across a wide range of diseases and samples (for an overview see Ditto, 2009; Renner and Schupp, 2011).

The Motivated Reasoning Perspective

Why is bad news less accepted than good news? The lower acceptance of negative health risk feedback than positive one is commonly seen as clear-cut evidence for 'self-defensive denial' or 'motivated reasoning' (e.g., Croyle et al., 1997; Helzer and Dunning, 2012; Kunda, 1990; McQueen et al., 2013). People who are informed having an elevated risk of disease appear to derogate the validity of the risk factor test in order to maintain a favorable sense of their health. At first glance, the motivated reasoning account, which proposes self-defensive denial in information processing, poses a straightforward explanation for the frequently observed asymmetrical acceptance pattern: people do not like bad news; consequently, they try to derogate it with superficial rational strategies. However, several limitations, such as the 'adaptive paradox,' have been noted (cf Ditto and Lopez, 1992; Renner and Schupp, 2011; but see McQueen et al., 2013). If the predominant response to threatening information is self-defensive denial, recipients should not see a need for adaptive action and protection, ultimately resulting in serious harm. In contrast, studies assessing intentions and behavior change commonly report adaptive responses instead of the predicted unresponsiveness to information that signals a health threat (e.g., Shiloh et al., 2013; see for a review Sheeran et al., 2013).

The Quantity of Processing Perspective

In an attempt to explain the asymmetrical acceptance of health risk information, Ditto and Lopez build upon the principle that negative information generally has greater impact than neutral or positive information (1992; for a review see Ditto, 2009). Their quantity of processing (QOP) view draws upon the fact that negative information triggers more elaborate cognitive analyses than positive information does. The more deeply people think about negative information, the more likely they are to consider plausible alternative explanations, producing greater uncertainty regarding the validity of the information. As a consequence, negative information is less likely to be accepted than positive information. Supporting this notion, participants who received negative TAA feedback accepted low-quality feedback less readily than high-quality TAA feedback. Moreover, while positive feedback was highly accepted regardless of whether it was of high or low quality, participants only accepted negative information to a similar degree when they believed the information was high quality (Ditto et al., 1998). These results are in line with the QOP view that negative risk information triggers more elaborate processing than positive risk information does, and that negative information is, therefore, less likely to be accepted than positive information (see also Mata et al., 2013). However, from a motivational reasoning perspective, one could argue that people receiving highly valid, negative TAA risk feedback only accepted it because there was virtually no leeway for derogating the information. Thus, it remains unclear whether the unambiguous acceptance of good news or differential acceptance of bad news indicates an adaptive or self-defensive denial reaction pattern.

The Cue-Adaptive Reasoning Perspective

It is commonly assumed that positive health risk feedback such as "Your lifetime risk for developing colorectal cancer is 10:10,000" is met with great acceptance and reassurance (Wardle et al., 2003). Curiously, this seems not always to be the case. Weinstein et al. (2004) examined primary care patients between 40 and 70 years of age who received computerized risk assessment feedback about their colon cancer risk. For most patients, the risk feedback indicted a lower risk status than they had expected (average actual risk: 10:10.000 vs average perceived pretest risk: 146:10.000). According to the motivated reasoning and QOP views, receiving such good news should have resulted in pronounced acceptance of the feedback. However, an opposite pattern of result emerged: post-feedback-perceived risk was in many cases still substantially higher than the actual risk, indicating that people often distrusted their personalized risk feedback. Similar resistance toward positive feedback or 'lack of reassurance' has been observed in various empirical studies (e.g., Dillard et al., 2006; Linnenbringer et al., 2010). One might argue that the personalized risk feedback was difficult for the recipients to understand and thus, the findings do not indicate a lack of reassurance but rather a lack of understanding. However, in an experimental study using personalized risk feedback about a (fictitious) fatigue syndrome, Gamp and Renner (manuscript submitted for publication) found a similar lack of reassurance after positive information in post-feedback-perceived risk. Conversely, post-feedback risk for an average peer was accurately adapted to the given peer risk feedback score. Hence, people are generally capable of understanding risk information and adapting their risk estimations accordingly. This raises the question, when and why do people resist self-related positive health risk feedback?

The cue-adaptive reasoning account (CARA) assumes that both negative feedback and risk feedback, which conflicts with preexisting risk perceptions, serve as cues that draw attentional resources for more elaborate processing (Panzer and Renner, 2009; Renner, 2004). If people spend more cognitive resources on negative or unexpected risk information, plausible alternative explanations are more likely taken into account. This, in turn, increases the likelihood that negative or unexpected risk information is perceived as being less valid and as a consequence it is less likely to be accepted than expected positive risk information. One important implication of this reasoning is that not only unexpected bad news, but also unexpected good news is received with greater reluctance. Data from a community cholesterol screening (Renner, 2004; see also Gamp and Renner, manuscript submitted for publication) showed that participants who received unexpected or expected negative risk feedback were sensitive to the quality of the given feedback. Indicating more elaborate information processing, feedback acceptance was significantly higher for high-quality risk feedback than low-quality (see Figure 2). Importantly, participants receiving unexpected positive risk feedback also showed sensitivity to feedback quality, and low-quality feedback was rated as less accurate than high-quality. The only group that was not sensitive to the quality of the feedback was the group that expected and received positive risk feedback information. This group accepted the given feedback independently of the quality. A similar pattern was also found for behavioral-proximal measures.

The assumption that unexpected good news also receives deeper processing might first seem counterintuitive. However, especially in the context of personally consequential feedback, it represents an adaptive response because accepting false 'all-clear' health risk feedback could result in the refusal or cessation of prophylactic measures. In this case, resources previously invested in preventive actions would be expended, while severe harm would not be prevented by protective action. Accordingly, the CARA view conceptualizes both, the lack of reassurance following unexpected positive health risk feedback and the asymmetrical acceptance of negative versus positive risk feedback as an unintentional by-product of the adaptive allocation of cognitive processing resources.

Conclusion

It is widely agreed that people's understanding of health risks is of central relevance for effective risk communication and health interventions. Being aware of health risks is certainly a precondition for accurate risk perception. But even when people are aware of a risk (general risk perception), this does not mean that they regard themselves as personally at risk (personal risk perception). Public health interventions portraying people at high risk may foster high-risk stereotypes and, as a consequence, induce a paradoxical effect: people might be well informed about the magnitude of the risk but at the same time they might be convinced that this misfortune will not happen to them because they feel highly dissimilar to the high-risk stereotype. Thus, although general risk perceptions might be substantial, personal risk perceptions might be low and optimistically biased. Research on personal risk perception has focused on absolute as well as comparative aspects of risk perception, and recent approaches adopted neuroimaging in order to shed light on the mechanisms of risk perception, whose nature is presumably less numerical and analytic, but rather more intuitive-experiential and affective. To cross the Rubicon between general and personal risk perceptions,

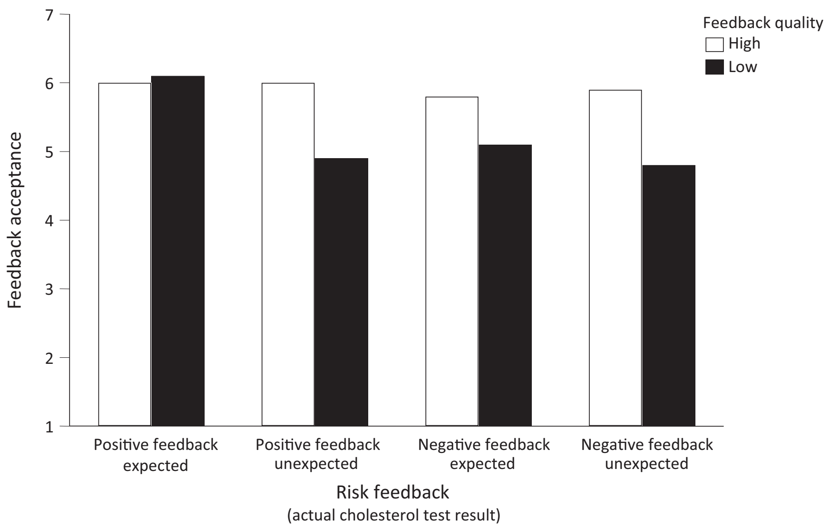

Figure 2 Feedback acceptance as a function of risk feedback valence, risk expectancy, and feedback quality. Reproduced from Renner, B., 2004. Biased reasoning: adaptive responses to health risk feedback. Personality & Social Psychology Bulletin 30 (3), 384–396. doi:10.1177/0146167203261296.

recipients should receive personalized risk information. However, personalized risk information is filtered through preexisting risk perceptions, and conflicting information is carefully scrutinized before it is accepted. Interestingly, this not only holds for negative risk feedback, but also applies to unexpected positive risk feedback. Therefore, to avoid increasing concern among participants or the need for retesting, an 'all-clear' nonelevated risk status should be as carefully explained and discussed as an elevated risk status health.

See also: Cancer Screening; Control Beliefs: Health Perspectives; Depression, Pessimism, and Health; Doctor–Patient Interaction in the West: Psychosocial Aspects; Explanatory Style and Health; Health Behavior, Psychosocial Theories of; Health Behaviors; Health Education and Health Promotion; Health Interventions, Community-based; Health Literacy; Health Promotion in Schools; Health Risk Appraisal and Optimistic Bias; Personalized Medicine; Sexual Risk Behaviors; Smoking and Health.

Bibliography

Croyle, R., Sun, Y., Hart, M., 1997. Processing risk factor information: defensive biases in health-related judgments and memory. In: Petrie, K., Weinman, J. (Eds.), Perceptions of Health and Illness: Current Research and Applications. Harwood Academic Publishers, Amsterdam, pp. 267–290.

Dillard, A.J., McCaul, K.D., Kelso, P.D., Klein, W.M.P., 2006. Resisting good news: reactions to breast cancer risk communication. Health Communication 19 (2), 115–123. http://dx.doi.org/10.1207/s15327027hc1902_3.

Ditto, P.H., 2009. Passion, reason, and necessity: a quantity-of-processing view of motivated reasoning. In: Bayne, T., Fernández, J. (Eds.), Delusion and Self-deception: Affective and Motivational Influences on Belief Formation. Psychology Press, New York, pp. 23–53.

Ditto, P.H., Lopez, D.F., 1992. Motivated skepticism: use of differential decision criteria for preferred and nonpreferred conclusions. Journal of Personality and Social Psychology 63 (4), 568–584. http://dx.doi.org/10.1037/0022-3514.63.4.568.

Ditto, P.H., Scepansky, J.A., Munro, G.D., Apanovitch, A.M., Lockhart, L.K., 1998. Motivated sensitivity to preference-inconsistent information. Journal of Personality and Social Psychology 75 (1), 53–69. http://dx.doi.org/10.1037//0022-3514.75.1.53.

Ferguson, E., Starmer, C., 2013. Incentives, expertise, and medical decisions: testing the robustness of natural frequency framing. Health Psychology 32 (9), 967–977. http://dx.doi.org/10.1037/a0033720.

Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S., Combs, B., 1978. How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits. Policy Sciences 9 (2), 127–152. http://dx.doi.org/10.1007/BF00143739.

Gamp, M., Renner, B. Lack of absolute and comparative reassurance: how negative expectancies mitigate the effects of positive health risk feedback, manuscript submitted for publication.

Gigerenzer, G., Gaissmaier, W., Kurz-Milcke, E., Schwartz, L.M., Woloshin, S., 2008. Helping doctors and patients make sense of health statistics. Psychological Science in the Public Interest 8 (2), 53–96. http://dx.doi.org/10.1111/j.1539-6053.2008.00033.x.

Häcker, F., Schmälzle, R., Renner, b., Schupp, H.T., 2014. Neural correlates of HIV risk feelings. Social. Cognitive, and Affective Neuroscience. http://dx.doi.org/10.1093/scan/nsu093.

Hahn, A., Renner, B., 1998. Perception of health risks: how smoker status affects defensive optimism. Anxiety, Stress & Coping: An International Journal 11 (2), 93–112. http://dx.doi.org/10.1080/10615809808248307.

Harris, P.R., Griffin, D.W., Murray, S., 2008. Testing the limits of optimistic bias: event and person moderators in a multilevel framework. Journal of Personality and Social Psychology 95 (5), 1225–1237. http://dx.doi.org/10.1037/a0013315.

Helzer, E., Dunning, D., 2012. On motivated reasoning and self-belief. In: Vazire, S., Wilson, T.D. (Eds.), Handbook of Self-knowledge. Guilford Press, New York, pp. 379–396.

Heron, M., Hoyert, D., Murphy, S., Xu, J., Kochanek, K., Tejada-Vera, B., 2009. Deaths: final data for 2006. National Vital Statistics Reports 57 (14), 1–134.

Jemmott, J.B., Ditto, P.H., Croyle, R.T., 1986. Judging health status: effects of perceived prevalence and personal relevance. Journal of Personality and Social Psychology 50 (5), 899–905. http://dx.doi.org/10.1037/0022-3514.50.5.899.

Kunda, Z., 1990. The case for motivated reasoning. Psychological Bulletin 108 (3), 480–498. http://dx.doi.org/10.1037/0033-2909.108.3.480.

Linnenbringer, E., Roberts, J.S., Hiraki, S., Cupples, L.A., Green, R.C., 2010. "I know what you told me, but this is what I think:" perceived risk of Alzheimer disease among individuals who accurately recall their genetics-based risk estimate. Genetics in Medicine 12 (4), 219–227. http://dx.doi.org/10.1097/GIM.0b013e3181cef9e1.

Lipkus, I.M., Biradavolu, M., Fenn, K., Keller, P., Rimer, B.K., 2001. Informing women about their breast cancer risks: truth and consequences. Health Communication 13 (2), 205–226. http://dx.doi.org/10.1207/S15327027HC1302_5.

Loewenstein, G.F., Weber, E.U., Hsee, C.K., Welch, N., 2001. Risk as feelings. Psychological Bulletin 127 (2), 267–286. http://dx.doi.org/10.1037//0033-2909.127.2.267.

Mata, A., Ferreira, M.B., Sherman, S.J., 2013. Flexibility in motivated reasoning: strategic shifts of reasoning modes in covariation judgment. Social Cognition 31 (4), 465–481. http://dx.doi.org/10.1521/soco_2012_1004.

McQueen, A., Vernon, S.W., Swank, P.R., 2013. Construct definition and scale development for defensive information processing: an application to colorectal cancer screening. Health Psychology 32 (2), 190–202. http://dx.doi.org/10.1037/a0027311.

Pachur, T., Hertwig, R., Steinmann, F., 2012. How do people judge risks: availability heuristic, affect heuristic, or both? Journal Of Experimental Psychology: Applied 18 (3), 314–330. http://dx.doi.org/10.1037/a0028279.

Panzer, M., Renner, B., 2009. Spontaneous reactions to health risk feedback: a network perspective. Journal of Behavioral Medicine 32 (4), 317–327. http://dx.doi.org/10.1007/s10865-009-9206-7.

Perloff, L.S., Fetzer, B.K., 1986. Self-other judgments and perceived vulnerability to victimization. Journal of Personality and Social Psychology 50 (3), 502–510. http://dx.doi.org/10.1037//0022-3514.50.3.502.

Renner, B., 2004. Biased reasoning: adaptive responses to health risk feedback. Personality & Social Psychology Bulletin 30 (3), 384–396. http://dx.doi.org/10.1177/0146167203261296.

Renner, B., Reuter, T., 2012. Predicting vaccination using numerical and affective risk perceptions: the case of A/H1N1 influenza. Vaccine 30 (49), 7019–7026. http://dx.doi.org/10.1016/j.vaccine.2012.09.064.

Renner, B., Schmälzle, R., Schupp, H.T., 2012. First impressions of HIV risk: It takes only milliseconds to scan a stranger. PLoS ONE 7 (1), e30460. http://dx.doi.org/10.1371/journal.pone.0030460.

Renner, B., Schupp, H., 2011. The perception of health risks. In: Friedman, H.S. (Ed.), Oxford Handbook of Health Psychology. Oxford University Press, New York, pp. 637–665.

Reyna, V.F., Nelson, W.L., Han, P.K., Dieckmann, N.F., 2009. How numeracy influences risk comprehension and medical decision making. Psychological Bulletin 135 (6), 943–973. http://dx.doi.org/10.1037/a0017327.

Schmälzle, R., Schupp, H.T., Barth, A., Renner, B., 2011. Implicit and explicit processes in risk perception: neural antecedents of perceived HIV risk. Frontiers in Human Neuroscience 5, 43. http://dx.doi.org/10.3389/fnhum.2011.00043.

Schmälzle, R., Renner, B., Schupp, H.T., 2012. Neural correlates of perceived risk: the case of HIV. Social Cognitive and Affective Neuroscience 7 (6), 667–676.

Sheeran, P., Harris, P.R., Epton, T., 2013. Does heightening risk appraisals change people's intentions and behavior? A meta-analysis of experimental studies. Psychological Bulletin 140 (2), 511–543. http://dx.doi.org/10.1037/a0033065.

Shepperd, J.A., Klein, W.M.P., Waters, E.A., Weinstein, N.D., 2013. Taking stock of unrealistic optimism. Perspectives on Psychological Science 8 (4), 395–411. http://dx.doi.org/10.1177/1745691613485247.

Shiloh, S., Dagan, E., Friedman, I., Blank, N., Friedman, E., 2013. A follow-up study on men tested for BRCA1/BRCA2 mutations: impacts and coping processes. Psycho-oncology 22 (2), 417–425. http://dx.doi.org/10.1002/pon.2106.

Sjöberg, L., Moen, B., Rundmo, T., 2004. Explaining Risk Perception. An Evaluation of the Psychometric Paradigm in Risk Perception Research. Rotunde publikasjoner Rotunde no. 84.

Slovic, P.E., 2000. The Perception of Risk. Earthscan Publications, London.

Slovic, P.E., Peters, E., 2006. Risk perception and affect. Current Directions in Psychological Science 15 (6), 322–325. http://dx.doi.org/10.1111/j.1467-8721.2006.00461.x.

Thornton, B., Gibbons, F.X., Gerrard, M., 2002. Risk perception and prototype perception: Independent processes predicting risk behavior. Personality and Social Psychology Bulletin 28 (7), 986–999. http://dx.doi.org/10.1177/01467202028007011.

Wardle, J., Williamson, S., Sutton, S., Biran, A., McCaffery, K., Cuzick, J., Atkin, W., 2003. Psychological impact of colorectal cancer screening. Health Psychology 22 (1), 54–59. http://dx.doi.org/10.1037/0278-6133.22.1.54.

Weinstein, N.D., 1980. Unrealistic optimism about future life events. Journal of Personality and Social Psychology 39 (5), 806–820. http://dx.doi.org/10.1037//0022-3514.39.5.806.

Weinstein, N.D., 2003. Exploring the links between risk perceptions and preventive health behavior. In: Suls, J., Wallston, K.A. (Eds.), Social Psychological Foundations of Health and Illness. Blackwell Publishing, Malden, pp. 22–53.

Weinstein, N.D., Atwood, K., Puleo, E., Fletcher, R., Colditz, G., Emmons, K.M., 2004. Colon cancer: risk perceptions and risk communication. Journal of Health Communication 9 (1), 53–65. http://dx.doi.org/10.1080/10810730490271647.

Wright, G., Bolger, F., Rowe, G., 2002. An empirical test of the relative validity of expert and lay judgments of risk. Risk Analysis 22 (6), 1107–1122. http://dx.doi.org/10.1111/1539-6924.00276.