Perception and Evaluation of Risks

Findings of the »Baden-Württemberg Risk Survey 2001«

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Contents

1. **Introduction** (Ortwin Renn)

Modern society has been preoccupied with the notion of risk (Jaeger et al. 2001, Beck 1992, Short 1984). Advances in science and technology have enabled societies to accelerate the speed of technological change and to extent the scope and magnitude of human interventions into nature and the life-world. This process has been accompanied by a major societal effort to assess, simulate, control, and mitigate the potential consequences of this change. The task of predicting and ultimately avoiding adverse consequences of human actions is based on the common understanding that future events are not unavoidable occurrences, caused by God, nature, or fate, but that society has the intellectual capability and the moral obligation to shape the future and to protect its members from potential harm.

The societal mandate to assess and manage risks faces two major obstacles. First, the prediction of physical consequences such as health impairments or accidents relies on methods of extrapolating from past experience to the future and requires the modelling of cause-effect relationships. However, external parameters frequently change, the novelty of the systems to be introduced makes it often impossible to find an adequate data base for drawing meaningful statistical inferences and the models used to predict effects are often too general or simple to account for the variance in outcomes (Jasanoff 1993). Furthermore, many potential impacts may be caused by a unique combination of events (surprises) which is impossible to predict. Thus uncertainty prevails in spite of the concerted effort to assess and manage risks.

A second major observation is that the social experience of risk is not confined to the likelihood of exposure to adverse effects. What human beings perceive as threat to their well-being and how they evaluate probabilities and magnitudes of unwanted consequences, is less a question of predicted physical outcomes but of values, attitudes, social influences and cultural identity.

These two aspects are interrelated. The attempt of risk analyses to extract the systematic, predictable elements of pending dangers from the ideosyncratic and unique elements runs parallel with a split in social awareness. The public demands anticipation of dangers rather than trial and error and holds those accountable who cause or fail to prevent hazardous events that fall in the first category. At the same time many people respond with anxiety or anger over the (alleged) hubris of ignoring or suppressing the hazards of the second category. Niklas Luhmann has referred to this as the *societal internalization of risk*, a process by which unknown dangers are incorporated into the action system of social agents (Luhmann 1990). According to his analysis, internalization makes people more aware of the hazards to which they are exposed

and creates a need for social interpretations (analytical or moral) of hazardous events. Interpreting events means to incorporate the situational circumstances, the organizational structure, the social and political context, and cultural values into the perception and evaluation of the risk involved. This is why risk perception research is a necessary and enlightening path to understand how risks are processed in society.

Where do we stand in risk perception research today? Although three decades of research on risk analyses and perceptions have created a substantial base of understanding of how people perceive and respond to risk, we still lack a comprehensive concept of the social experience of risk. i.e. the social processing of uncertainty in a complex society. The risk field is divided in many different schools and perspectives resulting in a patchwork of approaches.

The traditional approach of technical risk analysis focuses narrowly on the probability of events and the magnitude of consequences (Renn 1992). Obviously such an approach is unable to provide a conceptual tool for the analysis of social experience of risk. General mechanisms of people to process risks have been intensively studied, predominantly by psychometric quantitative methods. The so-called psychometric approach is based on four intentions Slovic 1992, Renn/Rohrmann 2000):

- to establish ›risk‹ as a subjective concept, not an objective entity,
- to include technical/physical and social/psychological aspects in risk criteria,
- to accept opinions of ›the public‹ (i.e., laypeople, not experts) as the matter of interest,
- to analyze the cognitive structure of risk judgments, usually employing multivariate statistical procedures such as factor analysis, multi-dimensional scaling or multiple regression.

Furthermore, analyses of people's heuristics in making inferences have shed some light on how risk information is generalized and evaluated intuitively (Tversky/Kahneman 1975, Kahneman/Tversky 1979). The psychological research spectrum has been amended lately by special studies on stigma. Stigmatization is expected to occur in the process of social amplification of risks (Kasperson et al. 1988, Renn et al. 1992). Risk sources may be associated with negative impacts that color the perception process and determine the perceived seriousness of risk. The more stigma relevant elements a person links with a specific risk source, the more likely this person will characterize this risk as unacceptable high, and will make attempts to avoid stigmatized places, objects or technologies. (Gregory/Flynn/Slovic 1995)

All psychological studies have been very useful in promoting a better understanding of how people perceive and evaluate risks. The psychological studies are unable to

explain, however, why individuals select the interpretative elements identified in these studies and why they ignore others. Furthermore, the social and cultural variance of risk interpretations is excluded from the analysis when focusing only on the individual as an information processor.

Broader risk concepts have been developed by the sociological and cultural sciences. In particular, sociological analysis provides further insights into the social, cultural and organizational factors that influence risk perception (Shubik 1991, Clarke 1989). Some studies attempt to identify social influences in the formation and change of attitudes towards risk-bearing activities or technologies (Short 1989, Gould et al. 1988). Some aspects, such as perceived fairness in the distribution of risks and benefits, have gained special attention as part of the dynamic interaction among the various groups involved in rejecting or legitimizing a proposed imposition of a risk on a certain population (Kasperson/Kasperson 1983, Rayner/Cantor 1987). More theoretically oriented studies have emphasized the social construction of risk interpretations and their affinity to different types of knowledge acquisition, social interests, and cultural values (Bradbury 1989, Cvetkovich/Earle 1992). Another major predictor for risk perception has been identified as trust in the scientific and political elite (Kasperson et al. 1992, Earle/ Cvetkowich 1995). In addition, the process of risk perception in society has been thoroughly analyzed from a ‹macro-sociological‹ perspective - cf. Beck 1986, 1992 van den Daele 1993, Luhmann 1990, Jaeger et al. 2001). Empirical studies have been rare: They are primarily based on individual or group responses to risk issues.

The sociological studies have been valuable and helpful to understand the variability of risk interpretations among different groups and to point out the organizational problems that aggravate the potential outcomes of risk implementations. However, they remain scattered and often fragmented and fail to build links between scientific risk assessments, individual perceptions, and the social and cultural experience of risk.

One contestant for a holistic cultural theory of risk is the proposal of cultural prototypes that are supposed to govern the risk perception process (Douglas/Wildavsky 1982, Dake 1992, Thompson et al. 1990, Schwarz/Thompson 1990). According to the »cultural approach«, risk is a »social and cultural construction« (Johnson/Covello 1987) - not an ›objective‹ entity to be measured independently of the context in which hazards occur. Consequently each society or social group may have its own specific set of risks believed to be of concern, based on its prevalent ›worldview‹. There exist several classifications of cultural biases. Usually, cultural groups have been classified into four generic types: entrepreneurial, egalitarian, bureaucratic, and stratified individualistic. Some authors add »autonomous« as a fifth type. Each of these cultural types is supposed to develop its own criteria and selection rules for constructing a

group-specific interpretation of risk. How people experience risk is thus a function of their cultural beliefs and values. Within this area, research has been more often qualitative than quantitative, including philosophical treatises of risk perception.

Cultural theory has been criticized by many analysts (cf. Johnson 1987, Sjöberg 1997). First, individuals may belong to different cultural groups depending on the social role they play. For example, a corporate manager (entrepreneurial role) may belong to a religious group emphasizing egalitarian values and solidarity. Second, being a member of one cultural group does not exclude the capability to understand and principally accept the rationale of the other groups as a different, but equally legitimate way of dealing with the issue. Third, and most important, empirical proof for the existence of these groups (so far they have only be made plausible by using empirical evidence as illustration of these value patterns) is still lacking, let alone any convincing evidence about the claim of mutual exclusiveness.

Since most of the empirical work on risk perception has been conducted in the 1970s and few studies are available that claim to span the full range of psychological, sociological and cultural variables, the Center of Technology Assessment in Stuttgart (Germany) has conducted a representative survey in the German State of Baden-Württemberg on risk perception in the general population. In addition, a qualitative investigation based on a sample of 62 respondents was launched in 2001. The objective of the study was to determine the relative importance of psychometric, stigma-related, social value-related, trust-related and cultural variables in explaining risk perception and acceptance. The following report summarizes the results of these investigations.

A large-scaled project like the Baden-Württemberg Risk Survey can't be carried out without personal and institutional support. Sincere thanks are due to the Center of Technology Assessment in Baden-Württemberg and to the University of Stuttgart for generously funding this study, and supplying us with infrastructure and competent aid. Managing the project, we are thankful to Sigrid Berner and her colleagues. The deployment of the questionnaire as well as the construction of scales was supported competently by Rolf Porst - Centre for Survey Research and Methodology (ZUMA) in Mannheim. Formerly ZUMA was also involved in constructing and improving the Zwick-scale. For this, special thanks are due to Dagmar Krebs. We are also thankful to Hans Kastenholz (Center of Technology Assessment), who invested much effort, constructing scales on institutional trust which proved to be very useful. Furthermore, we have to express our thanks to Christian Holst and Uwe Reising (Inra Deutschland) for managing the random sample, pretest and data collection reliably and punctually. The qualitative interviews were carried out by students, participating in a seminar on risk perception at the University of Stuttgart. We have to thank them also for tran-

scribing the abundance of text material. Alexander Sautter and Marcus Heinßen lend a hand developping and gradually improving a coding scheme. We have to thank them also for assiduously registering qualitative data. Last but not least, many thanks go to Christina Rhodes and Sabine Mertz-Bückle, who achieved the translation of text, figures and tables into English, while Birgit Spaeth generously took over proof-reading.

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2. Descriptive Findings of the Baden-Württemberg Risk Survey 2001

(Michael M. Zwick)

2.1 Introduction

»One is always exposed to some kind of risk«. We repeatedly came across this, or similar statements when carrying out the 62 handbook interviews on risk perception and assessment. It goes without saying that a semantic field with such a wide scope forces selection: the interviewees' limits of endurance must be respected when using qualitative approaches, even more so when using standardized survey instruments. This survey's average interview length of 45 minutes represented a clear tolerance limit which unmistakably showed in the tendency to break off the interview, a tendency which increased towards the end of the interview session.

The thematic focus was the surveying of attitudes to the risks of nuclear power plants, cellular phones and their associated transmission facilities, genetically altered food, the risk of global climate change, crime and smoking. This selection represents a compromise which was to consider equally habitual risks - the risk associated with smoking -, social risks - crime -, ecological risks - the risk of global climate change -, and technological risks. The latter include risks - in the case of cellular networks - caused by communications and product technology, risks caused by conventional large-scale technology - nuclear power plants -, and novel food technology - genetically altered food. The risks were selected in order to rouse the interest of the persons interviewed as well as to touch upon current sociopolitical topics. Moreover, this data was to counteract the lack of basic research in the field of risk sociology: A report by the official Enquete-Commission into the »Protection of Mankind and the Environment« by the German Bundestag which was to assess the state of the research on the ›acceptability of risks and technologies in Germany‹ (Renn/Zwick 1997), brought to light that Germany had surprisingly few studies on the subject of risk perception and assessment, some of which were obsolete and not rarely based upon small-scale or non-representative samples. In order to meet these basic research needs, comprehensive sets of questions were compiled, permitting a kind of ›empirical comparison‹ of stigma-theoretical, psychometric, culture-related theoretical and intermediary items, revealing the performance of, and confidence in institutions from the field of risk communication and management.[1] By asking open questions the interviewees were in addition given the opportunity to speak freely on the individual risks.

1 The complete questionnaire is included in the appendix.

The data set at hand is based on a three-stage stratified random sample, as an ADM-master sample, of the Baden-Württemberg German-speaking resident population over 16 years of age. Between the 12th of February and the 30th of March, 2001, *Inra Deutschland* carried out a total of 1.508 interviews.[2] The data set includes a weighting variable which permits analyses representative for individual persons, made possible by adjusting the sample to characteristics of the official population structure statistics. All subsequent analyses were carried out with the weighted set of data.

2.2 Risk perception and assessment among the public

Based on descriptive analyses this first empirical section will determine how the public assesses the individual risks. For this purpose, the so-called psychometric characteristics ascribed to risks by the public are introduced[3].

Subjectively experienced threat

As can be seen from Fig. 1, Baden-Württemberg's public does by no means appear apprehensive or panicky. Considering the fact that with respect to the prospects of the economy the population is frequently reprimanded as being averse to technology and prone to a certain risk-shyness, it may come as a surprise that, with only one exception, hardly more than one in six people are afraid of one of the listed risks. The problem of interior security, a favorite of the public which can attain election-deciding dimensions, the long-lasting debate of the safety of nuclear power plants, the transportation and storage of nuclear waste and not least the discussion of the BSE risk which was just easing off at the time of the survey, were factors which could have substantiated a dramatization of the perception and assessment of these risks. However, at 40% and more respectively, the proportion of those not feeling threatened is amazingly high, just as the proportion of those feeling considerably frightened is surprisingly small.

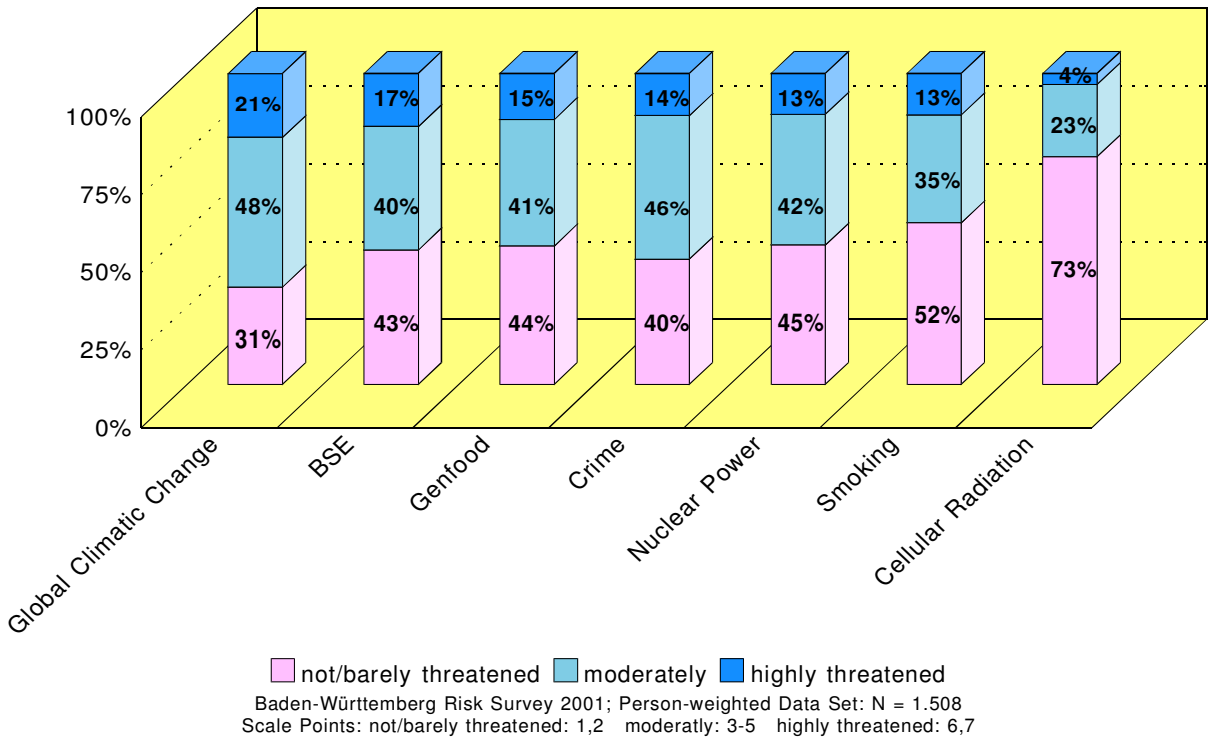
What is even more surprising is that it is global climate change which causes the most worry and concern in those interviewed, for several reasons: for one, it could have been expected that those risks which present an acutely threatening hazard to health or life of the persons interviewed are considered threatening. For another, it would be easy to assume that the subjectively perceived threat of risks varies with the density

2 Sample rate of response amounted to 64%.

3 Smoking and crime were covered by shorter question sets, as it could not be precluded that some aspects of these risks, such as personal or social benefit, could have caused irritation with some of the persons interviewed.

of mass-media coverage on a certain subject; during the period of the survey this certainly did not apply to climate change and its effects: the world climate summit in Bonn, which attracted considerable media interest, even a heavy thunderstorm over Bavaria and the flooding of the Oder in Poland took place in July 2001, long after the conclusion of the data collecting period. After all, it could be assumed that mainly those risks are dramatized which take effect in the living area of the persons interviewed, the effects of which can either be experienced with one's senses or directly communicated and thus triggering, as does crime, a more subjective affectedness than abstract and latent risks. Disregarding the Christmas hurricane »Lothar«, which struck Baden-Württemberg on Dec. 26, 1999, neither Germany nor Baden-Württemberg are among those regions afflicted by storms to a noteworthy degree.

Fig. 1: Subjectively Perceived Degree of Threat of Various Risks



Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: not/barely threatened: 1,2 moderatly: 3-5 highly threatened: 6,7

Due to the special significance this subject is obviously given in public perception, global climate change will be accorded its own chapter in this working report. The semantics of the world climate risk will then be developed from the qualitative data material.

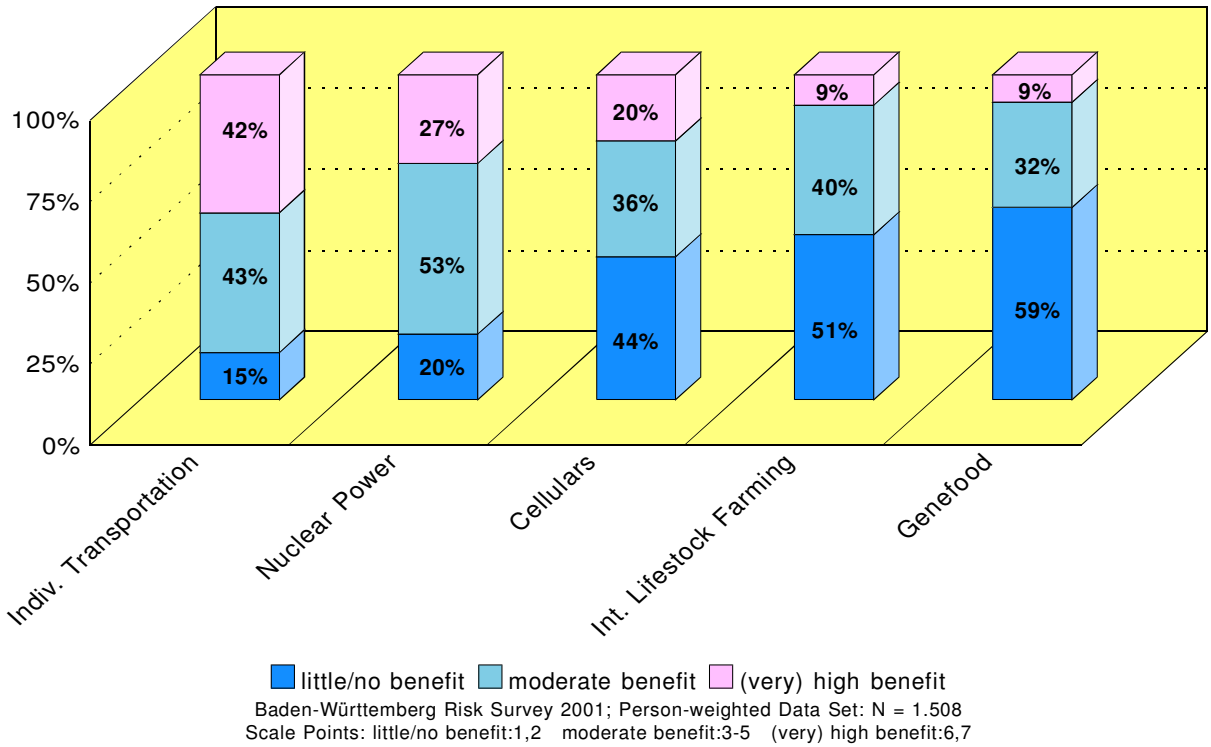
Looking at the alternatives shown in Fig. 1, it is not surprising that the risk of cellular networks merely triggers comparatively little concern in comparison. The level of response behavior however is surprising. Only 3.5% are afraid of cellular phone radiation and almost three-quarters of the persons interviewed consider this risk unproblematic. The media echo to citizens' initiatives against cellular network transmitting stations does of course suggest other proportions - we are obviously dealing with an example of how a small group of persons, who know how to mobilize a subject and turn it into a political issue, can have an effect considerably more staggering than its actual size. Analogous to cellular phones, smoking is also an ›everyday risk‹ where the individual - due to decisions in purchase and pleasure - has a high degree of autonomy and control over pleasure and risk, causing him or her to assess the risk, which moreover directly concerns only part of the population, as being relatively small.

For the synoptic summary of the perceived or ascribed risk characteristics at the end of the chapter, it can be noted that the risks of smoking and cellular networks are perceived as being particularly low, and the risk of global climate change is perceived as being comparatively threatening, whereas the remaining risks hardly differ and occupy a medium level position with regard to their degree of perceived threat.

Individual benefit and benefit-threat balance

In many cases risks have a Janus-faced appearance: sources of harm can simultaneously be the sources of personal or social benefit. This is also true for all of the risks investigated by us. It must be noted, however, that benefit and risk source can diverge in each case, for example when a technology or mode of behavior promising benefit, such as individual transportation, leads to external effects such as global climate warming, which in turn harbor potential harm. Fig. 2 shows the benefits analogous to the risks shown in Fig. 1. Fig. 3 attempts a benefit-harm balance. The latter seems obvious as individual benefit and threat potentials were measured on the same scales; however, subjectively perceived threat and benefit potentials may not necessarily be on the same factual level, it may even be that different standards are applied to them in the perception of the individual; it therefore seems appropriate to look at the balancing attempt in Fig. 3 with a certain critical distance, as a rule-of-thumb as it were. The majority of people sees little or no benefit in industrial food production, neither in genetically engineered food nor in large-scale livestock production.

Fig. 2: Assessement of Personal Benefit by...



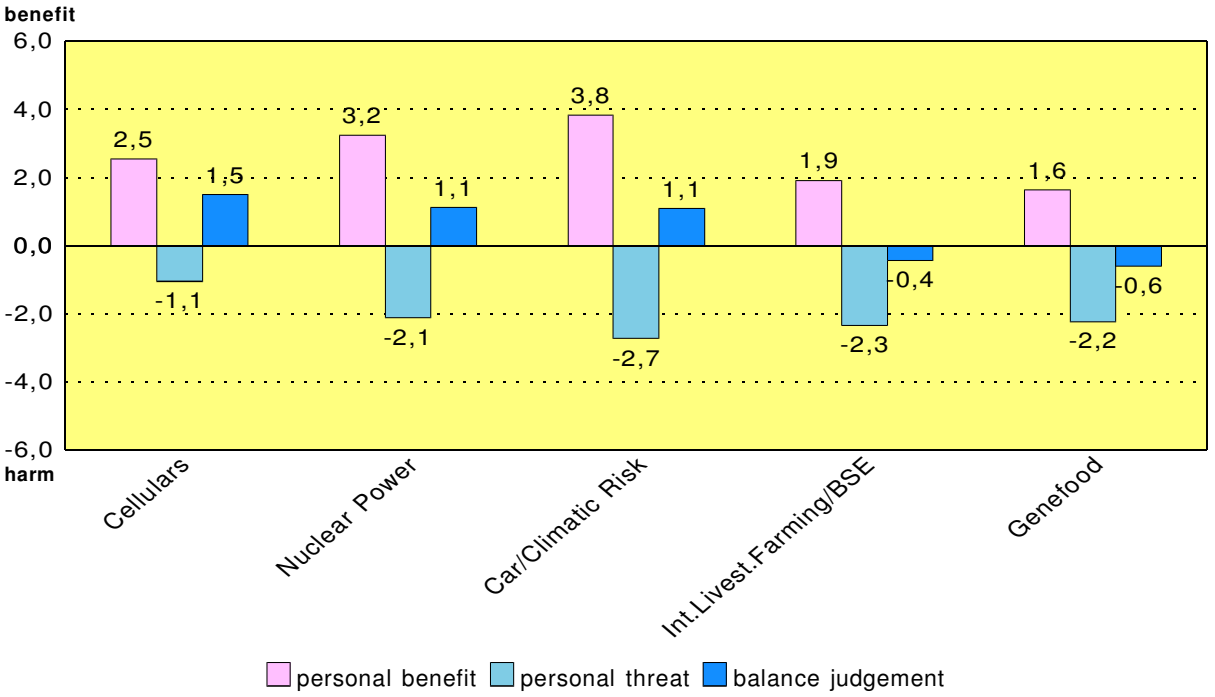
Considering the estimate according to which about 70% of all Germans will own a cellular phone by the end of 2001[4] (cf. Plica 2001), it is surprising that only 20% of the persons interviewed ascribe celullar network technology a benefit worth mentioning.

Possibly the discrepancy between cellular phone utilization and benefit can be explained by the »fun factor« of cellular phones: possession and utilization of this technology are possibly not based on the importance and concrete benefit of communication, but on the gain in status and fun. Nuclear power and above all motorized individual transportation can amass relatively high benefit potentials: only one-in-five people cannot see any real benefit in nuclear power and only one-in-seven in motorized individual traffic.

4 During the last years, in Germany the sale of mobile phones boomed. According to the ›Statistische Bundesamt‹ (2002), at the beginning of 1998 9.5% of all German households owned a mobile phone, in January 1999 16.5% and one year later already 29.8%.

Fig. 3 shows in what way benefit and threat potentials can be balanced. To this end the mean values of the scales, which originally comprised 7 characteristics, were compared with each other. Cellular phones show the best balance. The medium benefit level is opposed by only low risk potentials, thus yielding the best overall balance. But even with nuclear power the assumed personal benefit clearly surpasses the perceived threat. The same is true for the benefit of individual transportation - none of our other examples yields such high benefit assessments! Regardless of the considerable threat perceived in global climate change, which is in part caused by individual traffic, the persons interviewed here too provide a positive balance.

Fig. 3: Perception of Personal Benefit-Threat-Balance in the Case of...



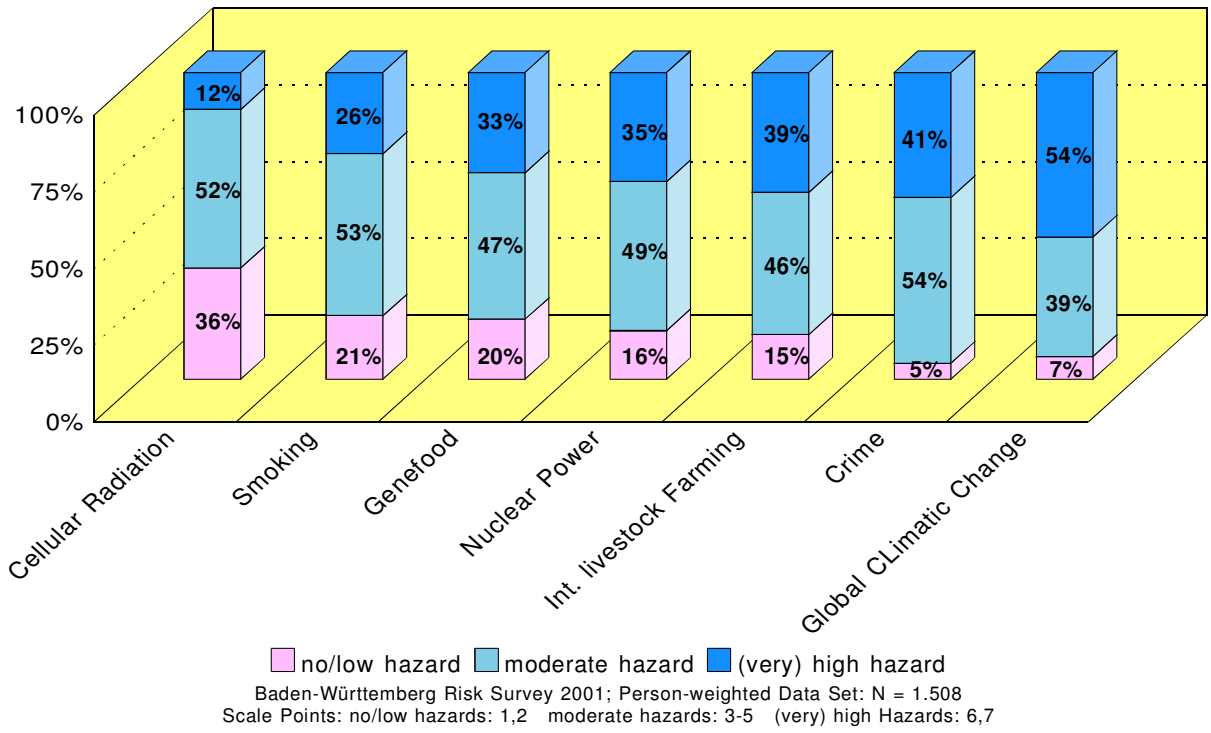
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Value Range of Balance Judgement [0 ; 6] and [-6 ; +6] respectively

That the risks, some of which are assessed as threatening, are compensated by even greater benefit potentials does not apply to mass-livestock farming resp. BSE and genetically engineered food. The risks - which are assessed to be higher than those of nuclear power in both cases ! - are faced with only low expectations of benefit. Both cases thus yield a negative balance of personal benefit and threat potentials.

Social damage and catastrophe potentials

Not only can the extent of the subjectively perceived threat or benefit potentials be critical for the perception and assessment of risks, but also the assessment of their positive or negative consequences for society. Earlier investigations even showed that social damage potentials are generally assessed more dramatically than the individually experienced threat of risks. Moreover, they are considered as being more significant indicators for the acceptability of risk sources compared with personal concern. Incidentally it seems justified to deal with global damage and catastrophe potentials en bloc: in the variables listed in Figs. 4 and 5 both dimensions are correlated to a high degree. The correlation measures r are between 0.57 and 0.77, so that it can be assumed that the semantic differences in the public perception of social damage or the catastrophe potential are small. Accordingly, both Figures show the same ranking of the individual risks.

Fig. 4: Social Hazards Caused by Various Risks



Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: no/low hazards: 1,2 moderate hazards: 3-5 (very) high Hazards: 6,7

Fig. 4 moreover shows that the social hazards of risks were assessed as being more dramatic by a distinctly higher proportion of the persons interviewed than the perso-

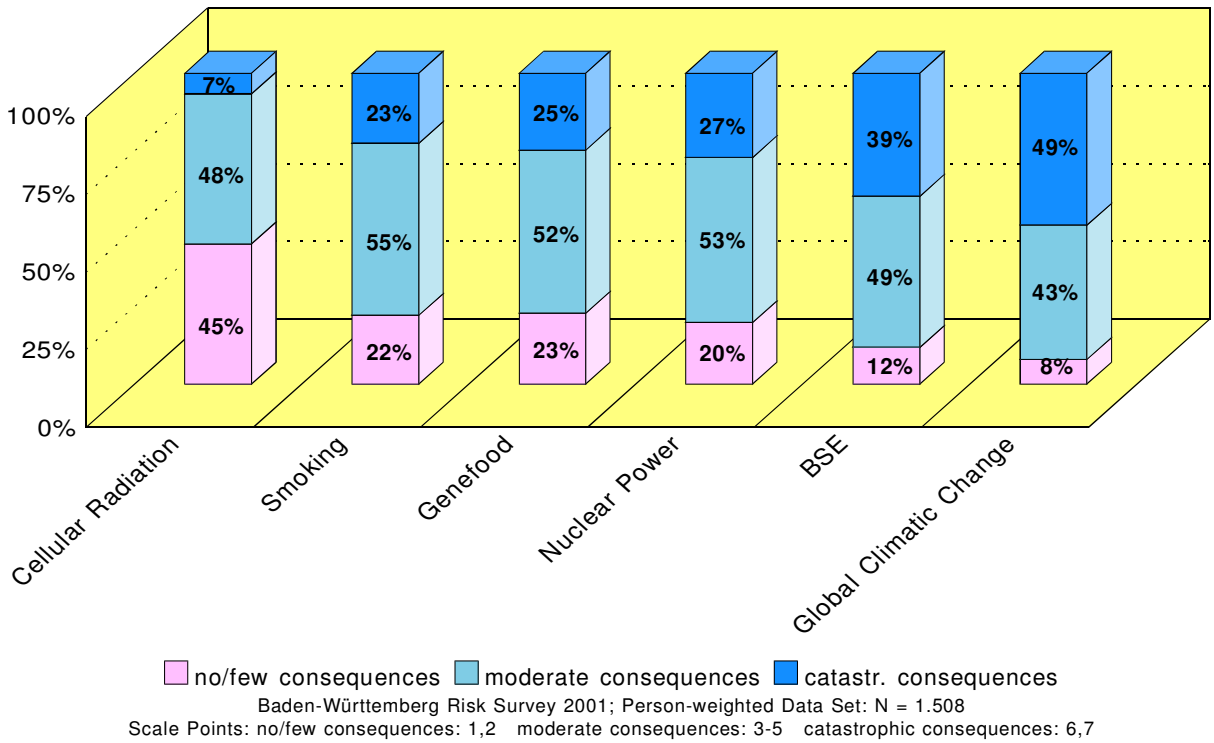
nally perceived threat represented in Fig. 1: a mere 21% feel personally threatened by the effects of climate change, but 54% make out a potentially high degree of social harm and 49% even a catastrophic potential! How can these in part extraordinary differences be interpreted? For one, personal exposure to risks could be an important factor: As qualitative findings show[5] the consequences of global climate change are expected first of all in particularly exposed countries and for subsequent generations, not for the German society of the present. Vegetarians need not fear the BSE risk, but can all the same expect considerable social consequences. Also, the perception of significant social consequences caused by crime do not necessarily coincide with personal experience and the perception of the situation ›at home‹. For another, divergence in perception can arise from convictions of control, namely the assumption that risks can be sufficiently determined by oneself or others, or that one could elude threatening harmful events more easily than others. Finally, harmful events are conceivable which are predominantly or wholly insured or compensated by the state's social institutions, so that private persons - regardless of the social damage - would be exposed to hardly any disadvantages by those events.

While genetically engineered food, large-scale livestock farming and nuclear power are ranked at a medium position, the cellular network risk is ascribed a lower potential for social harm. Surprisingly, the same applies to the social consequences of tobacco consumption. Risk potentials which are higher than average are assumed for crime and above all for global climate change.

Assessing catastrophe potential basically does not require special interpretation, as it essentially follows the perception of social damage potentials as shown above. Fig. 5 shows the same ranking of risks as Fig. 4. Merely the proportion of those assuming catastrophic consequences is somewhat smaller respectively, compared to Fig. 4. Considered in this way, the catastrophe potential is merely a critical development of significant events of social harm carried to the extreme. Nuclear power, genetically engineered food and smoking take a medium ranking. Cellular networks are ascribed a particularly low catastrophe potential, an especially high one is attached to the risks of BSE and global climate change.

5 See also the contribution of Höhle in this paper.

Fig. 5: Perception of the Catastrophe Potential of Various Risks



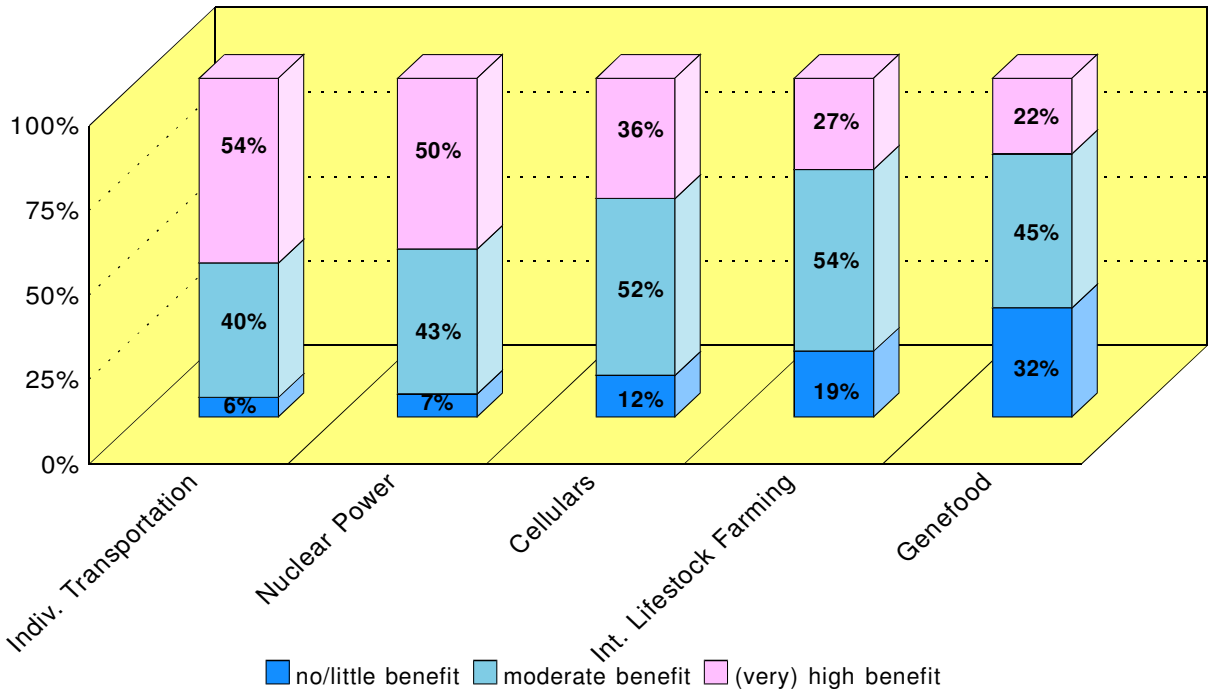
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: no/few consequences: 1,2 moderate consequences: 3-5 catastrophic consequences: 6,7

Social benefit potentials of risks

As in the individual case, benefit and damage potentials can also correspond on a social level and lead to a positive or negative balance in the interviewee's risk perception. The rankings of individual - Fig. 2 - and global benefit perception - Fig. 6 - correspond exactly. More than half of the persons interviewed see great social benefit potentials with personal mobility and yet every second person sees them in the utilization of nuclear power. Cellular phones take a medium ranking in both personal and social benefit; only one in four sees a social benefit in intensive livestock production and above all genetically engineered food. The main difference between Fig. 2 and 6 is in the level of benefit assessment. Regarding genetically engineered food, social benefit aspects are recognized on average by 11% more of the persons interviewed and by 23% more regarding nuclear power, compared to individual benefit aspects. From this point of view, the social significance of nuclear power is especially emphasized, whereas in the development of genetically engineered food, both benefit dimensions show particularly poor results. Two explanations can be offered: Possibly, public perception associates the development of genetically altered products more with

compact laboratories where few highly specialized biologists are at work, than with labor-intensive production facilities. For another, poor individual benefit perception could suggest the conclusion that genetically altered food is assumed to have only very poor chances on the market and that it is thus ascribed only little economic and labor-market significance.

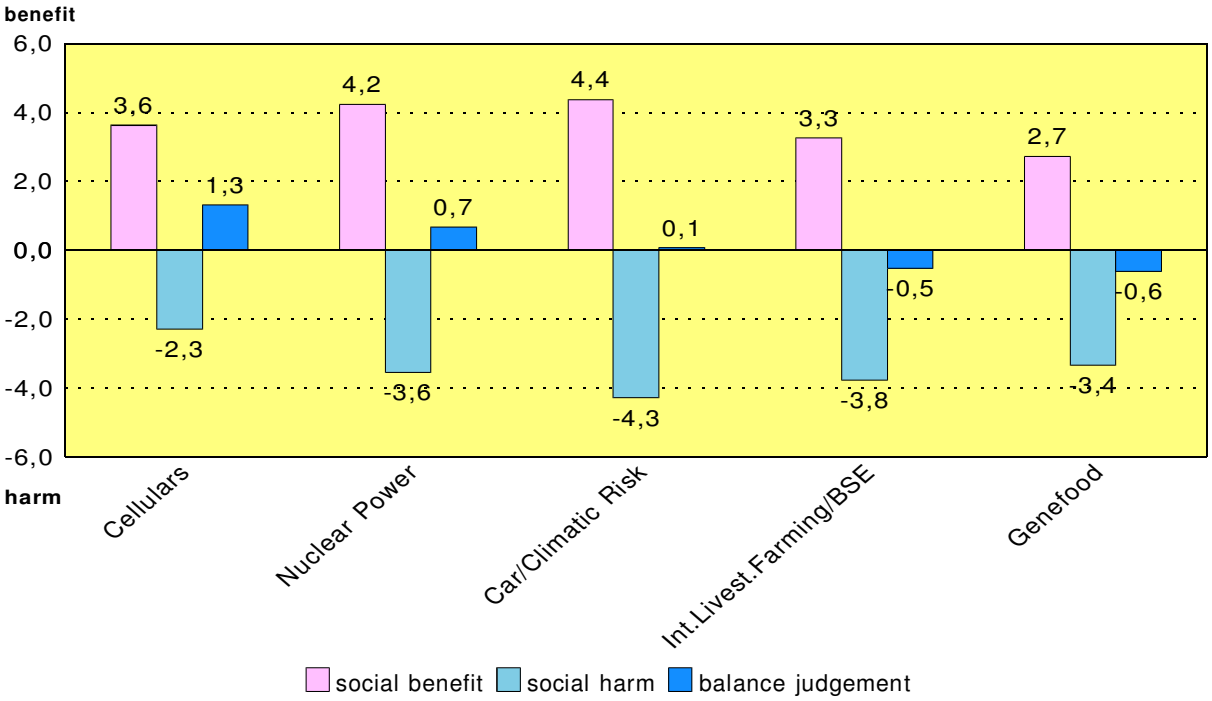
Fig. 6: Assessment of Social Benefit by...



Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: no/little benefit: 1,2 moderate benefit: 3-5 (very) high benefit: 6,7

When looking at the benefit-risk balance in Fig. 7 we will find complete correspondence of the individual and global dimensions, at least as far as the ranking of risks is concerned. Again, cellular networks and nuclear power have an especially high ranking, large-scale livestock production resp. BSE and genetically altered food an especially low one. It is surprising that global balances do no better in any of the cases than the specific ones, in personal mobility and climatic change even significantly worse! This is caused mainly by the fact that here the *individual* benefit and the *global* threat potentials are assessed as being particularly high.

Fig. 7: Perception of Social Benefit-Risk Balance Concerning...



Baden-Württemberg Risk Survey 2001; Personal-weighted Data Set: N = 1.508
Value Range of Judgement Balance [0 ; 6] and [-6 ; +6] respectively

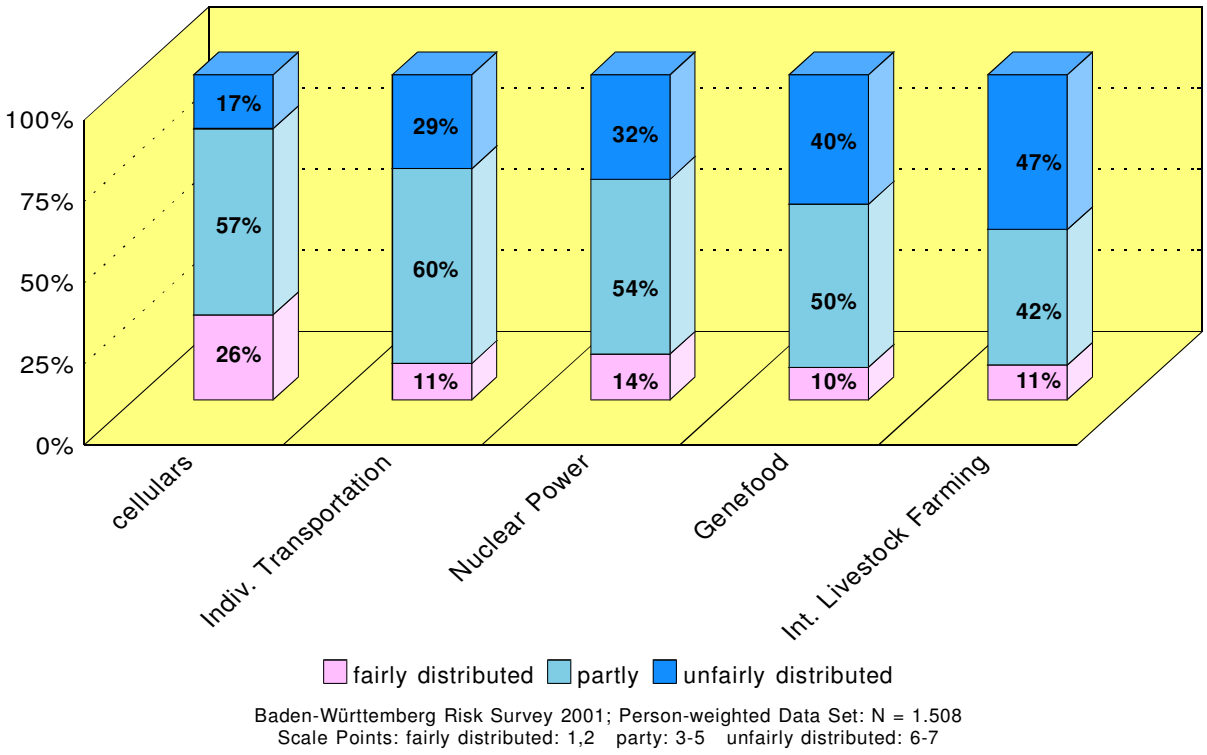
At this point already there is an indication that the majority of citizens are quite able to understand the dialectics of individual automobile usage and long-term global damage and catastrophe potentials. The fact that both global and - even more - individual benefit-risk balancing are in the positive range, permits the pointed conclusion that the public considers itself a ›prisoner‹ of social modernization. A Janus-faced modernization, which is associated by at least half of the people with enormous threat potentials and horror scenarios, however whose benefit potentials - resource-intensive consumption, mobility and living habits - one can not or does not want to do without. In this paradoxical situation Beck's theory of the potentially self-destructive consequences (1986: 28ff.) of a globalizing ›world risk society‹ (Beck et al. 1996: 44) seems to be reflected to some extent. The processes of individualization also diagnozed by Beck seem to express themselves in the shape of benefit-oriented market individualists: with no other risk the individually perceived benefit expressed in the balance result has a weight comparable to that of motorized personal mobility! The ›symbiotic‹ relationship of global horror made up for by the even greater, immediately realizable personal benefit makes it clear that the implementation of a sustainable

development[6] based on intergenerational justice providing the chances for living and self-fulfillment for future generations meets with little acceptance.

Fair distribution of benefit and risks

It has already become obvious that the perception of benefits and risks is important for the assessment of risks. Important differences can apparently be found in how individual and global cost and benefit aspects are balanced. The question of whether benefits and hazards are perceived as being distributed fairly or unfairly deals directly with this point.

Fig. 8: Fairness of Distribution of Benefit and Risks



Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: fairly distributed: 1,2 party: 3-5 unfairly distributed: 6-7

Fig. 8 contains a result which is at first surprising: All in all and especially in the case of genetically altered food and large-scale livestock production the fairness of distribution of benefits and detriments is clearly assessed negatively. Merely with cellular phones the picture is somewhat more well-disposed. Altogether, however, skeptical-

6 Brief summary: Knaus/Renn 1998: 27ff.

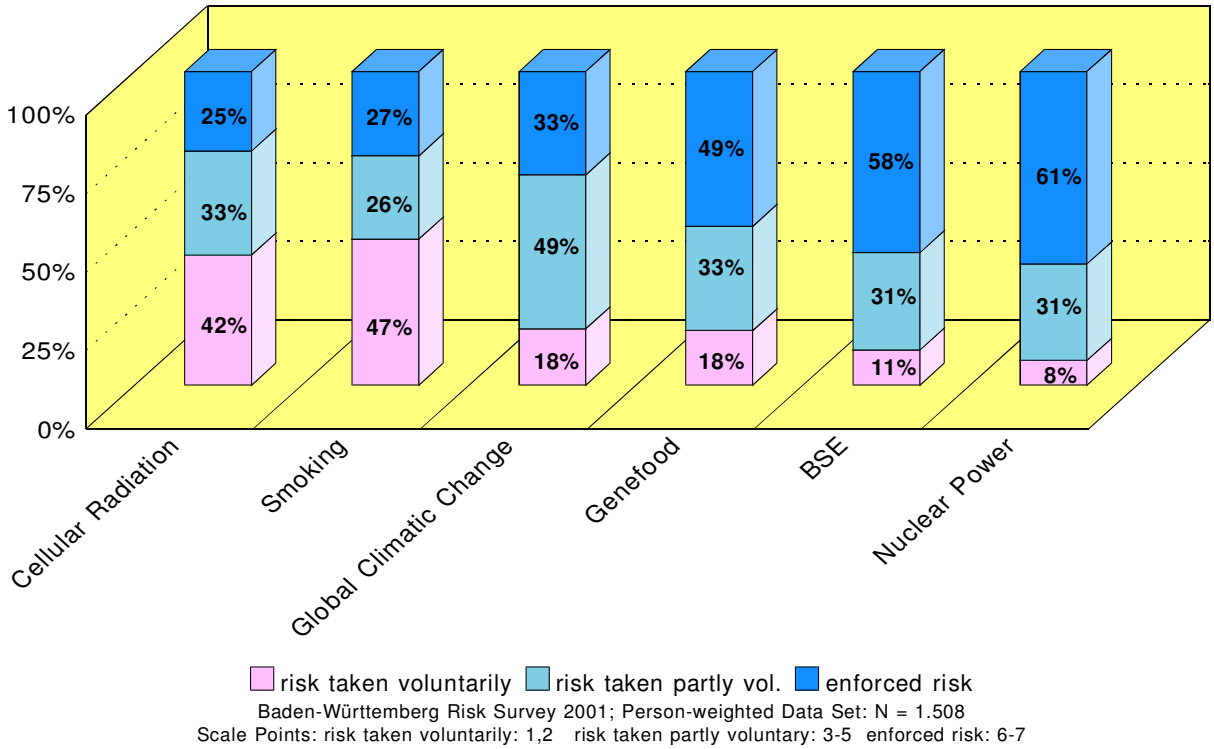
ambivalent opinions prevail here too. Again it is industrial food production - represented by large-scale livestock production and genetically engineered food - which is rated particularly negatively. Unfair distribution entails burdening the public with risks and the monopolization of benefit by others. Seen from a correlation-analytical point of view, the perceived unfair distribution does indeed involve particularly high correlation with the perceived social hazard and catastrophe potentials ($r \approx 0.40$ respectively), but also with the unvoluntary nature of risk taking ($r > 0.30$ respectively). On the one hand, the relatively dramatic assessment of social risks, as could be seen in Figs. 4 and 5, with the exception of the risk of cellular phones and smoking, explains that the distribution of benefits and detriments was perceived as highly unjust. On the other hand the voluntary nature of risk taking could be interpreted as an indication that the issue is not only the dimension of potential harm, but possibly *how* those risks are dealt with. Earlier research has shown that a ›creeping‹ introduction of technology - in the case at hand the involuntary exposure to risks - without sufficient citizen participation can cause irritation and negative attitudes (cf. Renn/Zwick 1997: 3.2.3.2).

The voluntariness of risk taking and subjective control of the risk

It can be assumed that enforced risks will create resentments towards sources of risk rather than risks taken voluntarily. At the same time, the perception of voluntariness and the conviction of subjective control possibilities correspond to the typology of risk sources described by Renn (cf. Renn/Zwick 1997: 24): Voluntariness - combined with extensive belief in control - can frequently be found in everyday and consumer technology, whereas these properties are only weakly pronounced with risks associated with external large-scale technology or mass production.

Indeed, we find the lowest perceived voluntariness in risk taking with the ›classical‹ external risk technology, the utilization of nuclear power, followed by nutritional risks caused by BSE and genetically altered food ›enforced‹ by food producers; whereas smoking and cellular phones are risks which can be handled largely voluntarily due to the purchase and utilization or avoidance of the products in question. The climatic risk is obviously considered by the public as caused and accounted for by its own acts but also by external global influences. Consistently, it takes up a medium position.

Fig. 9: Risks - Voluntarily or Enforced?

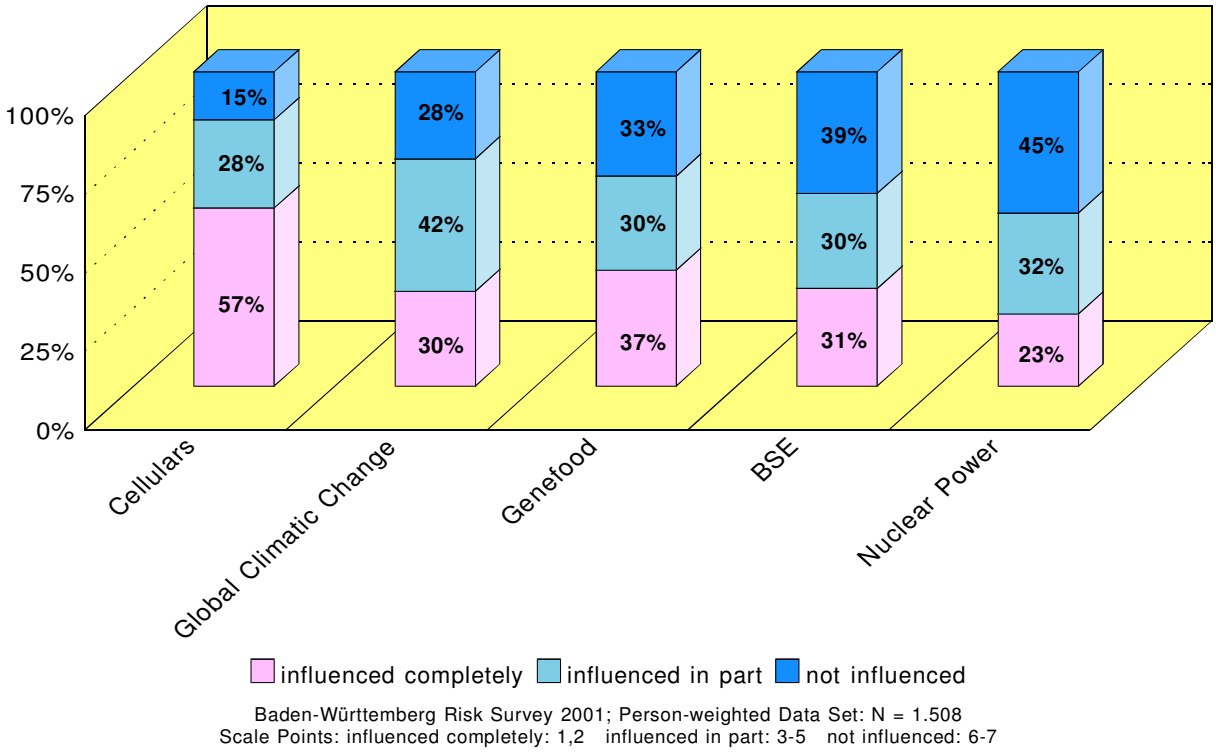


Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: risk taken voluntarily: 1,2 risk taken partly voluntary: 3-5 enforced risk: 6-7

The subjective ability to influence risks is also linked to voluntariness.[7] It is therefore no coincidence that Fig. 10 shows the same ranking of risks. The more sources of risk arise from products within the individual's power of influence, the easier is the subjective control of those risks. Risks forced upon the individual from the outside and above all those risks encountering people as a »neighbour« in the sense of an external risk technology, largely elude the realm of personal influence.

7 In the individual risks voluntariness and influenceability are correlated with $0.24 < r < 0.34$.

Fig. 10: Subjectively Perceived Ability to Influence Risks



Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Scale Points: influenced completely: 1,2 influenced in part: 3-5 not influenced: 6-7

Perceived responsibility and the performance of institutions

Who is responsible for avoiding the exposure of the public to inappropriately high risks? Table 1 shows the distribution of those institutions identified by the interviewees as being those mainly responsible with 1st and 2nd priority.

Politics, and to an even greater extent industry are made responsible almost universally for controlling and regulating risks. Merely where crime is concerned, 7 out of 10 persons interviewed admit to have joint responsibility for their protection against risk. Industry's particularly high responsibility for the risk due to cellular network technology supports the theory that the persons interviewed have in mind much more the ›cellular phone‹ risk source rather the electromagnetic fields radiating from transmitting stations. In the latter case the assumption that the state could be made largely responsible for independently controlling threshold values would be plausible. Where ›new‹ risk subjects like cellular networks or genetically altered food appear, science is made responsible with the second highest frequency: People demand experts to sort out uncertainties about risk potentials, and supply robust knowledge.

Table 1: Institutions Mainly Responsible (1st and 2nd Priority) for Controlling and Reducing Risks *(multiple answers)*

Institution	*Risk*					
	BSE	Nuclear power	Gene-food	Crime	Cellular phone transm. facilities	Climate change
Industry	**71.3%**	**66.4%**	**63.2%**	3.4%	**71.2%**	**52.1%**
Politics	***53.7%***	***64.2%***	45.2%	**92.5%**	32.0%	***50.2%***
Science	26.4%	42.5%	***49.0%***	5.3%	***38.4%***	42.0%
Individual person	22.4%	8.2%	19.3%	***70.6%***	30.6%	27.8%
Environmental agencies	21.4%	16.6%	21.0%	1.8%	15.4%	23.7%
Media	3.0%	2.3%	2.2%	20.9%	6.2%	3.3%
No-one	1.7%	0.9%	1.0%	3.7%	4.1%	2.2%
Baden-Württemberg Risk Survey 2001; Person-specifically weighted Data Set; N = 1.508						

Due to the fact that responsibility is to be provided by three institutions - industry, politics and science - it is subsequently sufficient to list the assessment of the performance of these three institutions. Performance criteria were included in the survey instrument in order to assess the effectiveness of institutions using the degree of confidence in these institutions, however with only four risks being applied:

Table 2: Confidence in institutions: the assessment of selected performance criteria of industry, politics and science on the basis of various risks

Institution/ Criterion	*Risk* BSE	Gene-food	Cellular phone transm. facilities	Climate change
The industry ...				
provides for adequate precautionary safety measures for the protection of the citizens concerning ...	20.6%	14.2%	18.0%	15.4%
in addition to economic interests, takes seriously the concerns of the public regarding ...	22.0%	11.0%	12.3%	16.1%
The politicians responsible ...				
protect the citizens from the risks caused by ...	22.7%	14.2%	16.2%	15.3%
take seriously the fears and apprehensions of the public concerning ...	32.5%	15.6%	14.4%	22.5%
and the authorities provide for adequate legal control concerning ...	39.1%	22.1%	18.6%	26.4%
The scientists ...				
are independent of economic and political interests concerning ...	26.8%	19.7%	21.3%	31.5%
fulfill their responsibility for the social consequences of their work concerning...	38.7%	29.3%	29.2%	42.8%
Baden-Württemberg Risk Survey 2001; Person-specifically weighted Data Set; N = 1.508				

Apart from the assessment of scientists' responsibility for their acts, the three institutions listed received a poor rating in the public's judgment. If the specific performance of these institutions is interpreted as an indication of their credibility and trustworthiness with respect to risk communication, prevention, control and management, it becomes obvious that the public feels largely left alone in matters of risk, one can hardly speak of a deposit of trust. If the extent to which these three institutions are made responsible for dealing with risks is compared with the degree of their

assessed effectiveness, then a profound lack of credibility and trustworthiness becomes apparent.[8]

Institutional handling of the BSE risk is the item that comes off best in Table 2. Many people no longer considered BSE an acute topic at the time of data collection. Despite an ever increasing number of BSE cases also in Baden-Württemberg, food was assessed as being well under control and safe, this was also shown in the answers to open questions. However, the assessment that the authorities provide sufficient legal control in the case of BSE is only a good one when seen in relation to the other risks; when seen in absolute numbers, just about 40% in agreement, a profound dissatisfaction within the population is signaled.

On the whole it is obvious that the population considers politics and industry as largely insensitive towards the concerns of the public and that both institutions provide the citizens with only insufficient protection against risks. These findings could be interpreted as a kind of »system-specific conclusion« and concentration on institution-specific problems and programs [9], while at the same time being unable to adequately recognize and solve problems of the system environment in question.

Subjective state of knowledge

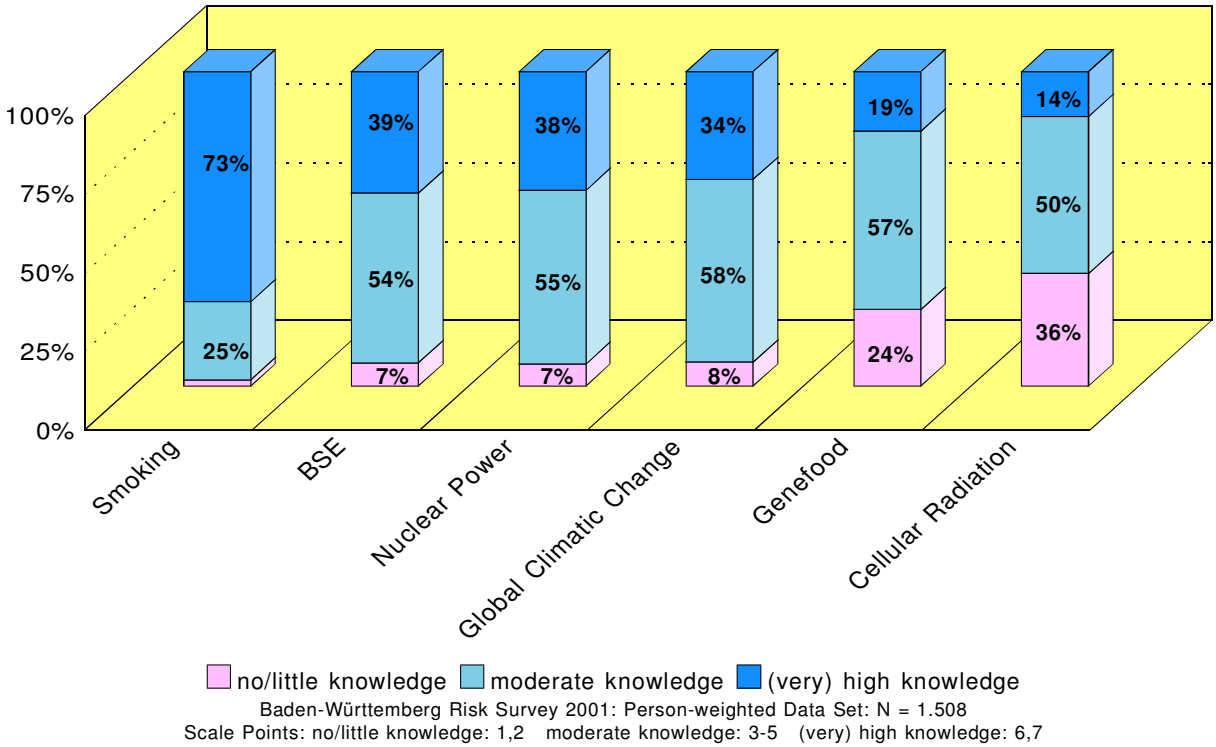
The knowledge about risks should depend largely on two conditions: How old or new is the risk and in what way did the mass media deal with it.

Fig. 11 shows that hardly a doubt seems to be harbored in the public about the risks of smoking. The ›old‹ and much discussed risk of nuclear power is in the medium range, as are the topics of ›global climate change‹ and BSE, which are represented equally highly in the media. Risks from genetically altered food and cellular network technology are new and relatively unknown, a markedly higher number of those interviewed complains about uncertainty here.

8 Similar results were found in the 1998 ›Baden-Württemberg Survey on the Acceptability of Technologies‹ (Renn/Zwick 1998: Chap. 6). They illustrate that the profound lack of credibility and trustworthiness might evoke political protest.

9 In this context Niklas Luhmann would speak of the tendency of social systems towards self--referential processes of conclusion, with a proneness to focus on systemic programs and codes; according to his opinion, problems of the system environment can only be perceived and dealt with when they meet with sufficient resonance, i.e. when the problem can be translated into the code of the system in question (1990).

Fig. 11: Subjective State of Knowledge of Various Risks

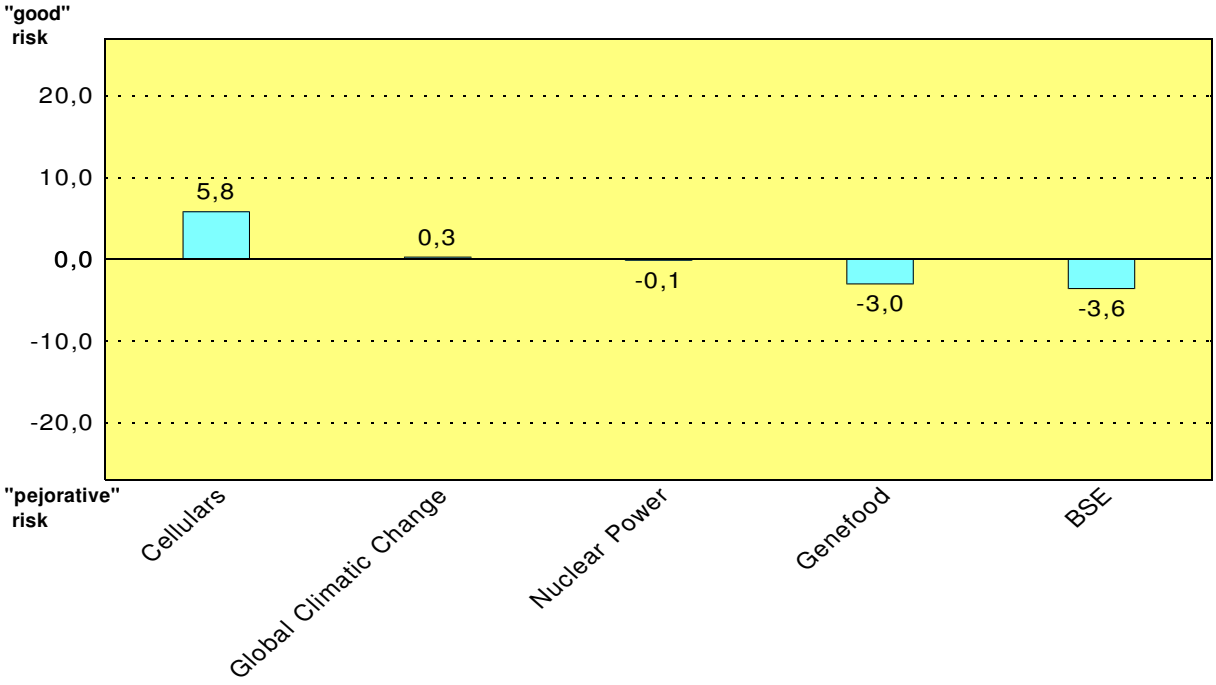


Baden-Württemberg Risk Survey 2001: Person-weighted Data Set: N = 1.508
Scale Points: no/little knowledge: 1,2 moderate knowledge: 3-5 (very) high knowledge: 6,7

Pejorative risk

Stigma theory has pointed out that the assessment of risks does not always involve rational processes of judgement. Stigmatized risks largely trigger negative chains of associations (cf. Gregory et al. 1995, Flynn 1999). ›Pejorative‹ risks of this type can also be identified in the data set at hand. Fig. 12 below is based on a Likert Indicator, which defines ›pejorative‹ risk as being highly individually threatening, enforced, involving a high potential for social harm and catastrophe, where benefit and potentials of harm are perceived as being unfairly distributed, that it cannot be influenced personally, that not much is known about it, and where no personal or social benefit is discernible. The indicator was finally standardized, with the intention of setting its range symmetrically at $-27 < x < 27$. This symmetry makes sense, as risks can of course be seen to encompass also chance and benefit potentials. Accordingly, the positive range means that, on the whole, positive aspects prevail in the public and vice versa.

Fig. 12: "Good" and "Pejorative" Risks



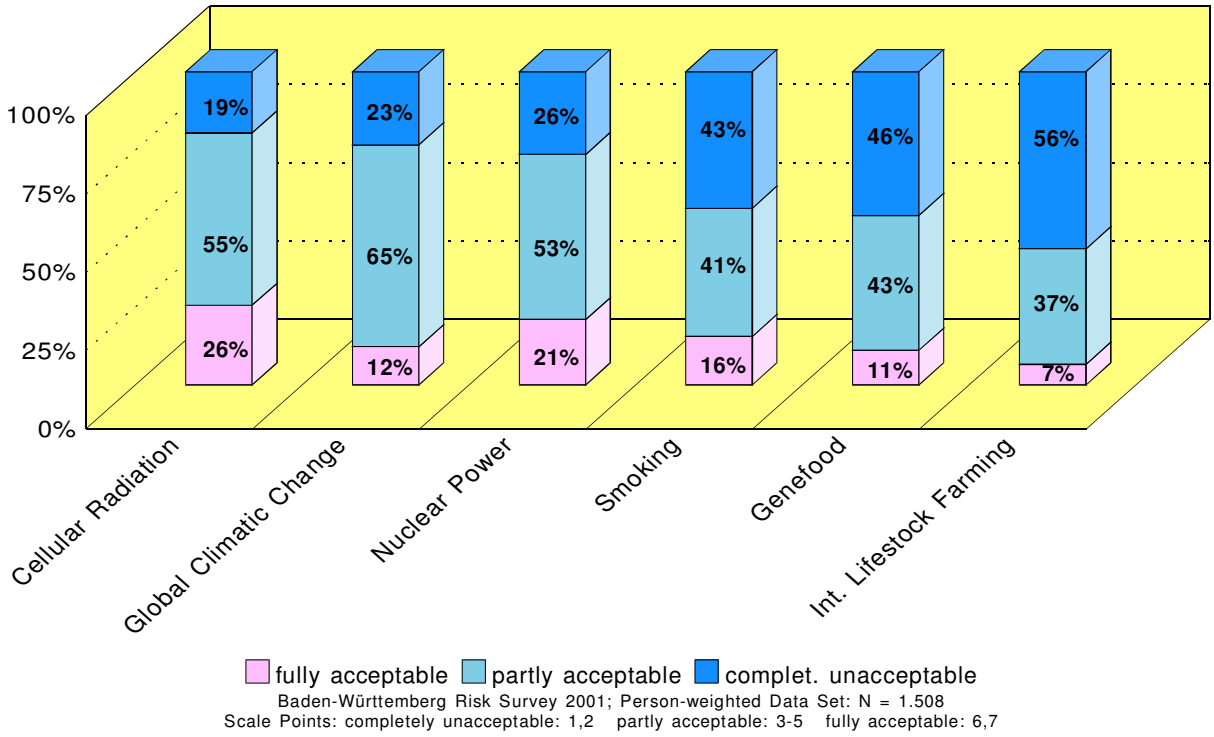
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set: N = 1.508
Value Range of Balance Judgement [0 : 6] and [-6 : +6] respectively

Fig. 12 differentiates three types of risk: Cellular phones are clearly in the positive range. Utilization of nuclear power and the risk of global climate change show an almost balanced result, genetically altered food and BSE are clearly in the negative range. If stigma is to be understood such that the negative end of the scale (6 or 7) was marked in all 9 characteristics, then the following were stigmatized: The cellular phone risk by 0.1%, nuclear power by 0.8%, global climate change by 1.1%, BSE by 4.2% and genetically altered food by 8.5% of those interviewed. This example also shows that it are those risks which are closest to everyday life - whose health- and life-threatening potentials are literally built-in, where the public shows the most sensitive reaction! As high correlations can be found between pejorative risks and the acceptability of risks ($.43 < r < .69$), it can be assumed that risk acceptance will follow the pattern of Fig. 12.

Risk: Acceptability or avoidance behavior?

The acceptability of risks was intentionally excluded from the above indicator, as it is not a perceived or ascribed risk characteristic in the proper sense but acts as an independent judgment. To what extent does risk, all things considered, appear to be acceptable or unacceptable? Fig. 13 provides the answer:

Fig. 13: Acceptability of various Risks



The risks investigated by us can have, depending on the point of view, more or less negative and positive aspects. It is therefore of little surprise that the skeptically ambivalent judgments of Fig. 13 are accorded a lot of credibility.

Fig. 13 shows one particularity: The protion of interviewees assessing the cellular radiation risk as acceptable exceeds the quantity of people valuating this risk being unacceptable! But even climate change and nuclear power are assessed as unacceptable by only one in four of the persons interviewed. Analogous to cellular phone technology, skeptical-ambivalent judgments prevail here. With the remaining risks - smoking, genetically altered food and large-scale livestock production resp. the BSE risk -

rejecting and skeptical-ambivalent judgments prevail. As expected it are the two food risks, genetically altered food and large-scale livestock production which evoke the highest rejection. Large-scale livestock production is even rejected by a clear majority of the population.

Rejection and - even more so - the stigmatization of risks can become influential on behavior and can lead to an avoidance of products or places. However, not everyone is prone to stigmatize sources of risk. Seen in this way, stigma is not a risk characteristic but a process: The source of risk in question is consistently associated with negative characteristics.

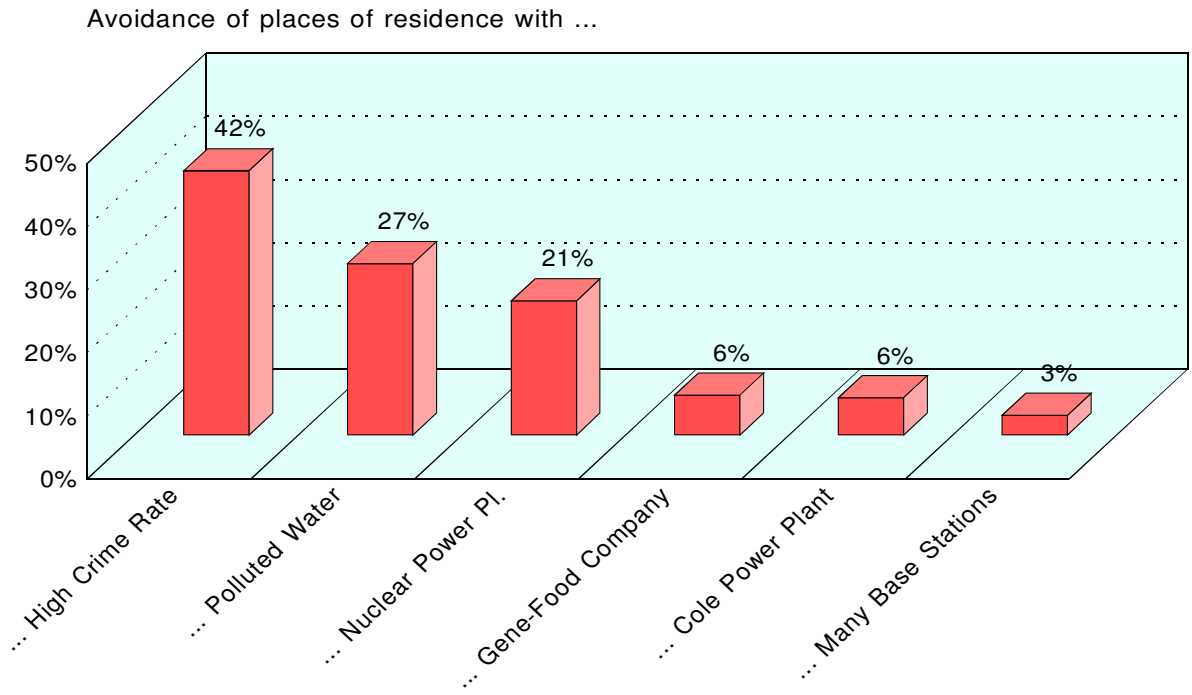
Current findings give occasion to the assumption that products which are or were suspected of being afflicted with BSE were stigmatized by a part of the population, and are being or were avoided, at least for a certain period of time. The temporary drastic decrease of beef consumption in Germany is in keeping with this assumption. According to the findings it can be assumed that genetically altered products, too, would be rejected by a considerable part of the population and stigmatized by a smaller part.

Places of residence can also be subject to the process of stigmatization. We asked: »Suppose you would have to move to another place. Be it that you are offered a dream job, be it for private reasons. Your residential area would be ideal, but unfortunately each of these places is afflicted with a certain danger«. On file cards we offered a town with a nuclear power plant, one with a coal power station, one with a company producing genetically engineered food, one with contaminated drinking water, one with many cellular network transmitting stations or with a high crime rate. The persons interviewed were to express the living place preference in a ranking order of the 6 risks. Fig. 14 shows those places evoking the highest rejection (sixth preference).

Interestingly it is the crime rate which would deter people most from moving to another place. Over 40% of those interviewed would rather avoid a place afflicted with a high crime rate. Combined with the comparatively low subjectively perceived threat from Fig. 1 this means that the majority of the people living in Baden-Württemberg do feel relatively safe, but are little inclined to move to an unsafe place. After a marked distance come places with in turn entirely different risks. If crime is in the class of social risks, contaminated drinking water would be in the risk class of the ›slow poisoning‹ type. The nuclear power plant follows in third place, probably because of its catastrophe and accident potential. Genetic engineering companies and coal power stations evoke markedly lesser aversions. Which is all the more surprising as due to both risk semantics and the type of hazard - slow, unavoidable poisoning - there are

strong parallels to contaminated drinking water. Far behind in last place finally comes the town with an particularly high number of cellular phone transmitting stations. Our findings clearly show that it is not the potential for harm which is important but rather the uncertainty surrounding the potential harm. High subjective belief in control and a fair share of personal and social benefit are more reasons to let this risk seem worth avoiding for a minority of only 3.5%.

Fig. 14: Preference of Places of Residence Afflicted with Specific Risks



Baden-Württemberg Risk Survey 2001: Person-weighted Data Set; N = 1.508
Percentages reflect the 6th (last) preference amongst the places of residence

2.3 Risk perception and assessment - attempting a synopsis

The findings represented here are complex - too manifold to reveal characteristic profiles for the various risks. Table 3 below thus ventures on an attempt of synoptically summarizing the particular, characterizing properties of each risk shown in the preceeding tables and figures. In order to gain firm clues, the original scales with seven characteristics were used and the scale mean values were compared across each dimension. Depending on the direction of the deviation, deviations exceeding ± 0.5 were marked with a **+** or **-**, deviations of more than ± 1.0 scale points with **--** and **++**.

However, the main issue is to make substantial deviations from the average easily recognizable and to clearly highlight risk-specific profiles.

Cellular phones show a distinct profile: very little knowledge combined with a low risk and medium benefit perception, all in all resulting in a positive benefit-risk balance. The risk is perceived as being distributed fairly and subjectively controllable. Its acceptability is high which is also expressed in living place preferences.

Nuclear power is experienced as an external technology whose risks people perceive as being forced upon them. However, this negative impression is largely compensated by the perception of high social and individual potential benefit, all in all leading to an average risk acceptability.

In the matter of the *global climate risk* high individual and social threat and catastrophe potentials culminate with the high individual and social benefit of motorized personal mobility. The balance of solely extreme assessments results in an average rating of acceptability and, what is also revealed later by the qualitative evaluations, an experience of high cognitive dissonance.

Genetically engineered food is revealed as a seemingly ›useless‹ undertaking: very small personal benefit and below-average social benefit with moderate hazard potentials yield a negative benefit-risk balance. Knowledge about genetically engineered food is represented as being rather poor. All in all, risk acceptability is still average; firms producing genetically engineered food are not stigmatized by the population.

BSE has the lowest rating of all: low personal benefit, unfairly distributed as well, enforced hazards and high catastrophic potential. Therefore, the persons interviewed reach an overall negative balance judgment with regard to risk acceptability.

For the two remaining risks, smoking and crime, not enough information is available to outline a clear profile. *Smoking* is represented as a risk which is taken mostly voluntarily, about which most seem to consider themselves well informed. Overall, the picture is that of a risk which is generally acceptable, especially to the smokers themselves.

Regarding the *risk of crime*, the high social hazards are emphasized. Preferences in place of residence point to low acceptability and an inclination by considerable parts of the population to stigmatize this risk.

Table 3: Synoptic representation of the determined risk profiles

Characteristic	*Risk*						
	Cellular networks	Nuclear power	Traffic Climate change	Gene-food	Intens. animal breeding/ BSE	Smo-king	Crime
Perceived threat	--	o	+	o	o	o	o
Benefit (personal)	o	+	++	--	-		
Benefit-risk balance (individual)	++	+	+	--	-		
Social hazards	--	o	+	o	o	o	+
Social benefits	o	+	+	-	o		
Benefit-risk balance (social)	++	+	o	-	-		
Catastrophe potential	--	o	+	o	+	o	
Benefit & risk justly balanced	+	o	o	o	-		
Risk is forced upon the individual	-	++	o	o	+	--	
Subjective abili-ty to influence	++	-	o	o	o		
Subjective state of knowledge	--	o	o	-	o	++	
Acceptability of risk	+	o	o	o	-	o	
Intention to avoid when selecting place of residence	--	+		- *)			++

Baden-Württemberg Risk Survey 2001. Empty squares signify that the dimensions were not surveyed. Symbols are explained in the accompanying text.
*) Company producing genetically altered food.

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3. What Makes Risks Seem Acceptable? An Empirical Comparison of Five Theoretical Approaches

(Michael M. Zwick)

3.1 Introduction

This article pursues the purpose examining the explanatory power of four prominent approaches of risk theory, as well as to examine selected sociodemographic characteristics for the acceptanbility of risks. Included in the consideration are psychometric risk characteristics, three approaches of value and cultural theory, the stigmatheoretical concept, as well as the question as to how the responsibility of, and confidence in institutions involved with risk communication, control and regulation, have an influence on the degree of risk acceptability.

The Baden-Württemberg Risk Survey 2001 works with the dependent variables of large-scale livestock production and the BSE risk associated with it, nuclear power plants, radiation exposure due to cellular network technology, the global climate change caused by individual motorized transportation, the acceptability and its risks, and criminality. For the risks of smoking a smaller set of explanatory variables and for crime even less predictors are availabe. Thus the latter was excluded from the analyses in this article. The dependent variables - the acceptability of risks - were measured on 7 point scales each.

After a short description of the most important theoretical aspects, a three-stage method will be introduced. *First*, all theory-based variables will be transformed in a way to use them in multivariate, metric procedures - be it as (approximately) metrically scaled or dummy variables. In order to obtain a rough overview of the predictors and their potential explanatory power, all multivariate analyses are accompanied by a table of bivariate correlations. In a *second* step those characteristics which are empirically most significant are selected by way of stepwise regression; this is to guarantee the relative independence of predictor variables required for regression analyses, as further highly co-linear predictor variables are excluded from the models. With regard to the concluding evaluation of the competing explanatory power of the five theoretical concepts it must be taken into consideration that they are hierarchic from a theoretical point of view. Age and sex, for example, can act as predictors for value orientations in a causal model, the converse, however, does not seem to be justifiable theoretically. *Thirdly*, due to this plausible logical hierarchization of theoretical concepts, path-analytical models seem to be a particularly appropriate analytical instrument. Because of their comparatively high transparency and simplicity and the easy calculation of the explained variance of risk acceptability of each theoretical

construct, path analysis is particularly suitable as an instrument of analysis.[1]

3.2 The psychometric paradigm

The term ›psychometric risk research‹ is somewhat misleading as it suggests a psychological theory of risk perception and evaluation. Paul Slovic, however, one of the founding fathers of psychometric risk research gives the »personality theory« stamp a completely different angle: »Borrowing from personality theory, we ... asked people to characterize the ›personality of hazards‹ by rating them on various qualities or characteristics (e.g. voluntariness, catastrophic potential, controllability, dread) that had been hypothesized to influence risk perception and acceptance... We have referred to this general approach and the theoretical framework in which it is embedded as the *psychometric paradigm*.« (1992: 119) In doing so, the working group around Slovic follows a *constructivistic* strategy of scientific empiricism: psychometric risk characteristics are not considered as ›objective‹ properties inherent in the source of danger, but are seen as a consequence of social perception and ascribing processes: risk is a social construct: »One of the most important assumptions in our approach is that risk is inherently subjective. Risk does not exist ›out there‹, independent of our minds and cultures, waiting to be measured. Human beings have invented the concept ›risk‹ to help them understand and cope with the dangers and uncertainties of life. There is no such thing as ›real risk‹ or ›objective risk‹... Nonscientists have their own models, assumptions, and subjective evaluation techniques (intuitive risk evaluation), which are sometimes very different from the scientist's methods.« (1992: 119)

In his discourses, Slovic at the same time undertakes a strategic positioning of psychometric risk characteristics: the designated properties of risks - voluntariness, damage and catastrophe potential, benefit aspects etc. - act as predictors for the evaluation of risks, but also for the extent of acceptability and the wish for control and risk minimization. On the other hand, the subjective ascription and evaluation of risk characteristics takes place on a socio-cultural background ›full of preconditions‹: Slovic explicitly points out a sensible, psycho-social and culture-specific assimilation of risk. This cultural apperception can also comprise socio-demographic characteristics, if and in as much as these describe social groups, institutions, value orientation patterns, life styles and social environments, which can influence the risk perception of the individual: »In sum, the psychometric paradigm encompasses a theoretical framework that assumes that risk is subjectively defined by individuals who may be influenced by a wide array of psychological, social, institutional, and cultural factors. The paradigm

1 On the advantages of this evaluation strategy see also Karger/Wiedemann 1998: 38.

assumes that, with appropriate design of survey instruments, many of these factors and their interrelationship can be quantified and modeled in order to illuminate the responses of individuals and their societies to the hazards that confront them.« (1992: 120)

Due to its empirical significance, empirical research based on the psychometric approach has highly influenced risk sociology. It was also able to determine a series of factors which significantly shape risk evaluation and acceptability: above all ›dread‹ - the dread of risks with a high degree of potential for damage and catastrophe -, but also a subjective feeling of being threatened and affected, the voluntariness of taking a risk or the perceived ability to control have - apart from many other risk characteristics[2] - repeatedly turned out to be particularly significant empirically (cf. Jungermann/Slovic 1993: 96ff.)

Considering the in part quite high explanatory power of some psychometric risk characteristics - above all those connected with the factor ›dread‹ -, it are rather the conceptional and theoretical problems involved with this approach which become the focus of criticism. Severe is, for one, the empirical openness, not to say ›arbitrariness‹, in the discovery of ever new risk characteristics. For another, it is the particularly high explanatory power of the dread factor which can cause a headache: in the strictly constructivistic perspective, the term risk remains intentionally open, resulting in a suspected tautology between dread-risk and risk which entails the consequence »that dread is not a determinant of perceived risk, but a different measure of perceived risk which focuses more on the affective dimension in risk perception. Thus dread would be a consequence (as is perceived risk) of the various characteristics... One could also assume that dread and perceived risk may mutually influence each other.« (Schütz/Wiedemann/Gray 2000: 6)

Bivariate findings for the psychometric approach

Table 1 shows nine psychometric risk characteristics and their bivariate correlation to the acceptability of six risks.[3]

2 One of the points of criticism of the psychometric paradigm is the almost ›arbitrariness‹ and abundance of characteristics, which curtail the theoretical yield, but above all the reproducability of results. An overview of those risk characteristics researched so far, which can be subsumed under the psychometric paradigm, is offered by Bobis-Seidenschwanz/Wiedemann 1993: 13 or Renn/Zwick 1997: 92.

3 Due to the high case numbers almost all effects become highly significant statistically ($\alpha << 0.05$), so that the significance level is provided only in those cases where $\alpha \geq 0.05$. For the same reason much more emphasis is put on the potency of correlations.

In defiance of the semantic variation of the selected risks, everything points to a high correlation between the perception of social damage and catastrophe potentials on the one hand, and the acceptability of risks on the other: in all examined risks the perceived catastrophe potential and the extent of social damage potentials show the highest bivariate correlations [r] by far. Incidentally, the special significance of global and social damage for risk acceptability is among the earliest results of cognitive risk research. As early as in 1969 Starr pointed out that »the public acceptance of risks is inversely proportional to the number of individuals affected by damage«. In contrast, the correlation between individual controllability and the subjective state of knowledge about risks and their acceptability is quite low.

Table 1: Public Acceptability of Various Risks According to Selected Psychometric Variables

Characteristic	*Acceptability of the risk of ... [r]*					
	BSE	Nucl. power	Mobile teleph.	Gene-food	Climate change	Smo-king[2)]
Catastrophe potential	**-.54**	**-.62**	**-.51**	**-.62**	**-.40**	**-.54**
Social hazard potentials	**-.51**	**-.59**	**-.48**	**-.61**	**-.36**	**-.55**
Subject. perceived threat	-.15	-.48	-.30	-.44	-.25	-.38
Personal benefit[1)]	.29	.35	.33	.45	.17	
Social benefit[1)]	.28	.42	.23	.47	.23	
Enforced Risk	-.38	-.27	-.19	-.40	-.21	-.44
Risks and benefits are distributed unfair	-.38	-.45	-.35	-.41	-.28	
No controllability	-.22	-.15	-.12	-.20	-.04	
Subject. state of knowledge	-.02[3)]	-.19	.02[3)]	.08	-.17	-.16

Baden-Württemberg Risk Survey 2001; person-weighted data set; N = 1.508

1) Large-scale livestock production was offered as benefit aspect for BSE, and individual motorized transportation as benefit for global climate change

2) Empty cells: the characteristic was not included in the survey

3) The effect is not statistically significant

The dimensions of psychometric risk characteristics

As far as analytical factors are concerned, predictor variables are split into three components. Firstly the perceived dread of risks. This factor is constituted by the

degree of individually perceived threat and the perception of social damage and catastrophe potentials. In each of the five risks[4], Factor 1 is associated the strongest with risk acceptability (-.40 < r < -.46).

Factor 2 comprises *control* and aspects of social *fairness of distribution* when dealing with risks: The question of whether risks are enforced or taken voluntarily, whether benefits and detriments are fairly distributed and to what extent risks can be influenced by the individual. In a first attempt, the state of knowledge was included and entered into this second factor. However, ›knowledge‹ considerably impaired the quality of factor analysis, so that this variable was ultimately excluded. As opposed to Factor 1, the acceptability of the various risks markedly varies with Factor 2: low correlation between control and acceptability is found for BSE and climate change (-.17 < r < -.22), clear correlation for nuclear power, cellular network technology and genetically altered food risks (-.30 < r < -.32).

Factor 3 ›*benefit*‹ - unites the perception of personal and social benefit potentials. It does not vary significantly with the acceptability of the BSE risk and varies moderately (.29 < r < .42) for mobile telephonee, nuclear power, climate change and genetically altered food.

The benefit gained from factor analysis is that several psychometric risk characteristics can be reduced to a few - theoretically and empirically - conclusive dimensions. It is surprising - and contrary to Slovic's own findings (1992: 123), that our own set of data yields three instead of two factors with Slovic, and that Slovic's Factor 2 »*unknown Risk*« cannot be reproduced. Subjective knowledge even had to be excluded from the model. Due to the multitude of variables included in factor analysis, case numbers also suffered greatly (N ≈ 660), so that in subsequent multivariate analyses the initital variables were used for calculations.

3.3 The acceptability of stigmatized risks[5]

Since ancient times, stigma expresses a one-sided, negative label that encompasses one or several characteristics, referring to things or persons. As a rule, the process of stigmatization is not the result of cognitive balancing processes aiming at a factually balanced judgment, but rather a ›short-circuited‹ derogatory generalization based on one or several striking characteristics (cf. Goffman 1968). Seen in this way, stigma is

4 Due to a smaller set of surveyed predictors smoking was excluded from factor analysis.

5 I want to thank Marcus Abel and Martin Bone, who contributed to this chapter.

not so much the characteristic of an object or a place, but the result of a social perception and evaluation process. If this *ascription* process is successful it entails far-reaching consequences for the behavior of the stigma carrier. Stigma can be understood as the antithesis of priviligization, as well as the opposite to differentiation.

During the past two decades stigmatheoretical approaches have been used increasingly in risk and technology sociology, such as for answering the question under what conditions technical facilities, certain products or places are judged excessively negatively or even avoided altogether (Gregory et al. 1995). Stigmatization can be understood as concomitant of industrial modernization processes, as they create increasingly complex knowledge, ever new technologies and as a result ever new risks. According to Sjöberg (1998) the tremendous differentiation of scientific and technological knowledge has led to the understanding that risk experts and laymen seem to live in two different worlds. On the one side there are experts with highly specialized, complex knowledge, on the other side is a lay public whose need for unambiguous, dependable knowledge about the consequences of (technical) risks on the envirnoment, health and society is not satisfied. With the increasing complexity of facts, the scientific and media institutions involved in risk determination and communication create uncertainty and insecurity. If, however, only insufficient or even contradicting expert opinions[6] on the effects and consequences of new technologies and risks are heard, this might encourage insecurity, create fear and possibly the inclination towards a one-sided derogatory judgment or stigmatization of risk sources. Stigma then is not about risk characteristics ›in themselves‹, but about subjective evaluation based on symbolic perception.

One can speak of stigma when technologies, products or places are suddenly considered excessively dangerous due to specific risks or past harmful events. The proneness to stigmatize varies with the dread of the risk, namely if a high degree of harm or catastrophe potentials are assumed in products, technologies or regions, potentials which trigger great fears of the looming danger: »The source of the stigma is a hazard with characteristics, such as dread consequences and involuntary exposure, that typically contribute to high perceptions of risk.« (Gregory et al. 1995: 221) One can assume that the probability of stigmatization will increase with the perception of personal threat.

Stigmatization can also occur when positive expectations turn into disappointment or when the benefit-risk ratio deteriorates drastically. Dramatic image losses of technolo-

6 Siegrist pointedly formulates the experts' dilemma: »Experts rarely agree. For every expert opinion, there is another expert who will be of the opposite opinion.« (2001: 9)

gies, products or places can be triggered by accidents or other events, which put a bad light on a risk source. In cases of carelessness and scandals when handling risk material, the persons and institutions entrusted with risk management, can also affect the risk evaluation of the lay individual: »This initial event sends a strong signal of abnormal risk« (Gregory et al. 1995: 222) But also unsuccessful risk management or risk communication can favor stigma formation. A study by Flynn shows how an unsuccessful image campaign for an ultimate nuclear waste storage facility in Nevada lead to the stigmatization of the project, resulting in far-reaching consequences for its acceptability in the public (Flynn 1992). Stigmatization can be a result of losses of confidence, for instance when risk management seems insufficient and the involved institutions or actors seem unreliable or incompetent. Hence, stigmatization is neither an inherent risk characteristic nor an inevitable consequence of industrial progress, but a possible consequence which can ensue when prestige, high expectations or optimism are disappointed.

The significance of the *subjectively perceived threat* of risk sources as well as the fact that stigmatization processes represent the opposite of differentiated perception and evaluation emphasize that stigmatization relies less on cognitive, but mainly on emotional and affective processes, like oversubtle fears: »Stigma is the outcome of widespread fears and perceptions of risk, lack of trust in management of technological hazards and concerns about the equitable distribution of the benefits and costs of technology.« (Gregory et al. 1995: 222)

Stigma causes avoidance behavior as the main effect: avoidance of *places* close to high-risk technical facilities or places which are ascribed a high crime rate - of *products*, such as genetically altered food, meat products suspected of being BSE-contaminated, or of *technologies* - this could be locations with nuclear power facilities or within the immediate vicinity of cellular network transmission stations. What seems important in all cases is that stigma tends to be coded *binarily* by the stigmatizing subject due to a lack of differentiated perception and evaluation: either person X stigmatizes object Y or he or she does not. On a collective level, however, other points of view take effect: there will be individuals who will be inclined - due to whatever dispositions - to react emotionally - anxiously, panicky - and to stigmatize; individuals of fearless nature will only be inclined to stigmatize in very drastic cases of accidents and loss of life, and again other individuals will not stigmatize at all concerning certain sources of risk. It could be assumed for example, that microbiologists do not perceive genetically altered food as being threatening. Realistically, this means that it cannot be counted on that sources of risk are labelled equally by all interviewees. If stigmatization processes are to be investigated it is important to examine which risk is stigmatized to what quantitative extent.

Operationalization of stigma

These considerations caused us to use various stigma indicators in the survey instrument.

Due to the symbolic perception of risk it was attempted to present the individual risks in two variants by means of the split-half method: one on a card which only read the name of the risk in print, e.g. ›nuclear power plant‹. The other variant showed an image depicting a nuclear power plant, in addition to the printed word. With each risk it was attempted to select the most neutral possible stimuli in order to avoid suggestive effects: if person X is prone to stigmatize object Y, then a weak optical stimulus should suffice to trigger aversive emotions and generalized reactions. The cards are shown in the appendix, at the end of the survey instrument.

These concisely-put theoretical arguments were to substantiate the theoretical arguments that it must be possible to represent stigmatization processes by a mathematical step function: they are based on a whole series of psychometric risk characteristics, which however are not treated with balancing but with binary thought processes. Thus, stigma touches upon the pejorative risk explained in the descriptive section above: a risk, which is subjectively perceived as highly threatening and not in control, a risk holding high potential for social harm and catastrophe, whose risk seems enforced, whose risks and benefits seem unfairly distributed in the extreme, where neither individual nor collective benefit aspects can be recognized and where little subjective knowledge is available. The acceptability of risks, on the other hand, can be understood as a balancing judgment - it is quasi the test case against which a hypothesis must be measured revealing whether those persons considering a risk as extremely pejoratively also consider this risk as absolutely unacceptable or not. Thus, a total of nine psychometric characteristics enter into the indicator for pejorative risks, as explained in the descriptive section above, except that in the case of stigma the indicator to be formed is not additive but logical: we will then speak of stigma when a risk is judged negatively in *all nine dimensions* with at least 6 out of a maximum of 7 points. To this end, it was counted for each person and each risk, how often one of the two extreme scale points were perceived or ascribed to negative charateristics. If the sum is ›9‹, this means that person X highly or very highly depreciates risk Y in all dimensions and stigmatizes it in the sense of a generalized judgment.[7] This showed that only two risks were stigmatized at all: genetically altered food was stigmatized on the basis of our definition by eight interviewees, climate change by two interviewees. Due to the extremely low case numbers it does not seem promising to use

7 Inverse coding of questions 26, 27 and 32 was considered accordingly.

these variables in multivariate models.

Poor institutional performance in risk management and communication as well as non-existent trust in actors and institutions were intentionally not considered in the construction of the indicators, as these variables are applied within the framework of their own ›trust-based‹ approach. Dual utilization would result in tautological conclusions in the multivariate model. It is obvious however, that in the ›causal‹ structure model stigma and trust dimensions must be very close.

Additionally, however, stigmatizing effects can also occur when minor events are interpreted as being the tip of the iceberg. Here it must be taken into account that the perception of risks as the tip of the iceberg can be interpreted as a ›foreboding‹ of even far worse instances of harm in the future, but also as a loss of confidence in the honesty of risk communicators, namely that far worse harm is hushed up according to the motto: »at no time was the population exposed to any hazard«. However, questions such as these were only surveyed for nuclear power facilities and genetic engineering laboratories. In order to guarantee the comparability of as many risks as possible, the ›tip of the iceberg‹ was therefore not included in the indicator for pejorative risks, but listed separately in the subsequent table.

Dependent variables

The acceptability of risks again functions as dependent variable, considered as a global balancing judgment of all kinds of relevant influencing parameters: in its result stigmatization is to be considered equal to the uncompromising rejection of a source of risk.

As a consequence, the avoidance of places can go along with stigmatization and the strict rejection of risks. As explained in the descriptive section, the interviewees were asked for a ranking of places having a particular risk, a nuclear power plant, a coal-based power station, numerous cellular network transmitting stations, bad drinking water, a company producing genetically altered food or a place with a particularly high crime rate. The interviewees had to give six different preferences. Strictly speaking stigma would have meant that a place would ›under no circumstances‹ be chosen as a place to live due to a risk. As it cannot be excluded, however, that interviewees attach a stigma to several risks it seems inappropriate to equate stigma with the least-favoured place of residence. The variables of question 34 were thus explicitly introduced as predictors. In the question of place of residence, the relevance and comparability of risks are a problem, as there are no other characteristics of risk perception for coal-based power and contaminated drinking water, crime has only a

restricted set of psychometric variables and the evaluation of genetically altered food does not coincide with the avoidance of a place where a company producing genetically altered food is located. Thus it can be assumed from the outset that the place of residence ranking is rather of descriptive and heuristic than of analytical value.

Bivariate findings on the stigmatheoretical approach

In contrast to the psychometric risk characteristics, the explanatory power of our stigma-theoretical variables is relatively poor. Merely where the question of the acceptability of nuclear power is concerned, does a stigma-relevant variable show substantial explanatory potential: If, in the case of minor incidents, individuals assume the hushing up of far greater harm or interpret these as forebodings of future accidents causing more extensive harm, then these individuals are inclined to consider this technology as not acceptable (table 2).

As assumed, the stigma indicator does not provide satisfactory results due to asymmetrical distribution of a variable. The split-half method does not fare much better: with BSE, nuclear power and cellular networks the coefficients even indicate an inverse correlation, i.e. the cards with optical stimuli even triggered a weak ›appeasing effect‹. Only with genetic engineering the effect, although weak, points in the expected direction, but it seems too insignificant to provide an explanatory potential in the multivariate model.

Only little data exists on the analysis of the intention to avoid locations. Here, too, nuclear power plays the only role worth mentioning: The relatively marked ›tip-of-the-iceberg effect‹ shows that a part of the public assumes - based on the acknowledgement of a happened ›small accident‹ - much more serious consequences and therefore avoids the vicinity of nuclear power plants as a place of residence. A similar picture applies for those individuals strongly rejecting nuclear power plants (last row in Table 2).

The unsatisfactory results do not mean, however, that stigma theory is an explanatory concept unsuitable for risk evaluation and the avoidance of sources of risk. The empirical power of explanation which a theory can unfold in our case is dependent on the selection of risks and on the time the survey was carried out. It could well have been that just three months earlier the BSE risk would have had a completely different result. Also, an accident in a nuclear power plant could have caused a highly sensitive response, which is shown by the tip-of-the-iceberg variable. Furthermore, there are altogether far fewer predictor variables, some of which are incomplete or incompatible, leaving additional, potentially highly explanatory correlations in the dark.

Table 2: Acceptability of Various Risks and Avoidance of Places of Residence According to Stigmatheoretical Variables[1)]

Characteristic	*1. Acceptability of the risk of ... [r]*					
	BSE	Nuclear power	Mobile telephonee	Genefood	Climate change	Smoking
Split-half	-.14	-.07	-.03[2)]	.15	.04[2)]	.01[2)]
Stigma indicator	0	0	0	-.09	-.04[2)]	0
Tip of the iceberg		**.39**				
Characteristic	*2. Avoidance of a place or residence having ... [r]*					
	a high crime rate	a nuclear power plant	many base stations	a gene-food-com-pany		
Split-half	-.04[2)]	.03[2)]	.10	.04[2)]		
Stigma indicator		0	0	.03[2)]		
Tip of the iceberg		**-.34**		-.16		
Rejection of the risk		**-.47**	-.06			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508

1) Empty cells: The characteristic was not included in the survey

2) The effect is not statistically significant

Finally, the question of how much explanatory power a theoretical concept can unfold, depends on its theoretical rigidity, but also on a successful operationalization. Where stigma is concerned, the theory suggests a highly ›rigid‹ indicator formation: as the generalized judgments are not balancing but ›eccentric‹, it is necessary that a whole series of psychometric variables *simultaneously* suggest a pejorative risk perception and evaluation. The asymmetrical distribution of the stigma indicator must consequently be interpreted as the non-stigmatization of risks. The case is different with the split-half method: here the question does indeed arise whether operationalization was successful, as ultimately images are always suggestive - compared to mere printed text they can conjure up dreadful images, or they can appease. On the whole, split-half has yielded unsystematic results of which some contradicted the hypotheses, altogether it did not provide any substantial results. Only the tip-of-the-iceberg effect could be recommended for use in the multivariate models to ›explain‹ risk acceptability in the case of nuclear power utilization.

3.4 The influence of responsibility, institutional performance and confidence in the acceptability of risks

Despite the »erosion of generalized trust« (Siegrist 2001: 28) that has become apparent in the past decades due to modernization, and that the public has less confidence in state institutions and their representatives (cf. Kasperson et al. 1992), but also in other people (cf. Inglehart 1999), trust is nevertheless ascribed an important filtering function in the perception and evaluation of risks. The assumption seems plausible that, above all in those cases where hazards are assumed as being enforced from the outside, actors and institutions are sought for which will be made responsible for safety, regulation and control, but also for contingency measures and, if necessary, for compensation. In the case of those risks which are held in the public eye with great uncertainty and insecurity, it will have to be expected that the institutions entrusted with risk expertise and communication - scientists, experts, the media - will be held responsible. Trust is linked to responsibility or the ascription of responsibility: risks about which we are very well informed, over which we ourselves have exclusive control - smoking, free-climbing etc. - will play just as small a role in responsibility and trust variables as in completely contingent harmful events with unforeseen consequences - e.g. a meteorite strike. In the latter case responsibilities could at best be construed in the form of general precautionary and catastrophe management measures.

Trust has the function of guaranteeing assured actions and orientation even in cases of complex and unpredictable situations. This aspect, which focuses mainly on trust being a strategy for the reduction of complexity, was pointed out by Luhmann (2000). From this the working hypothesis can be derived that trust, as a surrogate for certainty, will become effective as a perception filter in all those instances where uncertainty about risks, their origin and their management prevails. If this assumption, that trust is a surrogate for knowledge, is sound, then it could be expected that trust always occurs as a particularly strong predictor for the acceptability of risks in those cases, or partial correlations, where there is a lack of subjective knowledge.

However, nothing has been said yet about how trust is accomplished. »The numerous publications on trust ... illustrate, that there is no homogenous point-of-view. Varying conceptualizations of trust do not exist only inter-disciplinarily, but also within one field of research.« (Siegrist 2001: 3).

The simplest psychological concept defines trust as a characteristic of personality (cf. Rotter 1980). Here, trust is understood as confidence, or generalized faith: »Certain individuals show a stronger inclination to trust than other individuals.« (Siegrist 2001:

28). Conceptionally this generalized faith differs from social or ›active‹ confidence by the aspect that is does not basically result from repeated social interaction, where the ›other party‹ proves to be responsible, reliable, credible, in short, to be ›trustworthy‹, over longer periods of time. »Active trust arises only after considerable effort and must be kept alive.« (Giddens 1996: 319). Faith, just like socially acquired trust, can be disappointed and destroyed, but its origin is »preconditionless«, so-to-speak a deposit of trust uncovered by social interaction. In the data set at hand generalized confidence was operationalized as follows: »There are many people who are very trusting from the outset, others are very suspicious. How would you judge yourself in this respect?« The interviewees could express their opinion on a scale of 7.

Social trust

Social trust is acquired actively in a repeating mutual process. In contrast to confidence, it is based on continued experience distinguished by certain qualities, e.g. credibility, honesty, reliability, a feeling of responsibility etc. According to Slovic (1993) social trust has a highly asymmetric structure: it is difficult to acquire and takes a long time to do so, if it is disapppointed once it can be destroyed quickly and thoroughly.

The case of institution-related trust, which is much more interesting for risk perception, is even more problematic. For one because of the fact that »in some contexts we have no other way to decide than to make a decision relying upon expert knowledge which we have gained from entirely varying sources.« (Giddens 1996: 321) The first dilemma is that with progressively abstract technologies and thus increasingly ambient hazards, we know even less about a growing number of risks. We are forced to rely on the conscientiousness and responsibility of designers and operators of technical facilities, and ultimately on the professionalism and thoroughness of actors in the political-administrative sector when dealing with the regulation and control of risks. The second dilemma emerges from the asymmetry of communication: unlike with interpersonal social relationships, the information exchange between individuals and institutions is based on a different pattern, where the concrete actors can frequently only be perceived sporadically by way of official statements or the media, at times they even remain hidden entirely. Considering these asymmetrical communication processes, what does trust consist of here and how can it be reproduced?

Trust as specific institutional performance

It is the merit of Hans Kastenholz - who has supported the project in all questions concerning trust - of having made trust-relevant characteristics accessible to risk research by skillful operationalization. Unlike interpersonal behavior with its sym-

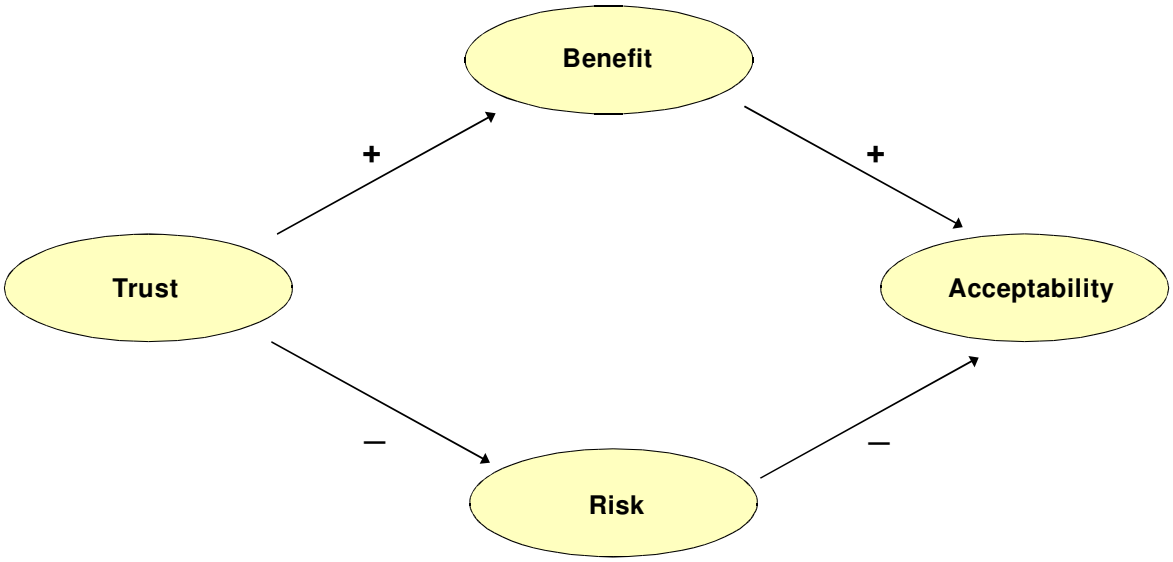
metrical interaction structures, where trust can grow and develop from a mutual exchange process which can be experienced by the individual's senses, institutional trust is based on the perception and evaluation of *specific performance*: social institutions - industry, politics and authorities, the media, science and experts, but also environmental and consumer agencies - fulfill specific functions respectively, where the origin, research and communication, regulation and control of risks is concerned. According to his opinion, trust is not based on ›vague‹ faith, but, more robustly, on experienced performance, based upon which trust is granted or withdrawn.

In this model, performance is not an objective characteristic of achievement of an institution, rather likewise a social construct, based on a process of subjective perception and ascription. Thus, trust is placed at a distance from knowledge, particularly from ›objective factual knowledge‹: it is not risk-specific or technical knowledge of details, but the subjective evaluation of the performance of institutions which determines in how far risks are perceived, and to what extent they are acceptable.

The concept of performance-based institutional trust has far-reaching consequences for the strategic position of the trust concept in the ›causal structure‹ of risk evaluation: trust stands behind the psychometric risk characteristics as a filter for the evaluation of risk characteristics but also the acceptability of risks, and not between psychometric risk characteristics and risk acceptability. Siegrist comments on this as follows: »According to this model, social trust has a positive effect on the perceived benefit and a negative one on the perceived risks. The acceptance of a technology is thus influenced indirectly by social trust. Acceptance is a direct function of the perceived risks and of the perceived benefit.« (Siegrist 2001: 24). Siegrist illustrates this with the model shown in Fig. 1.

It is obvious that this model can also be used in the same way for risk acceptability: the quality of institutional trust can expose the relationship between psychometric risk characteristics and the acceptability of risks as a complete or partial fictitious correlation. The intensity of the trust effect to be expected is a negative function of the subjective state of knowledge, but above all a positive function of the degree of institutional responsibility for certain risks.

Fig. 1: Trust Influencing the Perception and Acceptability of Technology



Siegrist, M. 2001: Die Bedeutung von Vertrauen bei der Wahrnehmung und Bewertung von Risiken: 24.

The operationalization of responsibility and performance-related trust

The operationalization of responsibility was rather simple: For each risk, the interviewees obtained a list containing six institutions or actors and one residual category. They were to assess, who has the main and who the second highest responsibility for the task that »citizens are not exposed to unacceptable consequences due to a particular risk«. This procedure was repeated for six risks (questions 49 with 54).

The operationalization of trust and performance criteria turned out to be far more complex, as not only risks had to be differentiated but also institutions and performance criteria. Hence, risks were restricted to genetically altered food, cellular network transmitting stations, BSE and global climate change. For institutions or institutional actors the following were selected:[8] media (clarity and balanced reporting), scientists (independence; assuming responsibility for the consequences of their work), politicians (risk prevention; sensitive towards the concerns of the public), authorities (reliability

8 The relevant performance criteria are included in brackets after each institution.

of legal controls), environmental and consumer agencies (factually correct information; supporting the public) and industry (safety measures for the prevention of risks; sensitive towards the concerns of the public). The question set comprises a total of 44 items (questions 36 with 41 and 44 with 48).

Bivariate findings on the trust-theoretical approach

The degree of acceptability of risks is almost completely independent of the ascription of responsibility to institutions or actors. A similar stance applies to the subjective state of knowledge. Merely the risk of nuclear power and global climate change seems even more unacceptable to the above-averagely informed. But the correlation is not particularly high (Table 3a).

Compared to that, the acceptability of risks is to a considerable degree dependent on the perceived performance of, resp. the trust in institutions: the influence of perceived media performance on risk perception is relatively low, the effects exerted by scientists, environmental and consumer agencies are higher, and the performance of politics, authorities and the industry influences risk acceptability even more.

Looking at the considered risks it is notable that the influence of institutional performance on risk evaluation varies; it is rather moderate where BSE is concerned, a risk perceived to be already highly regulated. The same is true for the climate risk - whose global character probably reduces national institutions‘ competence to resolve it. Where the risk of cellular network technology is concerned, however, and even more so where genetically altered food is concerned, the performance of institutions is scrutinized with particular intensity. In contrast to BSE these are ›creeping‹ risks, whose regulation a) is the responsibility of the individual countries, where b) politics and industry exert full control, by licensing or prohibition, or by allowing or banning the specific products and c) their hazards cannot be considered as ultimately regulated - there are still heated discussions about the risk of cellular network technology in some places, genetically altered food is not a current, but a latent ›problem‹.

Table 3b looks at the question of whether the hypotheses are correct, that the effect of institutional trust on the willingness to accept risks is the greater, the lower the knowledge of risks - trust as knowledge surrogate - or the higher is considered the institutional responsibility for a risk.

Table 3a: The Acceptability of Various Risks According to Selected Characteristics of Trust Theory

Characteristic	*Acceptability of the risk of ... [r]*					
	Controlling for ...[3)]	BSE	Nuclear-power[4)]	Mobile telephonee	Genefood	Climate change
Deposit of trust (confidence)		.11	.12	.08	.12	.03[2)]
Responsibility[1)]						
- Industry/Producers		-.07	.06	-.00[2)]	.08	.12
- Every individual himself		.13	-.02[2)]	.04[2)]	.03[2)]	-.01[2)]
- Media		.10	-.03[2)]	-.07	-.02[2)]	-.03[2)]
- Politics/Authorities		-.14	-.08	.03[2)]	-.08	-.06
- Environment.-/Consumers agencies		-.02[2)]	-.02[2)]	-.10	-.02[2)]	-.09
- Science/Experts		.08	.04[2)]	.03[2)]	-.00[2)]	.04[2)]
- No-one		-.02[2)]	.04[2)]	.02[2)]	-.01[2)]	.00[2)]
Subject. state of knowledge		-.02[2)]	-.19	.02[2)]	.08	-.17
Performance						
- Media		.02[2)]		.18	.24	.01[2)]
- Scientists		.17		**.33**	**.41**	.16
- Politicians/Authorities		.25		**.37**	**.46**	.23
- Environment.-/Consumers agencies		.10		.24	.32	.12
- Industry		.29		**.39**	**.48**	.23

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508

1) The highest and second highest responsibility were codes as ›1 = highly responsible‹, ›no explicit opinion‹ to 0.

2) The effect is statistically not significant

3) Table 3a does not yet contain controlling variables.

4) Empty cells: The characteristic was not included in the survey

At first sight, Table 3b shows a complex situation - and the two hypotheses do indeed require a certain revision: institutional trust mainly has an effect on the acceptability of risks in those cases where knowledge about risks is low, applies only in those instances and to those institutions which are responsible for risk-specific knowledge and its communication: science - only genetically altered food makes an exception here - the media and - as with the risk of cellular network technology and genetically altered food - also industry.

Table 3b: The Acceptability of Various Risks According to Institutional Performance, Controlling for Subjective State of Knowledge and Institutional Responsibility

Characteristic Performance of ...	*Acceptability of the risk of ... [r]*				
	Controlling for ...[1)]	BSE	Mobile telephonee	Genefood	Climate change
- Media		**.02**[2)]	**.18**	**.24**	**.01**[2)]
	w-	.11	.18	.30	.16
	w+	-.02[*)]	.15	.14	-.00[2)]
	v-	.02[*)]	.17	.25	.01[*)]
	v+	.02[*)]	.22	.10[*)]	-.37
- Scientists		**.17**	**.33**	**.41**	**.16**
	w-	.20	.35	.40	.24
	w+	.15	.27	.42	.15
	v-	.11	.32	.44	.14
	v+	.32	.33	.38	.19
- Politicians/Authorities		**.25**	**.37**	**.46**	**.23**
	w-	.23	.34	.46	.19
	w+	.27	.41	.46	.26
	v-	.21	.34	.42	.24
	v+	.27	.43	.52	.23
- Environment.-/Consumers agencies		**.10**	**.24**	**.32**	**.12**
	w-	.17	.21	.34	.24
	w+	.08	.31	.27	.11
	v-	.07	.22	.26	.04[*)]
	v+	.21	.30	.51	.31
- Industry		**.29**	**.39**	**.48**	**.23**
	w-	.28	.33	.43	.23
	w+	.30	.50	.54	.23
	v-	.34	.33	.52	.26
	v+	.28	.41	.46	.22

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508

1) v+: highest and second highest responsibility
v-: no perceived responsibility.
w+: high subjective state of knowledge (scale values 5,6,7)
w-: low subjective state of knowledge (scale values 1,2,3,4)

2) The effect is statistically not significant

The hypothesis that trust is a surrogate for knowledge is therefore overgeneralized. Much more important is what is considered the risk-specific task and performance of an institution. If it concerns the supply of knowledge and risk communication, this assumption is largely correct; if the focus is on risk management, control and prevention, this hypothesis does not hold. The latter is particularly true for politics and authorities, but also for environmental and consumer agencies.

Also, the assumption that the influence of the perceived institutional performance on risk acceptability is the higher, the greater the responsibility of an institution is assessed, does not apply unreservedly: only with environmental and consumer agencies and, with the exception of the climate risk, politics and authorities, it can be found as a regular pattern. With the responsibility ascribed to them, the performance influence of producers and operators of cellular networks on risk acceptability also increases.

Even if the two hypotheses cannot be completely ruled out, the suspicion presents itself - at least where the two as yet unregulated risks of genetically altered food and cellular networks are concerned - that in the assessment of institutional performance the degree of responsibility is included in the evaluation, as a syndrome; but also the performance of providing information and risk communication - these could also be considered performance criteria. E.g., it is notable that in all risks listed in Table 3a the performance of *politics* and *industry* has the highest influence on risk acceptability; but it are also those two institutions which were burdened with responsibilty by far by the most interviewees - as can be seen in the descriptive section in Table 1.

Finally, Table 3a shows that the psychological concept of confidence - in this case operationalized by the question of whether individuals are generally more inclined to be suspicious or trusting - correlates significantly with risk acceptability, however, the effects are markedly weaker than the sociological construct of a performance-based concept of specific institutional trust.

3.5 Value orientations and culture types as predictors of risk perception and evaluation

Individuals assess, decide and act on the basis of their subjective perception and interpretation of the world. In this process, value convictions or world views perform an important selection and filtering function. This is also true for the handling of risks. People have a tendency to integrate new information - which always must be interpreted subjectively - into already existing convictions with as little contradiction as

possible (cf. Siegrist 2001: 18). But not only processes of ›selective perception‹ and ›perception emphasizing‹ are carried out on a background of normative dispositions - for people values quite generally fulfill an orientation function, and they help assess situations.

Values are acquired within the ›biographic accumulation of experience‹. (Alheit/ Hoerning 1989) As a rule, they are anchored much more deeply within the personality than opinions or attitudes, and cannot be manipulated as easily from the outside. »Within the personality system, values possess a relative high consistency, persistence and resistance. They can be understood as central normative selection and control agencies, which focus and accentuate perception, help provide orientation and make it possible to create judgements, all being based on those aspects which are important, valuable and desirable to an individual. However, it must be noted that no determination can be assumed between values on the one hand and decision-making and behaviour on the other hand. Depending on the specific situation and context, various values and interests, but also moods and emotions and not least contingency can influence decisions. Most precisely, values can be described as *predispositions* for decisions and actions«. (Zwick 1998a: 6f.)

Disagreement exists about the theoretical focus of values, also about their ability to be operationalized and measured. Our data set contains two value scales. For one, the well-known Value Change Theory by Ronald Inglehart (1977), for another a more recent and somewhat more differentiating concept by Michael Zwick (1998a), which is based on six different value orientation patterns.

3.5.1 Inglehart's theory of changing values

Inglehart's approach is based on four simple hypotheses: According to the ›marginal-benefit hypothesis‹ known from economics, values are defined through scarcity. Goods which are scarce are considered valuable. Based on the socialization hypothesis Inglehart assumes that the individual's sensitivity for acquiring values varies with different phases of their lives. With regard to politically relevant value attitudes, Inglehart presumes the phase of adolescence as being a particularly influential period. He calls the period between 14 and 20 years of age the »formative years«. Whatever is perceived as being scarce in adolescence is promoted to value, due to his theory. According to Inglehart these values are maintained throughout one's whole life. Using Maslow's ›*hierarchy of needs*‹ (1970) Inglehart infers that there is a ›logical‹ *sequence of values*, whereby he reinterprets Maslow's hierarchy as a sequence of values: only those individuals whose material and security needs are safely guaranteed to a high level

will internalize ›higher-valent‹, participative, intellectual-aesthetic values oriented to quality of living and self-fulfillment. Inglehart calls these ›post-materialistic‹ values. Values thus reflect the socio-economic conditions prevailing at the time of adolescence. Finally he instrumentalizes the theory of generation-succession of Karl Mannheim (1964), who assumes the existance of different age-group cohorts in society imprinted by varying »collective historical experiences«. Due to the gradual ›dying‹ of the old war generation - i.e. individuals who as a result of the specific socialization conditions during their adolescence have adopted materialistic values - and the continuous succession of age cohorts socialized in the prosperous post-war period, materialistic values are being replaced by post-materialistic ones at a creeping rate, but with radical consequences.

Inglehart proposes a ranking method for the measurement of values and offers two variants. His set of questions comprising four items which we also used in our data set (question 29) achieved the highest prominence. Materialists are those individuals selecting the two items »maintenance of law and order in this country« and »fight against rising prices« with first or second priority, post-materialist are those who put the first two preferences as »more citizens' influence in government decisions« and »protect the right to free speech«. Those who select one materialistic and one post-materialistic item with first and second priority respectively are so-called ›mixed types‹.[9] An obvious advantage of this typology is its metric scale quality: under the first two preference types, materialists have two, mixed types one and post-materialists zero materialist items. Thus, the Inglehart indicator can be directly applied to metric models as a predictor variable.

3.5.2 Value orientation patterns by Zwick

Starting point of the considerations of developing an own, ›new‹ indicator was the growing dissatisfaction with the Inglehart approach. Above all the, over the years, excessively growing proportions of mixed types - 59.7% in our data set - which are excluded from theoretical statements resulting in a gradual decrease of theoretical and empirical explanatory power, made a reorientation seem essential. For one, problems of operationalization hide behind these high proportions of mixed types: that the »fight against rising prices« does not so much measure a value but reflect the country's economic situation should be obvious. For another, the theoretical focus on *politically*

9 Inglehart's theoretical concept, but above all its operationalization, caused criticism and controversies ongoing to the present day. We will not go into detail about them here, they did not diminish the concept's popularity. As an example see also Lehner 1979, Herz 1979, more detailed: Alheit a.o. 1994: 4.1.

relevant value attitudes turns out to be a possible pitfall: in times of growing individualization and sociocultural differentiation and de-politicalization processes, politics play an ever more insignificant role to an increasing number of people.[10] A new indicator would have to take into consideration socio-cultural differentiation beyond politics. 60 percent of mixed types are a clear signal for the fact that the intentional simplicity of his typology, which ultimately only is to differentiate between two theoretically founded clusters - materialists and postmaterialists -, threatens to become obsolete in a world characterized by the differentiation and pluralization of values, life styles and milieus.

In his type formation Zwick, unlike Inglehart, did not use a deductive procedure of a ›theoretically closed‹ link of medium-range theories. To him it was far more important to develop a typology in the process of an inductive, ›grounded theory‹ (Glaser/ Strauss 1979). Using theoretical sampling, 48 persons were progressively selected and textbook interviews implemented.[11] Normative dispositions with positive valence were specifically looked for while the data material was successively evaluated: What do the interviewees consider desirable, beautiful, valuable, worth striving for, what do they perceive as positive or important. To what sphere of life - work, leisure time, family, enjoyment - the values referred to were, as opposed to Inglehart, intentionally kept open. When looking at the data material it became quickly obvious that values are a highly complex matter, or put more pointedly: all people are ›mixed types‹. Upon closer examination, however, it is possible to discover profiles and configurations which occur more frequently and which can also be found in other interviews as recurring motives. Even with individual persons ›mixed type‹ does not necessarily mean complete heterogeneity, but just the simultaneous occurrence of positive valences in various spheres of life. Upon closer examination it turned out, that in many cases some motives were dominating, others tended to be peripheral. These two properties of the data material made it seem promising to find value orientation patterns by way of *central*, i.e. *recurring* motives which are marked as particularly *relevant* by the interviewees. All in all, six patterns turned out to be characteristic, they will be briefly introduced in the following:

»Most positively inclined towards ... [modern technologies, ed.], are the representatives of the *TECH*: the *technocratic orientated, liberalist social climbers*. Their objections center around success, prestige, and power. They utilize technologies as a means to reach economic and social goals. Being progressive and future-optimistic, they have a clearly

10 For Germany Zwick proves the gradual decay of political or politically relevant institutions with a multitude of time-series data (1998a: 3).

11 A more detailed description of the selection method and evaluation strategy can be found in Zwick 1998b: 2.

positive orientation towards technologies. More than this: Among this group one could find market individualists for whom risk serves as a base for business. Thus they will be risk-seeking. Finally one can expect them to conform with a political and economic system, which permits them to obtain everything they bargain for.

The second social highly integrated type is *ASKO*, the *conservative bourgeois*. They have already won what the technocrats are still longing for. Plenty of economic, social and cultural resources are at their disposal. They cultivate an elitist lifestyle. On average they are older and more conservative than the technocrats. Their logic is not one of gaining and winning goods, on the contrary, they rather defend what they have already accomplished. Thus they reject an all too rapid social, economic, political or technological change. One can expect them to favour the premises of a growth-orientated economy as well as the development of innovative technologies, but not so intensely as technocrats do.

Realists - REAL - are *pragmatically oriented*. They try to accomplish an adequate standard of living and look for a decent quality of life; they are flexible, adaptable and averse to any fundamentalism. Realists tend to balance the potentials of risk and benefit with respect to [new technologies, ed.]...

The *conventionalist bourgeoise middle-class - KOBU -* likes comfort, an unburdened life on a middle-ranged level, and feels attached to ›law and order‹. The daily range of activities and aspirations is smaller compared to the other types. They try to design their life as an easily comprehensible idyll. [Modern technologies, ed.] ... won't fit well into the lifeworld of this type. So we can expect a moderate disapproval founded on basic arguments or feelings of doubts and vague fears.

The *individualized pleasure-orientated* type - *INGE -* belongs to the camp of comparatively modernized individuals: They reject conventional values and institutions. Their goals are absolute pleasure and self-actualization. They are younger than the conventionalists. They feel attached to action, fun, and pleasure. Their attitude towards risks is paradox: On one hand, they seek leisure-time risks for mastering dangerous adventures, on the other hand, they fear large-scale technological risks. Small technologies and nature are very essential resources for their lifestyle. Thus one can expect that they will highly agree to ›small‹ technical products of everyday life but will clearly reject key technologies as an imposition to their lifestyle and a threat to pure nature.

The type most averse to [high external risk, ed.] can be described as the *critical, culture-pessimistic, and alternative* group *(KALT)*. People belonging to this prototype long for a postmaterialistic kind of self-realization, strive for egalitarianism, emancipation, and

political participation. They are deeply discontent with the present shape of society, they reject its political and economic imperatives, representatives and institutions. For these people genetic engineering [as other technologies labelled as risky, ed.] is a symbol for a society they despise.« (Zwick 1998b: 12ff.)

In further steps those interviews corresponding to a certain type with as little deviation as possible were selected from the data material. Then those codes and motives constituing the relevant value type were extricated. The 4 aspects central to each type respectively were finally used to create a standardized scale.

Constructing the scale[12]

The item set comprises a total of 24 characteristics divided into Question 35 A-L and Question 55 A-L. The Construction of the typology is based on six Likert scales, each comprising characteristics considered central. Question 35 A-D refers to REAL, 35 E-H to TECH, 35 I-L to INGE. The Likert scale for KOBU is constructed from Question 55 A-D, ASKO from 55 E-H and KALT from question 55 I-L, where it must be noted *that the third one characteristic in each scale is polarized negatively!*[13] Ultimately the scales were standardized such that the value range of each Likert scale counts from 0 to 16. Type allocation was then carried out for a certain case, when the Likert scales yielded a one-peak distribution *and* the maximum was at 11 or more scale points. Multi-peak distributions were excluded from the calculation as being ›mixed types‹, peaks below 11 scale points were excluded from the calculations due to having ›no-profile‹.

After several preliminary tests the scale was improved and has so far been used in three surveys of the Center of Technology Assessment: in the ›Biotech Survey 1997‹ (cf. Zwick 1998a, 1998b and 1999), in the ›Survey on the Acceptability of Technologies in Report Baden-Württemberg‹ (Zwick 1998c) and the ›Baden-Württemberg Risk Survey 2001‹ at hand.

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12 This work required a high degree of methodical experience. Fortunately, the scale construction was expertly supported by the ›Centre for Survey Research and Methodology‹ (ZUMA), Mannheim, Germany.

13 The types were operationalized with the help of the following dimensions: *REAL*: 1. Balanced model of living, 2. Pragmatic problem-solving competence, 3. Flexible ability to adapt and orient, 4. Realistic concept for pleasure. *TECH*: 1. Liberalistic career orientation, 2. Meritocratic success and pleasure orientation, 3. Optimism concerning progress, 4. Technocratic instrumentalization of resources. *INGE*: 1. Escapist individualism, 2. Hedonistic orientation of enjoyment, 3. Rejection of success and prestige orientation, 4. Anticonventionalism. *KOBU*: 1. Conventionalism, 2. Religious order, 3. Ascetic frugality, 4. Traditional parochialism. *ASKO*: 1. Demanding professional orientation, 2. Distinctive pleasure, 3. High-level social usurpation, 4. Classical bourgeois orientation. *KALT*: 1. Cosmopolitan idealism, 2. Cultural pessimism, 3. Multicultural egalitarianism, 4. Ecological criticism of consumer society. More explicit methodical details about scale construction, an extensive characterization of the types and a more precise dimensioning of the base variables are given in Zwick 1998a.

The results of the two predecessor studies showed that in some instances considerable differences between the value types were revealed in the perception and evaluation of technology and its risks. This circumstance may not however be hastily equalled to a high statistical explanatory power as most technologies are evaluated ambivalently and most interviewees give ambivalent judgments. Sharply contoured tendencies show only at the small eccentric edges of the typology: on the one side TECH with an extremely high acceptance of technology and its risks, on the other side culturally pessimistic progress-sceptical alternatives (KALT) signalling considerable reservations and resistance to large-scale technology and external risks. With a proportion of 4.4% (TECH) and 5.7% (KALT), these types number only few, though. Another difficulty is that the typology only has nominal scale quality, it is thus basically unsuitable as predictor variable to be used in ›metric‹ models like path analysis. It is possible, though, to use the Likerts scales on which the types are based for explaining risk acceptance. Thus, it must be assumed that a risk will seem all the more acceptable, the more index points a person scores on the TECH scale, and the fewer points are scored on the KALT scale. For the remaining - moderate - types comparatively low correlations with risk evaluation are assumed.

3.5.3 The cultural typological approach by Dake

Despite the fact that ›Cultural Theory‹ is based on the effectiveness of standards and values too, it is not necessarily directly compatible with the value orientations discussed above. Since the early beginnings of cultural theory with Mary Douglas (1966), questions apparently focus on different aspects. In value orientation patterns *individual* normative dispositions are made the starting points of analyses, cultural theory however claims to interpret *intercultural variations* on the basis of prevailing specific standards and values: »Our guiding assumption says that each social form generates ... its own selected point-of-view, which in turn influences that society's selection of attention-relevant hazards... Each form of social life has its own typical risk structure. Common values lead to common fears.« (Douglas/Wildavsky 1993: 120f.) Thus Cultural Theory feels, from its very beginnings obliged to use ethnological and anthropological research traditions, traditions which considered risk perception as not being an individual but a collective construct: Cultural Theory of risk perception understands »the social environment, selection principles and the perceiving subject as a whole system.« (Douglas/Wildavsky 1993: 119).

This approach results in a basic methodological difference to the individualistic understanding of values as we found them in the two value concepts discussed: »Methodological individualism that extrapolates from individual behavior to social action has no

place in cultural analysis«. (Rayner 1992: 86) According to the conviction that attitudes and behaviour are influenced by the *group-specific* validity of standards and values - the term ›cultural bias‹ is used here -, Cultural Theory favors aggregate data analyses. This seems problematic not only because culture-theoretical findings cannot be compared with other normative approaches, but also because of the impossibility of implementation into multivariate models for the ›explanation‹ of risk perception and evaluation, even if only one predictor variable is based on individual data logic. Finally the methodological problem arises that some statistical procedures react highly sensitively to aggregate data, resulting in the fact that in some cases, unrealistically high explained variances are suggested, which could not be reproduced on an individual data basis under otherwise equal conditions (cf. Küchler 1979: 51).

The approach of culture theory also causes problems in the conceptual aspect. Sjöberg rightly points out that social group affiliation cannot be distinguished accurately: social group affiliation depends »on which group membership is considered: work group, family, or leisure. If a person responds to a questionnaire, which role is he or she adopting?« (1997: 115) Finally, the culture-typologizing comparison loses sight of the in some cases considerable interior cultural variance of risk perception and evaluation. Thus, it is of little surprise then that finally Dake himself used his indicator in studies based and analyzed on an individual data basis. Group-specific culture types hereby mutate to individual value orientations.

It is the merit of Karl Dake having operationalized cultur-theoretical assumptions and having made them available to survey interviews (cf. Wildavsky/Dake 1990 and Dake 1992). Dake presented his typology in two variants. One in the shape of a question set comprising 28 items differentiating between four types - hierarchical, individualistic, egalitarian and fatalistic. (Dake 1992) For the other he uses a set of items discriminating three types by seven characteristics: egalitarians, individualists and hierarchists (cf. Earle/Cvetkovich 1995: Table I). This shortened scale was used in the risk survey for reasons of research economy.

Culture types and perception of risk

Sjöberg gives a short characterization of the three Dake types:

»*Hierarchy ideology* supports the establishment, promotes trust in expertise and abhors social deviance.

Individualist ideology, on the other hand, gives priority to individual achievement and stresses that people should have material rewards for their work.

Egalitarians, finally, are distrustful of institutions and their experts, which are seen as motivated by selfishness and greed, and as obstacles to a society characterized by brotherhood and equality.« (1997: 116)

From this description it is obvious that Egalitarians - due to their distrust of experts, operators of technical facilities and institutions entrusted with risk prevention and management - will assess risks - especially risks resulting from technical facilities - as particularly high and unacceptable. In a converse conclusion it can be expected that Hierarchists and Individualists will perceive and accept risks more moderately, but it must be noted that Hierarchists should be highly sensitized for deviating behavior and Individualists for economic risks.

On the construction of the typology

The Dake item set is contained in the survey instrument as question 13. Particular problems were presented by the translation of the question set as some items - above all D, E and G - relate to cultural idiosyncrasies of US American society, which cannot simply be transfered to German conditions. We are much obliged to Ortwin Renn for taking upon himself the difficult task of transferring the items.

At first the arithmetical mean values of the characteristics A and B - Egalitarians -, C and D - individualists - and E, F and G - Hierarchists - were determined for the construction of the types. In a second step, the maximum of these three mean values was determined for each interviewee and then - if the distribution was single-peak - allocated to the relevant type. After excluding 15% mixed types, 59.1% Egalitarians, 25.3% Hierarchists and 15.6% Individualists were derived. As this typology is on a nominal scale, Likert scales, on which typology is based, are used for the analyses as is done in a similar way by the Zwick scale.

3.5.4 Bivariate findings on value orientation and culture types

There are highly diverging opinions on the theoretical relevance and empirical explanatory power of value-based explanation approaches in risk research. They range from the conviction, that »personal views of the world have ... a strong influence on our perception of the world« (Siegrist 2001: 18), to ›fundamental criticism‹ a la Sjöberg: »The most likely explanation of the present results, in my view, is, that cultural theory is simply wrong.« (1997: 126) ... »It is concluded that Cultural Theory explains only a very minor share of the variance of perceived risk«. (1997: 113).

The findings gained by the cultural theory scale of Dake are indeed barely suitable to refute Sjöberg's criticism. In Table 4, for example, the Egalitarian scale would at best explain $0.18^2 \approx .03$, i.e. 3 percent of the variance in the acceptability of the BSE risk. Inglehart's value change theory does not fare much better. This may turn out to be fertile for the assessment of politically controversial risk technologies (cf. Fuchs 1991) - for the perception and evaluation of risks it must be considered as almost useless.

Table 4: The Acceptability of Various Risks According to Selected Characteristics of Value and Culture Theory

Characteristic	*Acceptability of the risk of ... [r]*					
	BSE	Nuclear power	Mobile telephonee	Genefood	Climate change	Smoking
Inglehart[1)]	-.03[2)]	-.13	-.09	-.12	-.10	-.05
Zwick:						
- TECH scale	-.07	.15	.13	**.24**	**.24**	-.01[2)]
- ASKO scale	-.15	.05	.04[2)]	.11	.12	-.17
- KOBU scale	-.14	.00[2)]	-.15	-.10	.04[2)]	-.21
- REAL scale	-.11	.05	.12	.13	.14	-.04[2)]
- INGE scale	.13	-.05	-.03[2)]	.00[2)]	-.07	.14
- KALT scale	-.18	**-.28**	**-.25**	**-.26**	**-.32**	-.12
Dake:						
- egalitarian scale	-.18	-.07	-.08	.04[2)]	-.03[2)]	-.07
- individualistic scale	.11	-.03[2)]	-.04[2)]	.05[2)]	.00[2)]	.12
- hierarchist scale	-.08	.07	-.01[2)]	-.05	.03[2)]	-.07

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508

1) Negative coefficients mean that a risk is less acceptable to postmaterialists.

2) The effect is statistically not significant.

Remains the scale by Zwick. As expected it is suited to differentiate at the two edges, whereas those scales which stand for ›moderate‹ orientations distinguish themselves by indifference. Those individuals however who score high values on the TECH or KALT dimension show markedly different attitudes towards the acceptability of risks associated with nuclear power, genetically altered food, cellular network technology or global climate change. Indifference prevails merely with smoking and the BSE risk. Apart from that, it is the KALT scale above all which offers potential explanations between approx. 5% and 10%. At a first glance this may seem low, but it must be considered that value orientations in the ›causal funnel of explanation‹ are much farther away semantically from the dependent variable than the semantically ›proximate‹ - if not suspected of tautology - psychometric characteristics. A concluding

evaluation of the facts can only be carried out with the multivariate analyses.

3.6 Selected socio-demographic characteristics and risk perception

In the past, socio-demographic variables gained significant results explaining attitude variables - such as the perception and evaluation of technology and its risks, because of the fact that socio-demographic characteristics were considered indicators of affiliation to social group, which influenced individual perception and evaluation patterns. Meanwhile, however, scepticism abounds. Large social groups have disintegrated or at least lost their social power of influence, due mainly to progressive individualization and processes of withdrawal from social and political institutions, but also due to the heterogenization of social unequality. New lines of social conflicts are predominantly of a socio-cultural nature and organized informally, a circumstance which is detrimental to the explanatory power of demographic characteristics. »The new political line of conflict is not based on socio-structural group conflicts, as is the old one, but above all in value conflicts.« (Fuchs 1991: 6).

Various studies on the perception and evaluation of technology - a research question closely related to risk perception research - reveal sobering balances with regard to the discriminative power of demographic variables: a study on genetic engineering comes to the conclusion that factors such as age or level of education cause only »minor differences« in attitudes (Gloede et al. 1993: 140). In a different study on the perception of technology Scheuch formulates the result: »As a whole, the evaluation according to demographic factors is disappointing... In the Federal Republic of Germany the attitude towards technology is hardly influenced by group affiliations traditionally important in the formation of attitudes. Only subgroups are an exception: The mentioned cultural professions and students.« (1990: 113f.)

Huber's study of 1989 examined the circumstance that professions frequently hide value orientations and special socialization processes which favor specific attitude patterns. These in turn can be circularly reinforced by certain professional practice and group affiliation. He thinks even of being able to identify so-called ›eutopian‹ and ›dystopian‹ concepts of technology which are based on socialization processes and which, on becoming denser, turn into polarized concepts of the world. He maintains that their protagonists are predominantly technicians, natural scientists and engineers on the technology-eutopian side; human service workers i.e. persons working in social, eductional and art-oriented professions on the other, dystopian, side. As, at the time of the survey, not all interviewees still practised the profession they were trained for, Table 5 additionally lists the professional branch for which they were trained. Fur-

thermore, the educational level - measured in completed educational years - as well as the current professional prestige or - with individuals no longer in profession - the professional prestige attained at their last job.

Table 5: The Acceptability of Various Risks According to Selected Socio-demographic Characteristics

Characteristic	*Acceptability of the risk of ... [r]*					
	BSE	Nuclear power	Mobile telephonee	Genefood	Climate change	Smoking
Sex[1)]	.16	.16	.16	.10	.10	.17
Age	-.06	-.01[2)]	-.10	-.06	.02[2)]	-.17
Generation of new social movements[3)]	-.03[2)]	-.06	-.11	-.11	-.05	-.06
Years of education	-.03[2)]	-.02[2)]	.04[2)]	.00[2)]	-.01[2)]	-.05
Main professional group resp. characteristic of activity						
- Pupils/Students	.03[2)]	.08	.07	.09	-.00[2)]	-.01[2)]
- Household	-.10	-.10	-.10	-.06	-.07	-.07
- Pensioners	-.03[2)]	.02[2)]	-.03[2)]	.01[2)]	.04[2)]	-.14
- Human services	-.02[2)]	-.03[2)]	.03[2)]	-.01[2)]	-.03[2)]	-.05
- Technicians/Engineers/ Natural Scientists	-.08	-.08	-.01[2)]	-.09	-.06	-.07
Prestige of profession						
- Treiman	-.00[2)]	-.05	-.00[2)]	-.07	-.03[2)]	-.09
- Magnitude	-.02[2)]	-.06	.01[2)]	-.07	-.07	-.10
Professionally trained in ...						
- naturas scienc./technical	-.00[2)]	-.01[2)]	-.02[2)]	-.02[2)]	.04[2)]	.02[2)]
- pedagogic profession	-.05	-.08	-.02[2)]	-.04[2)]	-.06	-.05
- artistic/journalistic	-.02[2)]	-.02[2)]	-.05[2)]	.00[2)]	-.02[2)]	-.01[2)]
- social sc./psychologic	-.02[2)]	-.05	-.01[2)]	-.03[2)]	-.06	-.01[2)]

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508

1) Positive coefficients mean that men consider a risk rather more acceptable than women

2) The effect is statistically not significant.

3) Dummy-coded variable 0 = ›does not apply‹ 1 = ›characteristic applies‹

The ›Survey on the Acceptability of Technologies in Baden-Württemberg‹ (Zwick/Renn 1998) moreover showed, that there are considerable gender-specific differences where interest in technology and technical informedness are concerned. But above all,

differences can be found in the emotional attitude towards technology (1998: 8). For risk perception it should be of particular significance that women express more fear by far than men - especially concerning technology which is considered external risk technology (1998: 32). Apart from the *professional group* and *gender effect* it can be assumed that the protagonists of student unrests and the ›new social movements‹ assess technology and its risks maybe even more critically than other age cohorts, due to their collective historical experience and interpretation patterns which were certainly not benevolent towards large-scale and risk technologies. Here one must consider the age group of individuals currently 40 to 65 years of age who - if it is indeed a cohort effect - as yet show above-average sceptical attitudes towards technological risks and a remarkably low acceptance of forced risks.

The attempt to explain differences in the acceptability of risks by socio-demographic factors must be considered as failed. Most effects are not statistically significant, they are also substanceless from a theoretical point of view. Thus an interpretation would be misleading. If any, gender shows systematic and significant correlations: men are prone to evaluate all investigated risks as slightly more acceptable than women. The explanatory power of the gender effect, however, amounts to a mere 1-3 percent.

3.7 Risk acceptability - the empirically founded selection of predictors

The previous chapters had the purpose of attaining a *theoretically* founded selection of predictor variables for risk acceptability. This section will pick out, from the multitude of possible predictors, those with the highest *empirical* power of explanation. The necessity of selecting methodologically also arises from the fact that variables with great semantic similarity are contained in psychometric risk characteristics, especially - such as social potentials for harm and catastrophe potentials - variables which are therefore highly correlated. Most multivariate methods of analyses react sensitively however, when two or more strongly colinear variables are used as predictors. In other words, a suitable selective method is required which ensures two preconditions: The selection of empirically significant variables and the decision in favor of an alternative with a higher power of explanation where semantically similar predictors are concerned.

Stepwise regression analyses are a proven method. To start with, all possible predictor variables are examined for co-variation with their dependent variable - in our case the acceptability of a risk. For this, the variable attaining the highest T-value is selected as first predictor with the highest explanatory power. This process is continued until a criterion for break-off is reached or all variables have been selected. Normally, the

5%-significance level serves as criterion for break-off. However, in cases with a high number of cases the problem arises that even those variables attain significant results whose additional explanatory power is near zero. As the task of empirical social research is to attain the highest possible explanatory power with the most economical models, a criterion for break-off seems suitable which becomes effective when an additional predictor variable would contribute less than 1% explanatory power.

In some cases it was attempted to combine several variables on the basis of theoretically founded indicators - such as social harm and catastrophe potentials under the heading of ›global dread‹ - hoping of being able to attain an even higher explanatory power due to synergetic effects, rather than by - highly confused - individual variables which would moreover have a detrimental effect on the model's stability.

Table 6 shows that the acceptability of each of the six risks can be ›explained‹ between well and excellently by only a few predictors, as with a basis of individual data 20% variance clarification are considered a »success« (Küchler 1979: 51). In all cases the individual characteristic with the highest explanatory power is from the group of psychometric risk characteristics.

Table 6a: Selection of Predictors of Acceptability of the Risk of Nuclear Power

Rank / Characteristic	**[r]**	**[ß]**
1. Personal and social benefit-risk balance BILANZAT = V34+V39-V4-V29)[14]	.68	.40
2. Catastrophe potential (V58)	-.62	-.25
3. Benefit and risk is unfair distributed (V44)	-.45	-.13
4. Controllability of nuclear power (V116)	.41	.10
5. Performance of industry managing (all) risks (PERFIND = V137+ ... +V144)	.32	.08
6. Leftwing-rightwing scale (V200)	.22	.06
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508 Result of stepwise regression analysis;[15] R^2 = .56; Durbin-Watson coeffizient = 1.75		

In the cases of the risks of nuclear power, cellular networks and climate change, balance judgment are to be found on the first place respectively: balancing of social benefit and risk aspects with climate change, the combined personal and social benefit-risk balances of nuclear power and cellular networks. In all three cases the perception of catastrophic potential follows in second place. Here already high explanatory

14 The questionnaire - including all variable labels - is printed in the appendix.

15 All regression analyses were calculated with pairwise exclusion of missing values.

potentials of psychometric risk characteristics appear in outlines. But stepwise regression calculations do not express anything about the ›causal‹ explanatory structure. Proceeding from the theoretical preparatory work it must be expected that part of the explanatory power of psychometric variables is based on pseudo-correlations and enters into other predictors.

In Table 6a, looking at the risk of nuclear power, two remarkable features can be seen: rank 5 shows the trust in industry with regard to the handling of risks. However, not the perception of operators of nuclear power plants referring specifically to the risk of nuclear power - this was not surveyed - but the evaluation of the performance of industry with respect to all four risks surveyed in questions 36ff: genetically altered food, cellular network technology, BSE and climate change. Hence, this is a latent personality variable which describes to what extent an individual is inclined to generally trust or distrust industry as a whole. Unfortunately it cannot be verified whether the specific perception and judgment of the performance of nuclear power plant operators resulted in a modification of the model. All the same it is interesting that generalized trust or distrust can also occur as a predictor with high explanatory power.

The occurrence of the leftwing-rightwing scale as predictor variable is also worth mentioning. With nuclear power it was able to assert itself against other, theoretically more complex scales such as KALT. This is probably due to the fact that the subject of nuclear power is a relatively old and highly politicized subject, which was distinctly fought out in the Federal Germany of the seventies and eighties on the line of conflict between the political left and right.

The acceptability of the risk of nuclear power does not seem to be influenced primarily by the evaluation of its catastrophic potential, but by its benefit-risk balance. With precaution this could be interpreted as in indication that the polarization, ideologization and emotionalization of the risk of nuclear power is slowly giving way to a more sober approach. Descriptive findings already showed that benefit aspects play a role not to be neglected in the perception of the utilization of nuclear power.

Cellular network technology is a fresh subject, whose perception is highly determined by a favorable benefit-risk balance, as descriptive findings have shown. It is thus of little surprise that also the degree to which this risk seems acceptable is primarily influenced by *social* benefit-risk balances and secondly by the evaluation of its catastrophic potential. In the ›explanation‹ of the risk acceptability the measure of trust invested ›en bloc‹ in the state and the operators, as those mainly responsible, moreover turns out to have a higher explanatory power than the two individual variables. As

expected, culture-pessimistic alternative orientations assert themselves as predictors against the leftwing-rightwing scale with this young subject, unlike with the risk of nuclear power.

Table 6b: Selection of Predictors of Acceptability of the Risk of Cellular Network Technology

Rank / Characteristic	**[r]**	**[ß]**
1. Personal and social benefit-risk balance (BILANZHA = V35+V40-V5-V30)	.54	.33
2. Catastrophe potential (V59)	-.51	-.30
3. Performance of industry and politics managing the radiation risk (PERFPIHA = V108+V112+V126+V138+V142)	.40	.19
4. Culture-pessimistic alternative orientations (KALT = V195+V196-V197+V198)	-.25	-.06
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508 Result of stepwise regression analysis; R^2 = .42; Durbin-Watson coeffizient = 1.84		

The lowest explanatory power is obtained with regard to the acceptability of the risk associated with global climate change. All in all, only 30% of its variance is explained by six predictors. Again two variable complexes are at the fore: social benefit-risk balancing and catastrophic potential. The perception of the performance of all institutions responsible for risk determination, communication and management taken together follows in third place. This can be interpreted as an indication of the complexity of the problem which involves a lot of uncertainty and which could be controlled by one of the institutions mainly responsible. Apart from the question of the fair distribution of benefits and detriments, culture-pessimistic alternative value orientations again play a role in the evaluation of the acceptability of this risk. A latent personality variable can be found in sixth place, i.e. the question whether an individual is inclined to assess risks as threatening on the whole. An above-average proportion of individuals reacting sensitively to risk in this sense frequently consider the climate risk as being not acceptable.

Table 6c: Selection of Predictors of Acceptability of the Risk of Global Climate Change		
Rank / Characteristic	**[r]**	**[ß]**
1. Social benefit-risk balance (KLGESBIL = V42-V32)	.44	.20
2. Catastrophe potential of climate change (V61)	-.40	-.19
3. Performance of social institutions managing the climate risk (PERFOKLI=V94+V98+V102+V106+V110+V114+V128+V132+V136+V140+V144)	.22	.12
4. Benefits and detriments are unfairly distributed (V47)	-.29	-.14
5. Culture-pessimistic alternative orientations (KALT = V195+V196-V197+V198)	-.32	-.09
6. Fear of risks (BEDROH = V1+V4+V5+V6+V7+V15+V17)	-.32	-.10
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508 Result of stepwise regression analysis; R^2 = .30; Durbin-Watson coeffizient = 1.62		

With the three remaining risks - BSE, genetically altered food and smoking - the perceived ›dread‹ dominates. It is understood here to be the extent of social harm *and* of the catastrophic potential. Benefit variables follow respectively on second rank in varying combinations. This is surprising as in all three cases these are risks whose consequences first of all have an impact on the individual. In each case these are products taken as foodstuff or consumables permitting a high degree of personal control on part of the user.

Table 6d: Selection of Predictors of Acceptability of the BSE Risk		
Rank / Characteristic	**[r]**	**[ß]**
1. Dread of BSE risk (BSESCHR = V28+V57)	-.60	-.47
2. Personal benefit by large-scale lifestock production (V33)	.29	.21
3. Benefit and risk of large-scale lifestock production unfair distributed (V43)	-.38	-.14
4. Performance of industry managing the BSE risk (BSEPIN = V139+V143)	.29	.11
5. Farmers (main professional group)	.17	.10
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508 Result of stepwise regression analysis; R^2 = .44; Durbin-Watson coeffizient = 1.87		

With the BSE risk an as yet different peculiarity appears: it is the only risk where a sociodemographic characteristic influences risk acceptance: to the farmers interviewed the BSE risk seemed somewhat more acceptable than to the other interviewees.

Table 6e: Selection of Predictors of Acceptability of the Risk of Genefood		
Rank / Characteristic	**[r]**	**[ß]**
1. Dread of genefood risk (GENSCHR = V31+V60)	-.67	-.44
2. Personal and social benefit of genefood (GNUTZGEN = V36+V41)	.53	.29
3. Performance of industry and politics managing the genefood risk (PERFPIGE=V107+V111+V125+V137+V141	.51	.15
4. Incidents are just the tip of the iceberg (V120) (negatively polarized item)	-.38	-.08
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508 Result of stepwise regression analysis; R^2 = .55; Durbin-Watson coeffizient = 1.80		

Genetically altered food also shows a peculiarity: it is the only case where a stigma-theoretically relevant variable makes its influence known on risk acceptability. However, the ›tip-of-the-iceberg‹ effect is semantically ambiguous: incidents and irregularities can be perceived as both attempts to hush up, i.e. low trust in the producers, or as forebodings of worse events to come. Only the latter interpretation would be compatible with stigma theory. Where trust is concerned, the perception of industry and politics in general again asserts itself against the relevant individual variables.

Table 6f: Selection of Predictors of Acceptability of the Risk of Smoking		
Rank / Characteristic	**[r]**	**[ß]**
1. Dread of the smoking risk (RAUSCHR = V19+V21)	-.54	-.34
2. Interviewee is smoker (V227)	.50	.35
3. Disposition to dramatize risks (GESSCHR = V16+V28+V29+V30+V31+V32+V57+V58+V59+V60+V61)[16]	-.33	-.14
4. Personal threat caused by smoking (V17)	-.38	-.13
Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; N = 1.508 Result of stepwise regression analysis; R^2 = .47; Durbin-Watson coeffizient = 1.57		

What is remarkable with the subject of smoking is that, after the last step of regression analyses, the influence of the question of whether the interviewee him- or herself is a smoker is the best predictor for the acceptability of the risk associated with smoking: even shortly before the perception of the dread associated with the harm caused by smoking the following applies: the risk of tobacco consumption is acceptable mainly to smokers. Another personality characteristic can be found on rank three: the degree

16 GESSCHR does not contain any characteristics refering to smoking, in order to avoid a tautology with RAUSCHR.

to which individuals are inclined to dramatize risks - to generally assume high social hazards and a high catastrophe potential. Risk-sensitive fearsome natures such as these are inclined to reject smoking more than average.

Finally it seems remarkable, that the extent of a personal feeling of threat only occurs as a predictor of risk acceptance with smoking and global climate change. Trust and performance criteria of institutions were not surveyed for the subject of smoking due to its clear character as being a voluntary risk.

Concludingly it can be said that the acceptability of all examined risks can be ›explained‹ well to excellently by a few high-powered predictors. The very low influence of stigma-theoretical and sociodemographic characteristics is remarkable. Value and trust-theoretical variables seem to exert moderate influence on the acceptability of risks, psychometric characteristics the highest, whereby social characteristics - social benefit, social harm and catastrophe potentials seem to prevail over individual consequences. A precise quantification of the individual effects will be left to the concluding path analysis models.

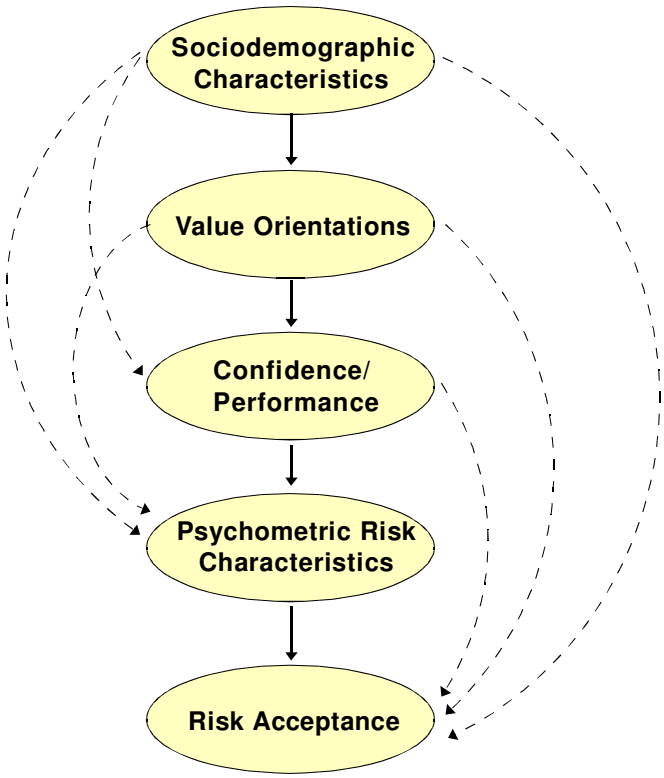
3.8 On the causal structure of the models

Path analysis seems to be particularly suited for an empirical comparison of various theoretical approaches for the evaluation of risks, as it permits a precise quantification of the explanatory power of any model level in relation to the dependent variable. Moreover, it permits accurate analysis of direct and indirect mechanisms of effect and the exposure of fictitious correlations. When representing trust-theoretical arguments it was surmised that part of the explanatory power of stigma-theoretical characteristics can ›in reality‹ be attributed to logically paramount characteristics, characteristics called ›distal‹ by Sjöberg (1997: 114). Path models thus require the theoretically founded commitment to a model, where the individual theories are grouped in hierarchical levels and the maintained influences are of a non-recurring nature. Fig. 2 shows such a model.

The two corner points do not cause any problems. That risk acceptance as dependent variable occupies the last model level is just as trivial as the uppermost level which is occupied by sociodemographic characteristics. The latter are either ascriptive or acquired, whereby the course for their acquisition is generally set a long time back and does not seem to be influenced by current risk perception and evaluation. In our models this uppermost level concerns farmers with respect to the acceptability of the BSE risk and possibly smokers with whom tobacco consumption can in some cases

develop into a descriptive and persistent personality characteristic. From the fact that the characteristic ›smoker‹ is not correlated with the knowledge of the risks of smoking ($r = -0.02$; $\alpha > 0.2$) it can be deduced that the decision to smoke is not based on knowledge, i.e. it was not made on the background of rational benefit-risk considerations. The evaluation of the risk, but also the question of the acceptability of smoking are thus not the cause but a consequence of tobacco consumption.[17]

Fig. 2: Causal Structure Underlying the Theoretical Approaches Explaining Risk Acceptance



In the discussion of psychometric risk characteristics it was assumed that risk practically coincides semantically with damage or catastrophe potential. Since the beginning of empirical risk research ›dread‹ is, with good reason, considered to be among the most immediate characteristics of risk. »Risk perception can be well explained, but only with proximal variables,« (Sjöberg 1997: 127) by which Sjöberg understands psychometric risk characteristics - ›real risk‹ (1997: 113) - and their communication by the mass media. He concedes that »proximal variables are semantically close to the target

17 Pointedly it could also be said that the non-correlation of smoking and the subjective state of knowledge about its risks speaks for the addiction theory and against the rational decision theory.

behavior to be predicted.« (1997: 114) However, the closer predictor and dependent variables are together in the ›causal funnel of explanation‹, the higher the empirical explanatory power of the predictors thus turns out, the more questionable can the theoretical significance of the ›explanation‹ - due to the arising suspicion of tautology - become. For the moment, however, it may suffice to derive - from the presented arguments - the fact that psychometric risk characteristics occupy the level immediately paramount to the dependent variable.

Following the argumentation of Siegrist the trust in social institutions with regard to risk communication and risk management is a variable filtering the perception of risks which are considered threatening, highly harmful etc.. The perception and evaluation of institutional performance thus is no intervening variable stepping between psychometric risk characteristics and risk acceptance but takes its place before the psychometric variables: The extent of institutional trust can influence the quality of the perceived risk. It can thus also expose as a fictitious correlation the explanatory power of risk characteristics for the acceptability of a risk.

Siegrist also emphasizes that institutional trust can depend on normative personal dispositions. Thus it is easy to conceive that progress-optimistic technocrats or Dake's Hierarchists have more trust in institutions and evaluate their performance in risk management more benevolently than cultur-pessimistic, modernization-sceptical alternatively oriented individuals. Value orientations thus come before institutional trust.

Inglehart's theory offers a wonderful example for the point that the value level follows after the level of sociodemographic characteristics: value attitudes are acquired early where socioeconomic socialization conditions during adolescence are decisive. With Inglehart, however, interindividual differences also turned out to be significant: in his model, variables such as age, level of education or socioeconomic status are closely correlated to postmaterialistic values.

On the whole, the theories used provide plausible and non-contradictive grounds for the causal structure suggested in Fig. 2.

3.9 The multivariate ›explanation‹ of risk acceptability

The predictor variables determined in the previous sections will now be entered into hierarchical, non-recurring path models in order to determine the extent to which risks seem acceptable to the public. The causal structure of the path models corresponds to the pattern explained in chapter 3.8. The individual levels of explanation follow our theoretical approaches, this means that - for instance - all psychometric variables included in the model are allocated to one and the same level.

Each path model is followed by a table showing a very detailed causal structure. The third to last column - explained variance (R^2) - shows the explanatory power of a certain predictor to the dependent variable. In those cases where several predictor variables from the same theoretical concept are included in the model on the same ›logical‹ level, it is impossible to calculate the explanatory power of a specific variable. In these cases only the common explanatory power of the block of variables can be determined. The last column of the table cumulatively indicates the model's total explanatory power. The lowest segment respectively is of special significance, it shows the acceptability of risk as dependent variable.

›Non-causal effects‹ are fictitious correlations, i.e. when part of the bivariate correlation - column 3 - cannot be attributed to predictor variable, because the effect is caused by a higher-level variable in a certain model. For instance, it is possible to demonstrate that the explanatory power of psychometric predictors to risk acceptability is fictitious to a considerable extent. For example, the bivariate correlation between perceived catastrophe potential (V58) and the acceptability of the risk of nuclear power (V68 in Fig. 3 resp. Table 7) is r = -.62. The vast majority (-.37) however emerges being fictitious while only 40% (-.25) can be regarded as ›causal‹ effect. This example demonstrates the effectiveness of institutional trust filtering the subjective perception of catastrophe potential influencing risk acceptability. Moreover, it is possible to separate ›direct‹ effects from ›indirect‹ ones. Indirect effects are shown for instance in Table 7, columns 5 to 9. Direct and indirect effects add up to ›causal effects‹; ›causal‹ and ›non-causal‹ fictitious effects add up to the bivariate correlation in column 2.

›Causal‹ and ›non-causal‹ effects are set into quotation marks as the entire explanatory model depends on the given path and causal structure. Modifications of the model structure entail changes in the empirical explanatory power of individual variables, thus also changing individual theoretical approaches!

The acceptability of the risk of nuclear power

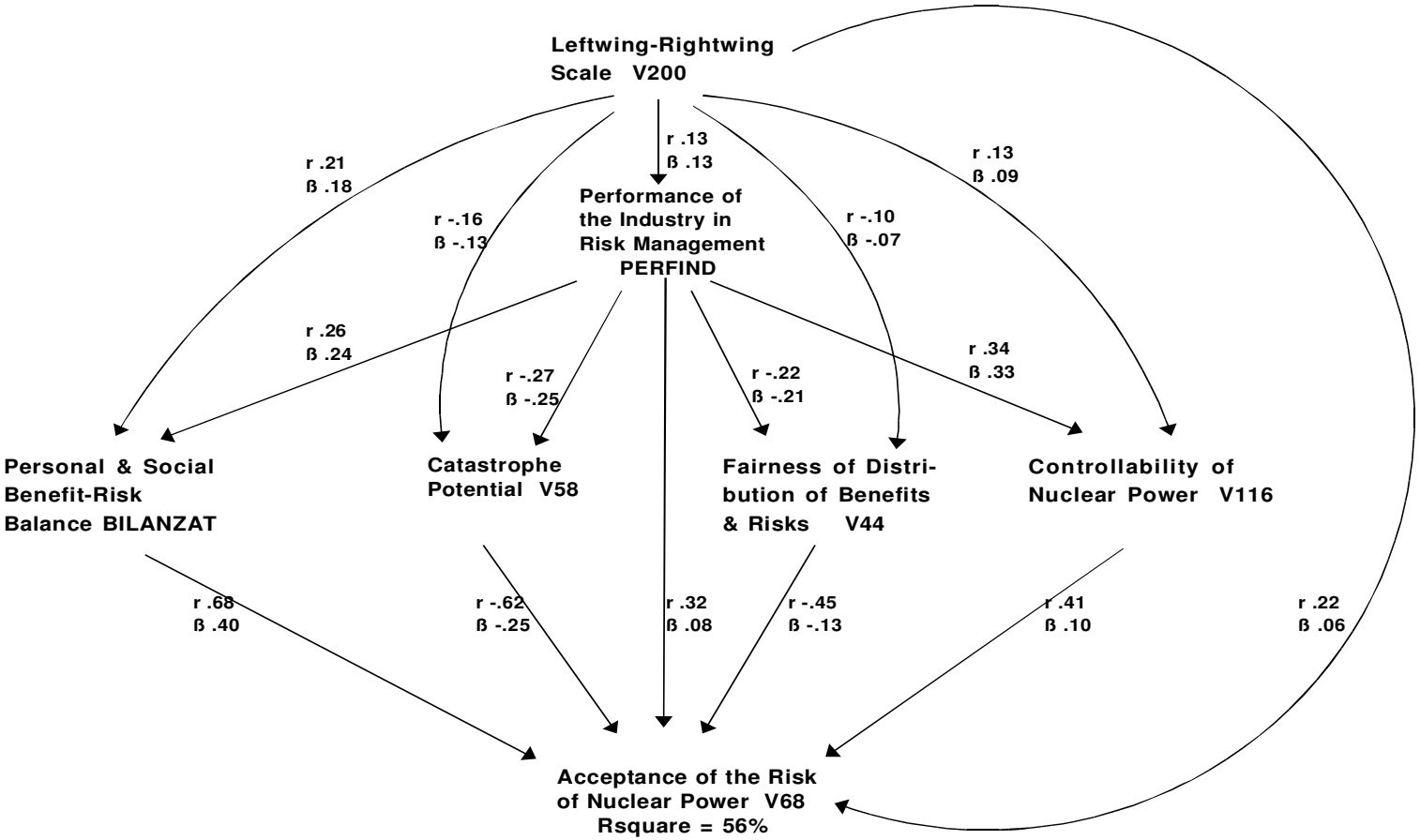
Up to 56% of the variance of the acceptability of the risk of nuclear power can be explained. The level ›value orientations‹ provides 5% variance explanation - represented here by the leftwing-rightwing self-rating: the farther to the right individuals rate themselves, the more acceptable the risk of nuclear power seems to them. Trust in the industry contributes another 9% of variance explanation. The main proportion of 42% variance explanation is contributed by the block of psychometric variables with benefit-risk balancing showing the most significant explanation power by far - as was shown by the strong ›causal‹ effect - followed by the perception of the catastrophe potential. These findings signal a ›modern shifting‹ of a ›classical‹ risk: the predominance of the leftwing-rightwing variable over differentiated ›modern‹ lifestyles or value orientations marks the nuclear-power topic as an old, conventional one. In contrast, the strength of benefit-risk balance enunciates the end of a highly polarized debate and the beginning of a rational reasoning. Possibly, this change is caused by the government's decision to phase out nuclear energy production.

The acceptability of the risk of cellular networks

42% of the differences in the acceptability of the risk of cellular networks can be explained by the model shown in Fig. 4. Culture-pessimistic alternative individuals have above-average reservations. The explanatory contribution of this characteristic amounts to 6%. The better the performance of industry and politics in the management of this risk is evaluated, the higher is the willingness to accept this risk. Institutional trust contributes another 13% variance explanation. Probably this finding is typical for new and not well-known risks, where knowledge is weak and the demand for regulation and control high.

At 23% the explanatory power of the two psychometric characteristics is somewhat stronger than the combined value and trust level. Benefit-risk balancing and the perceived catastrophe potential have about the same effect on the acceptability of the risk of cellular network technology, with inversed signs, however: the better the benefit-risk balance and the smaller the catastrophe potential are evaluated, the more acceptable the risk.

Fig. 3: Path Analysis Determining the Acceptability of the Risk of Nuclear Power



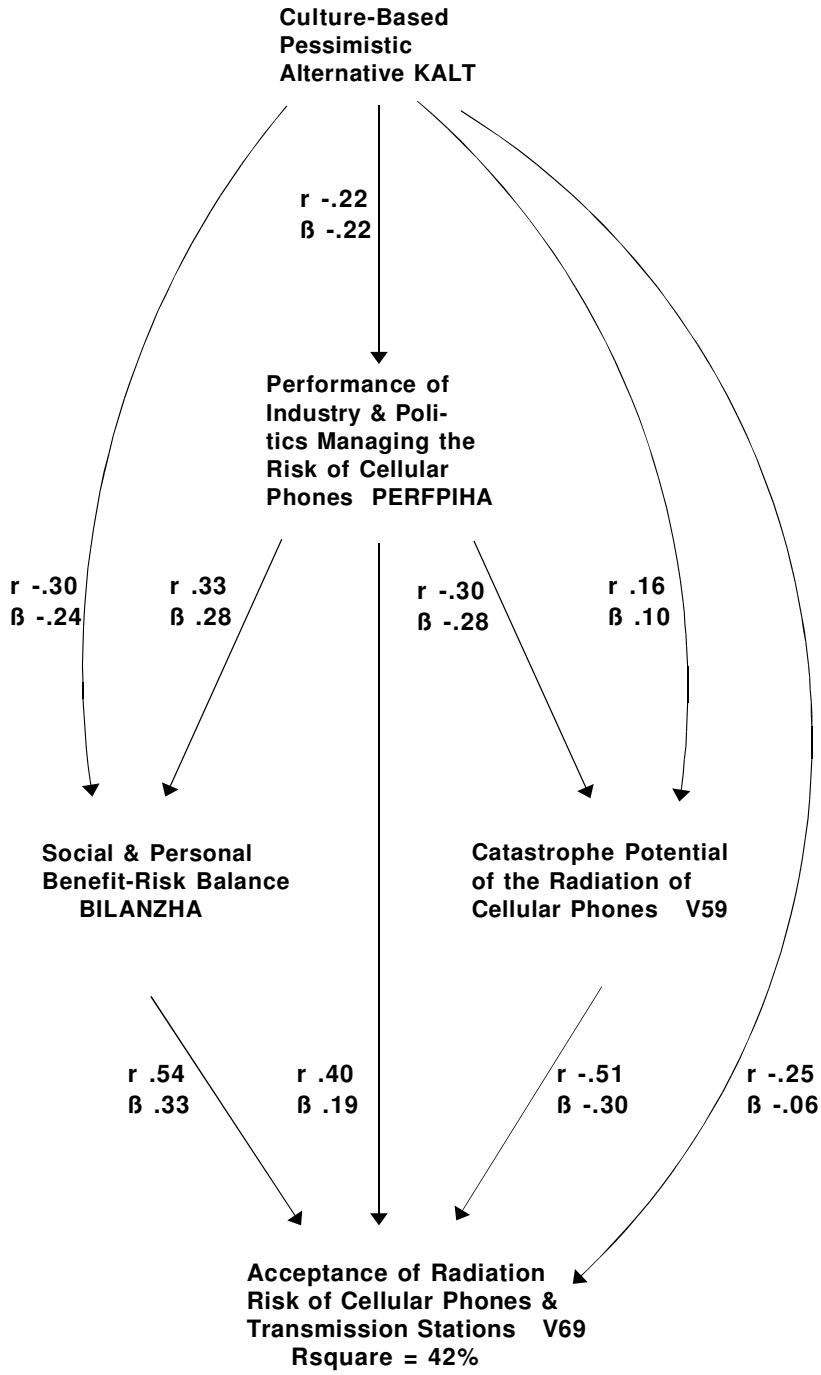
Baden-Württemberg Risk Survey 2001 Person-weighted Data Set N = 1.508
Pairwise Deletion of Missing Cases; Durbin-Watson-Coefficient: 1.75

Table 7: Path Model: Explanation of the Acceptability of the Risk of Nuclear Power

Dependent variable	Predictor	Bivariate correlation (r)	Direct effects (ß)	Indirect effects (ß) via ... perfind	bilanzat	v58	v44	v116	›Causal effects‹	›Non-causal‹ effects	Explained variance (R^2)	Multiple correlation (r)	Σ Expl. variance (R^2)
PERFIND	V200	.13	.13						.13	-	.02	.13	.02
BILANZAT	V200	.21	.18	.03					.21	0	.04	.21	.04
	PERFIND	.26	.24						.24	.02	.06	.32	.10
V58	V200	-.16	-.13	-.03					-.16	0	.02	.16	.02
	PERFIND	-.27	-.25						-.25	-.02	.07	.30	.09
V44	V200	-.10	-.07	-.03					-.10	0	.01	.10	.01
	PERFIND	-.22	-.21						-.21	-.01	.04	.23	.05
V116	V200	.13	.09	.04					.13	0	.02	.13	.02
	PERFIND	.34	.33						.33	.01	.10	.35	.12
V68	V200	.22	.06	.01	.09	.04	.01	.01	.22	0	.05	.22	.05
	PERFIND	.32	.08		.10	.06	.03	.03	.30	.02	.09	.37	.14
	BILANZAT	.68	.40						.40	.28	.42	.75	.56
	V58	-.62	-.25						-.25	-.37			
	V44	-.45	-.13						-.13	-.32			
	V116	.41	.10						.10	.31			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; Pairwise deletion of missing cases; N = 1.508; Durbin-Watson-Coefficient: 1.75

Fig. 4: Path Analysis Determining the Acceptability of the Radiation Risk of Mobile Telephonee



Baden-Württemberg Risk Survey 2001 Person-weighted Data Set N = 1.508
Pairwise Deletion of Missing Cases; Durbin-Watson-Coefficient: 1.84

Table 8: Path Model: Explanation of the Acceptability of the Radiation Risk of Mobile Telephonee

Dependent variable	**Predictor**	**Bivariate correlation (r)**	**Direct effects (ß)**	**Indirect effects (ß) via ...** perfpiha	bilanzha	v59	›Causal‹ effects	›Noncausal‹ effects	Explained variance (R^2)	Multiple correlation (r)	Σ Expl. variance (R^2)
PERFPIHA	KALT	-.22	-.22				-.22		.05	.22	.05
BILANZHA	KALT	-.30	-.24	-.06			-.30	0	.09	.30	.09
	PERFPIHA	.33	.28				.28	.05	.07	.40	.16
V59	KALT	.16	.10	.06			.16	0	.02	.16	.02
	PERFPIHA	-.30	-.28				-.28	-.02	.08	.32	.10
V69	KALT	-.25	-.06	-.04	-.10	-.05	-.25	0	.06	.26	.06
	PERFPIHA	.40	.19		.09	.08	.36	.04	.13	.43	.19
	BILANZHA	.54	.33				.33	.21	.23	.65	.42
	V59	-.51	-.30				-.30	-.21			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; Pairwise deletion of missing cases; N = 1.508; Durbin-Watson-Coefficient: 1.84

The acceptability of the risk of climate change

Despite the comparatively complex model and a multitude of predictors, the acceptability of the climate risk can be explained much less successfully. Only 30% variance explanation could be attained.

On the highest level, culture-pessimistic alternative orientations are complemented by individuals feeling personally threatened above average by all the risks surveyed here. Timidity stands rather for an emotional disposition than for value orientation; it seems impossible to separate both levels of explanation by theoretical arguments.

The relatively high explanatory power of this first level is possibly due to the fact that the climate risk hardly becomes manifest in our latitudes. This might also effectuate, that risk acceptability is rather ›explained‹ by the level of ›distal‹ value orientations resp. personal dispositions (16%) than by proximal psychometric characteristics (13%).

Institutional trust supplies a mere one percent explanatory power, since *national* institutions are probably ascribed a markedly lower problem solving capacity for the successful management of this *globally* caused and effective risk. (cf. the contribution of Höhle in this paper)

This leaves us with the psychometric risk characteristics. These show a marked loss in explanatory power if the control is carried out according to the highest level: roughly half of the explanatory potential turns out to be a fictitious correlation. All in all, social benefit-risk balancing, the catastrophe potential caused by climate change and the question of the fairness of distribution of benefit and harm contribute an additional 13% variance explanation. The latter variable is polarized negatively in the survey instrument, so that risk acceptance increases with fairness of distribution as expected.

Three hypotheses could be inferred from these findings for future research: Firstly, the significance of normative explanatory potentials increases with the *abstractness of risks and detriments,* and the explanatory potentials of concrete risk characteristics decrease. Secondly, in non-manifest, abstract risks variance explanation is altogether lower than with risks which are well-known und where concrete damage has already taken place. Thirdly, institutional responsibility on the national, regional or local level declines with the increasing globalization of risks and vice versa.

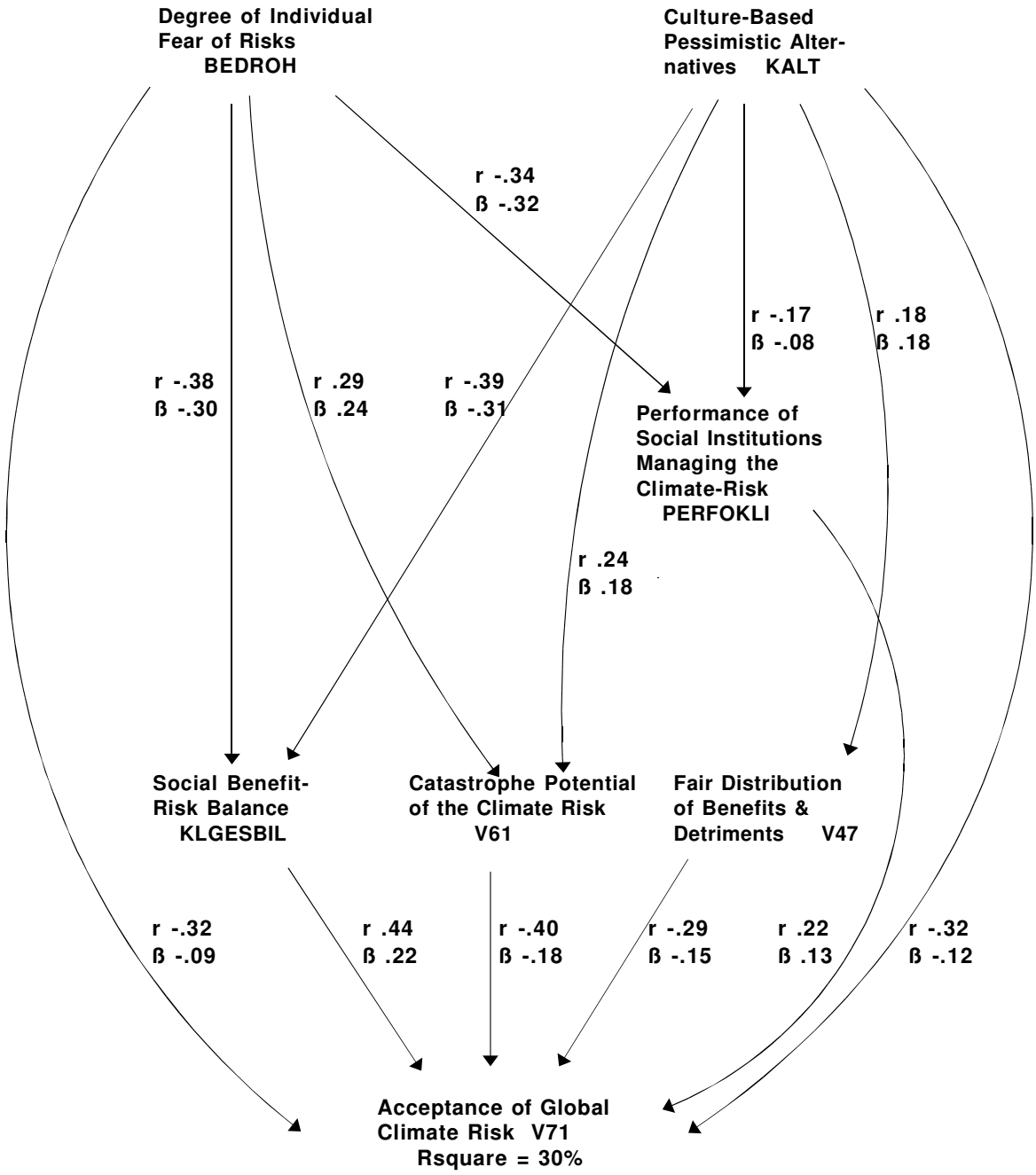
The acceptability of the BSE risk

At 44% variance explanation a markedly better result could be obtained with the explanation of the BSE risk. This is the only case where a demographic characteristic was able to assert itself: to farmers the BSE risk seems somewhat more acceptable than to the remaining population (3% variance explanation).

A markedly higher influence is based on the trust in producers: individuals ascribing high problem solving competence to the producers also consider the BSE risk acceptable to an above average degree (8% variance explanation).

It is of little surprise that in the case of the one risk, whose damage has already become apparent, the perceived risk characteristics have the largest proportion of explanatory power at 33%. Above all the dread of the risk - operationalized by *social* harm and catastrophe potentials - turns out to be a predictor with an especially high explanatory power. Whereas personal benefit potentials seen in large-scale livestock production and the perceived fairness of distribution of benefit and harm markedly drop off. The latter variable is again negatively polarized; the acceptability of the BSE risk increases with the perceived fairness of distribution.

Fig. 5: Path Analysis Determining the Acceptability of the Risk of Global Climate Change



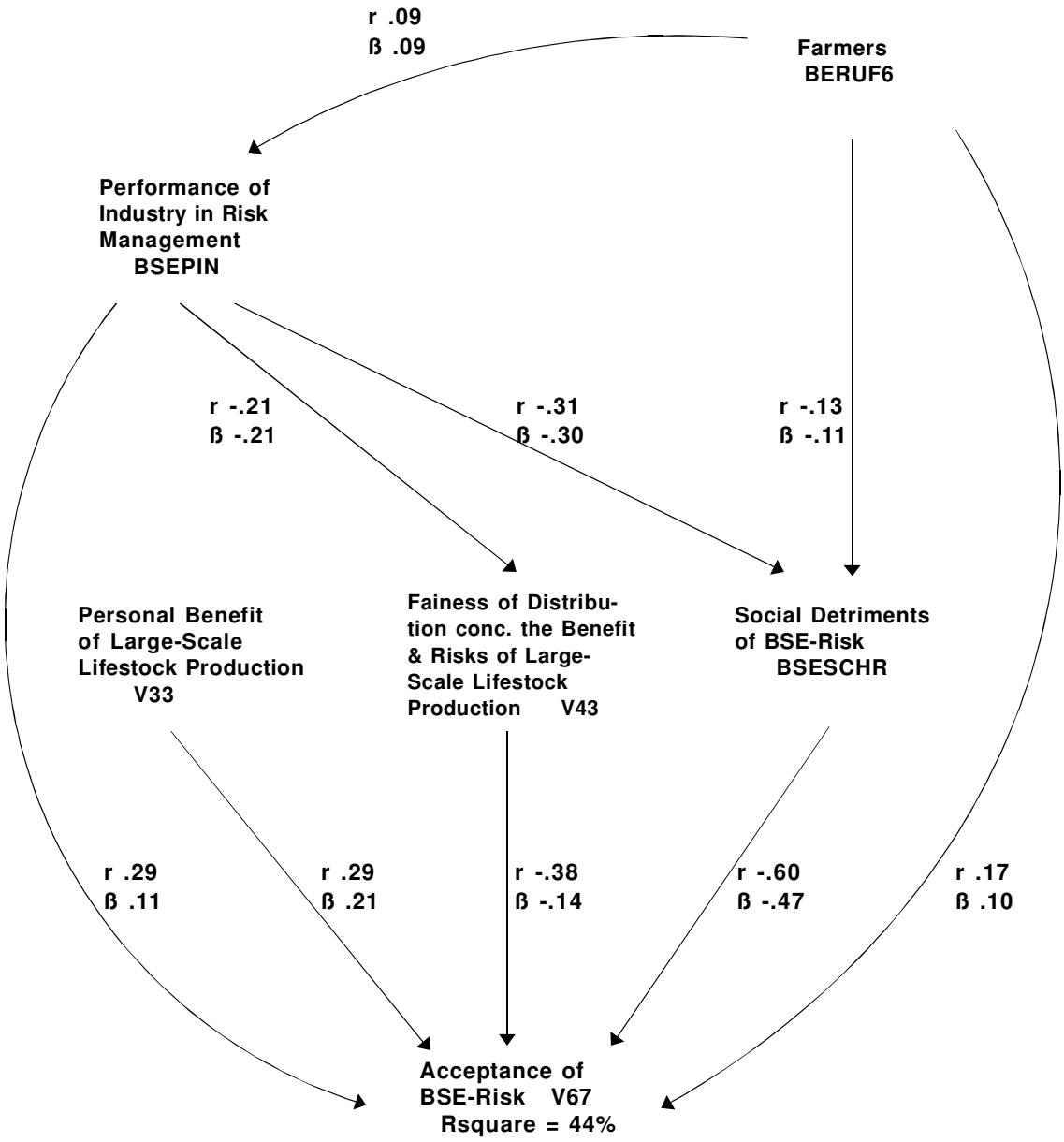
Baden-Württemberg Risk Survey 2001 Person-weighted Data Set N = 1.508
Pairwise Deletion of Missing Cases; Durbin-Watson-Coefficient: 1.62

Table 9: Path Model: Explanation of the Acceptability of the Risk of Global Climate Change

Dependent variable	**Predictor**	**Bivariate correlation (r)**	**Direct effects (ß)**	**Indirect effects (ß) via ...** perfokli	klgesbil	v61	v47	›Causal‹ effects	›Non-causal‹ effects	Explained variance (R^2)	Multiple correlation (r)	Σ Expl. variance (R^2)
PERFOKLI	BEDROH	-.34	-.32					-.32	-.02	.12	.35	.12
	KALT	-.17	-.08					-.08	-.09			
KLGESBIL	BEDROH	-.38	-.30					-.30	-.08	.23	.48	.23
	KALT	-.39	-.31					-.31	-.08			
V61	BEDROH	.29	.24					.24	.05	.11	.33	.11
	KALT	.24	.18					.18	.06			
V47	BEDROH	n.s.	-					-	-	-	-	-
	KALT	.18	.18					.18	0	.03	.18	.03
V71	BEDROH	-.32	-.09	-.04	-.07	-.04	-	-.24	-.08	~.08	.40	.16
	KALT	-.32	-.12	-.01	-.07	-.03	-.03	-.26	-.06	~.08		
	PERFO-KLI	.22	.13		-	-	-	.13	.09	.01	.41	.17
	KLGESBIL	.44	.22					.22	.22	.13	.56	.30
	V61	-.40	-.18					-.18	-.22			
	V47	-.29	-.15					-.15	-.14			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; Pairwise deletion of missing cases; N = 1.508; Durbin-Watson-Coefficient: 1.62

Fig. 6: Path Analysis Determining the Acceptability of the BSE-Risk



Baden-Württemberg Risk Survey 2001 Person-weighted Data Set N = 1.508
Pairwise Deletion of Missing Cases; Durbin-Watson-Coefficient: 1.87

Table 10: Path Model: Explanation of the Acceptability of the BSE Risk

Dependent variable	Predictor	Bivariate correlation (r)	Direct effects (ß)	Indirect effects (ß) via ...				›Causal‹ effects	›Non-causal‹ effects	Explained variance (R^2)	Multiple correlation (r)	Σ Expl. variance (R^2)
				bsepin	v33	v43	bseschr					
BSEPIN	BERUF6	.09	.09					.09	-	.01	.09	.01
V43	BSEPIN	-.21	-.21					-.21	0	.04	.21	.04
BSESCHR	BERUF6	-.13	-.11	-.02				-.13	0	.02	.13	.02
	BSEPIN	-.31	-.30					-.30	-.01	.08	.32	.10
V67	BERUF6	.17	.10	.01	-	.00	.06	.17	0	.03	.17	.03
	BSEPIN	.29	.11			.03	.14	.28	.01	.08	.33	.11
	V33	.29	.21					.21	.08	.33	.67	.44
	V43	-.38	-.14					-.14	-.24			
	BSESCHR	-.60	-.47					-.47	-.13			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; Pairwise deletion of missing cases; N = 1.508; Durbin-Watson-Coefficient: 1.87

The acceptability of genetically modified food

With a frugal model more than half of the variance - 55% - of the dependent variable can be explained. However, it is difficult to separate the levels because of the semantic ambiguity of variable 120: That reported incidents are perceived as ›a tip of the iceberg‹ can, on the one hand, be interpreted as distrust of the institutions entrusted with risk communication and risk management. On the other hand it can be interpreted as stigma effect, according to which minor incidents - as tip of the iceberg - are the precursors of much more severe harmful events. The interpretation as stigma effect would have required to place V120 on a separate explanation level in this model, whereby the logical status of stigma seems by no means unambiguous.

As indicator for low trust in institutions V120 explains - combined with the evaluation of the performance of industry and politics (PERFPIGE) - 29% of the variance, with the latter variable presenting itself as highly superior! The trust level thus becomes an even stronger predictor than the two psychometric variables which together contribute another 26% explanatory power. Here again the anticipated dread of risk - social harm and catastrophe potentials - proves to have a particularly high power of explanation. This findings underline the high importance of regulation, control, and conscientiousness people demand of producers and politics, when foodstuff-risks are to be assessed.

The acceptability of the risk associated with smoking

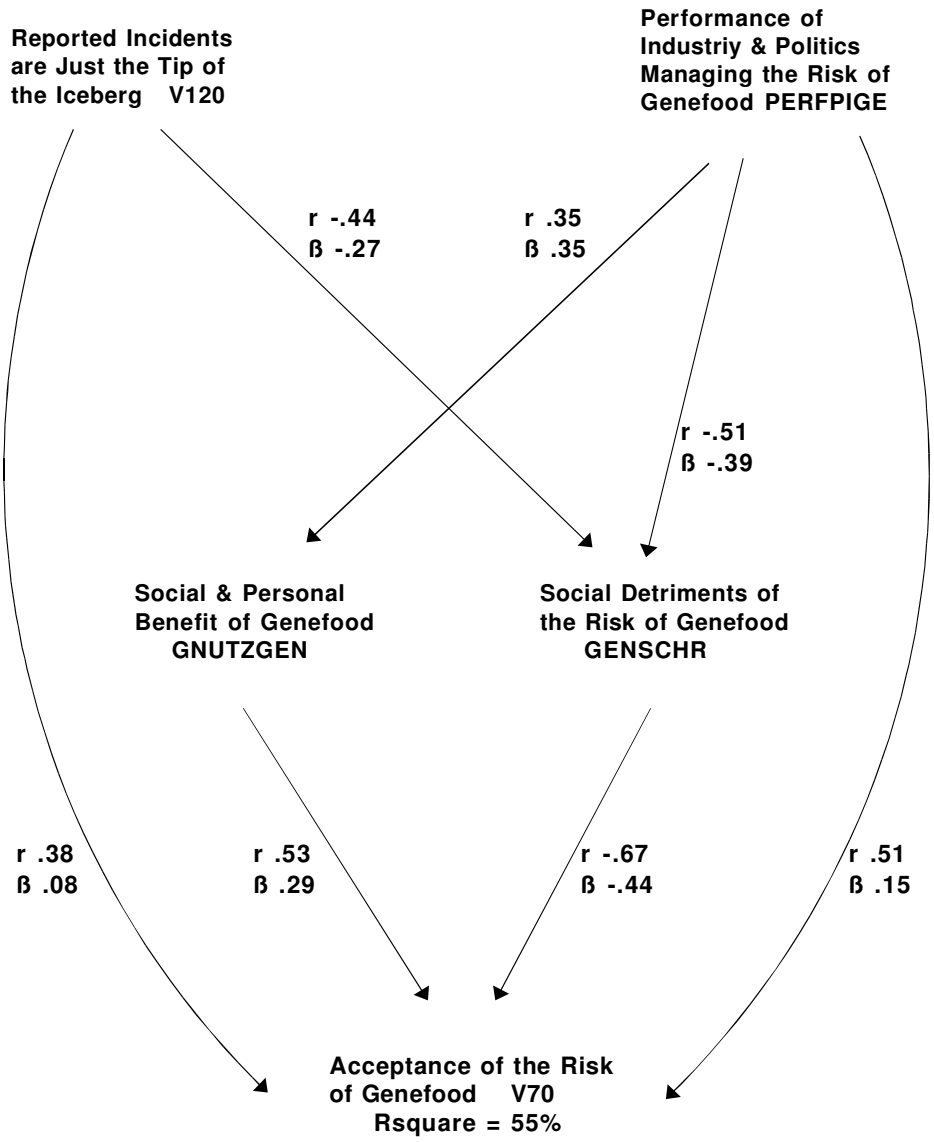
An important predictor for the acceptability of this risk is the question of whether a person is himself or herself a smoker (25% variance explanation!). Smokers are generally not inclined to overly dramatize risks: They evaluate the surveyed social damage and catastrophe potentials of all surveyed risks rather lower than non-smokers. The acceptability of the risk associated with tobacco consumption also grows (12% explanatory power) with the personality disposition of dramatizing risks only to a small degree.

It is highly plausible that values or the perception of the performance of social institutions do not play a role in this model, since smoking is obviously perceived as *voluntary risk*: after all, we are looking at a risk from the field of consumption and pleasure behavior, whose control lies almost entirely with the user himself or herself. In this point the risk also varies from BSE or genetically altered food, where individuals perceive markedly less control convictions and consider the need for institutional action and regulation greater.

In this old and well-known manifest risk, psychometric risk characteristics attain the highest explanatory power. The ascription of dread above all - high social harm and catastrophe potentials - turns out to be especially significant here. It may come as a surprise though that the question of feeling personally threatened by smoking and the risks associated with it plays only a minor role for acceptability.

The latter can be generalized for all the risks examined here: where the acceptability of risks is concerned, *social risk aspects*, above all harm and catastrophe potentials, usually outweigh the feeling of *personal threat*. In each of the models at least one of these two characteristics standing for social dread can be found in the psychometric risk characteristics. On the individual side, however, the benefit aspects or the balancing of benefit and risk potentials rather prevail perceived threat.

Fig. 7: Path Analysis Determining the Acceptability of the Risk of Genetically Modified Food



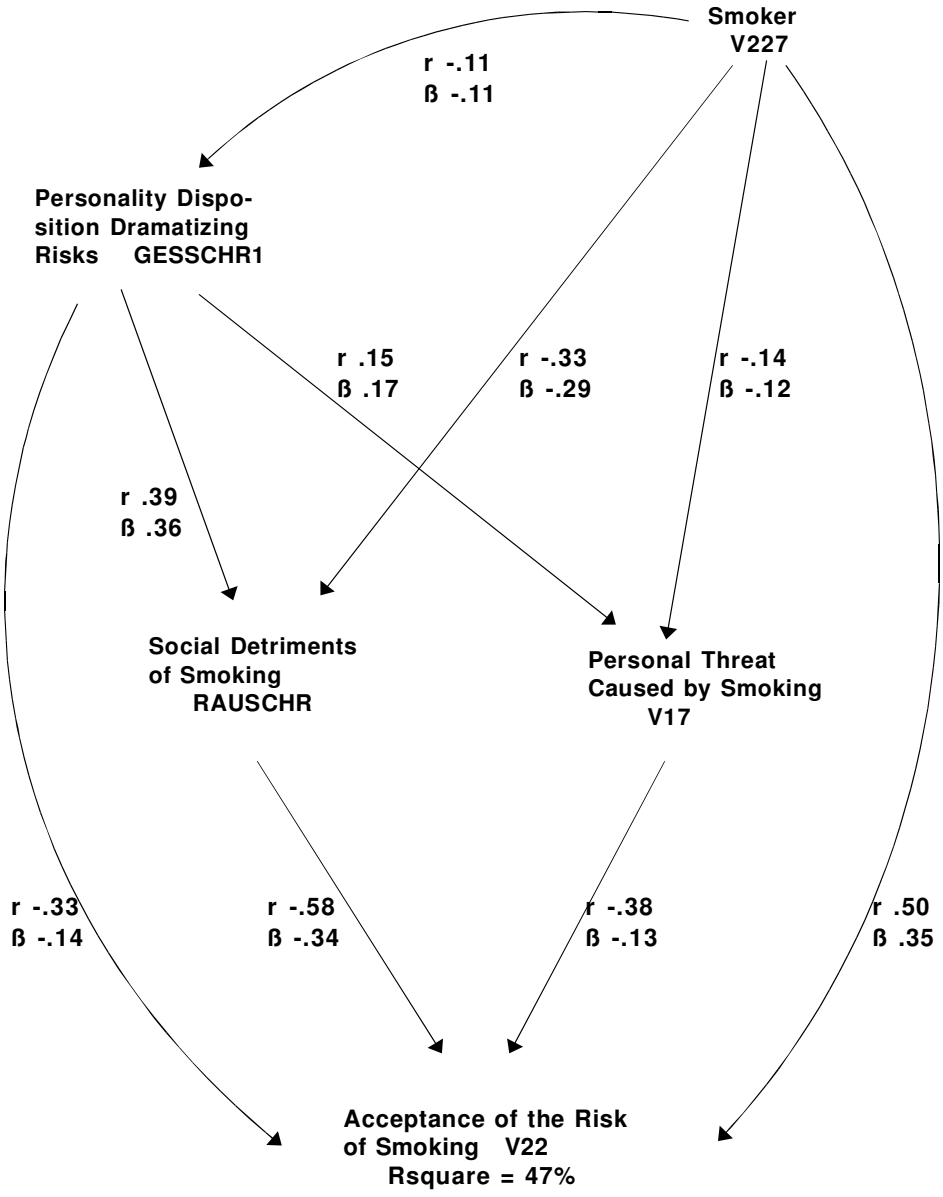
Baden-Württemberg Risk Survey 2001 Person-weighted Data Set N = 1.508
Pairwise Deletion of Missing Cases; Durbin-Watson-Coefficient: 1.80

Table 11: Path Model: Explanation of the Acceptability of the Risk of Genetically Modified Food

Dependent variable	**Predictor**	**Bivariate correlation (r)**	**Direct effects (ß)**	**Indirect effects (ß) via** gnutzgen	genschr	›Causal‹ effects	›Noncausal‹ effects	Explained variance (R^2)	Multiple correlation (r)	Σ Expl. variance (R^2)
GNUTZGEN	PERFPIGE	.35	.35			.35	-	.12	.35	.12
GENSCHR	PERFPIGE	-.51	-.39			-.39	-.12	.32	.57	.32
	V120	-.44	-.27			-.27	-.17			
V70	PERFPIGE	.51	.15	.10	.17	.42	.09	.29	.54	.29
	V120	.38	.08		.12	.20	.18			
	GNUTZGEN	.53	.29			.29	.24	.26	.74	.55
	GENSCHR	-.67	-.44			-.44	-.23			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; Pairwise deletion of missing cases; N = 1.508; Durbin-Watson-Coefficient: 1.80

Fig. 8: Path Analysis Determining the Acceptability of the Risk of Smoking



Baden-Württemberg Risk Survey 2001 Person-weighted Data Set N = 1.508
Pairwise Deletion of Missing Cases; Durbin-Watson-Coefficient: 1.57

Table 12: Path Model: Explanation of the Acceptability of the Risk of Smoking

Dependent variable	**Predictor**	**Bivariate correlation (r)**	**Direct effects (ß)**	**Indirect effects (ß) via ...** gesschr	rauschr	v17	›Causal‹ effects	›Non-causal‹ effects	Explained variance (R^2)	Multiple correlation (r)	Σ Expl. variance (R^2)
GESSCHR	V227	-.11	-.11				-.11	-	.01	.11	.01
RAUSCHR	V227	-.33	-.29	-.04			-.33	0	.11	.33	.11
	GESSCHR	.39	.36				.36	.03	.12	.48	.23
V17	V227	-.14	-.12	-.02			-.14	0	.02	.14	.02
	GESSCHR	.17	.15				.15	.02	.02	.21	.04
V22	V227	.50	.35	.02	.11	.02	.50	-	.25	.50	.25
	GESSCHR	-.33	-.14		-.12	-.02	-.28	-.05	.07	.57	.32
	RAUSCHR	-.58	-.34				-.34	-.24	.15	.68	.47
	V17	-.38	-.13				-.13	-.25			

Baden-Württemberg Risk Survey 2001; Person-weighted Data Set; Pairwise deletion of missing cases; N = 1.508; Durbin-Watson-Coefficient: 1.57

3.10 Summary

On the whole, the acceptability of the examined risks can be explained well to very well by regression analysis. The path models introduced have some special features. Table 13 offers a synopsis of the main findings:

Table 13: Risk Acceptability: The Explanatory Power of Different Theoretical Approaches - a Synopsis

Predictors	Risk					
	Nuclear Power	Cellular Phones	Climate Change	BSE	Gene-food	Smoking
Stigma	0%	0%	0%	0%	0%	0%
Socio-demography	0%	0%	0%	3%	0%	0%
Personal disposition	0%	0%	≈8%	0%	0%	32%
Value orientations	5%	6%	≈8%	0%	0%	0%
Trust in institutions	9%	13%	1%	8%	29%	0%
Psychometry	42%	23%	13%	33%	26%	15%
Σ explained variance	**56%**	**42%**	**30%**	**44%**	**55%**	**47%**

1. Socio-demographic characteristics are almost insignificant in the explanation of risk acceptance. For one, this may be caused by the circumstance that - as Sjöberg explains (1997: 114) - it seems difficult for distal characteristics to disclose explanatory power. For another, processes of individualization and the dissolution of large social groups with demographically ›typical‹ members surely does not speak for the strength of demographic variables.

2. The situation is similar with the effects of stigmatization. However, we make the restriction here that stigma theory in itself cannot be refuted with the analysis at hand. For one, it is conceivable that there may appear certain risks which are highly stigmatized, with corresponding empirical significance of stigma-theoretical predictor variables. During the data collection period of the survey at hand, there was no ›hot spot‹ of risk communication. For another, it became obvious how difficult it is to operationalize stigma theory. It cannot be excluded that the weakness of the stigma-theoretical approach has to do with the selected operationalization strategies. Here qualitative research could help determine suitable characteristics clearly geared to stigma.

3. When considering the examined risks only those predictors which stem from approaches using trust, value and above all psychometric theories gain explanatory power. In the latter, characteristics relating to social aspects of risks prevail: Especially social harm and damage potential turn out to develop high explanatory power in all models.

4. On the side of the conceived personal risk consequences, however, the subjective threat exerted by risks plays a subordinate role. Instead, the interviewees are inclined to make the acceptability of risks dependent on the balancing of aspects of benefit and harm. These findings rather speak out against the assumption that the public is prone to emotionalize perception and to generally reject risks.

5. By and large psychometric risk characteristics turn out to be the strongest predictors; they constitute roughly half to two thirds of the overall explanatory power in each case. With the remaining proportions of explanation predictors, trust theory proved to be altogether stronger than those of value theory. But the picture is not homogenous. There is a strong impression that psychometric risks have a particularly high explanatory power where known risks are concerned, where experience can fall back on already occurred damage. Possible future harm or abstract risks, however, seem to support rather value theories.

6. It seems that with the subjective conviction of decreasing individual control, the significance of the trust-theoretical approach increases. Yet, the opinion that trust is a surrogate for knowledge could not be confirmed. The attempt by Kastenholz to operationalize trust-theoretical variables by institutional performance proved to be excellent. This sociological construct of institutional trust has definitely asserted itself against the confidence-based variant of trust, as was shown by the bivariate findings.

7. Where value orientations as predictors of risk assessment are concerned, it becomes obvious that concepts offering a wide semantic basis of the term ›value‹ as well as a comparatively high sociocultural differentiation have the highest potential of explanation. As the majority of interviewees tend to rather guarded, ambivalent or sceptical attitudes where risk perception and evaluation is concerned, it is plausible that value concepts can unfold the highest differentiating power at the small but ›eccentric‹ edges of value orientations. Particularly technocratic on the one hand and culture-pessimistic orientations on the other hand become reasonable predictors for risk acceptability.

8. Our models largely provide proof that variables have a higher explanatory power for the willingness to tolerate risks the more proximate the predictors are to the dependent variable and vice versa. It seems exaggerated however to deny distal predictors all power of explanation, as was done in Sjöberg's radical criticism of approaches based on culture theory (1997). It is not only the data's high differentiation, but also the question of the theoretical significance of explanations which speak against such a point of view. If it should prove that the semantic understanding of risk in the public is synonymous to social harm or catastrophe potential, then the *empirical* potential of explanation of these variables for risk acceptability is certainly high. Because of the partial tautology with these psychometric predictors and risk semantic, few would be gained in *theoretical respect*!

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4. The Public's Understanding of Risk
A Qualitative Analysis of the Semantics of a Many-Faceted Term

(Marcus Heinßen, Alexander Sautter, Michael M. Zwick)

4.1. Introduction

Risk is a kaleidoscopic, variable term, the implications of which people are confronted with daily in the shape of threats and hazards; to others it offers opportunities and challenges. Numerous recent studies on the perception and evaluation of risks deal with social topics such as the question of the acceptability of large-scale technologies, the willingness to purchase and operate technical products, the evaluation of places of residence, and many others associated with the evaluation of risk. The example of BSE has shown that risks which are perceived to be inappropriately high can lead to the boycotting of products, in some instances involving dramatic consequences to the economy. But even politics is occasionally interested in gaining more insight, for example in cases where it would be advantageous to know whether to promote one technology or another, where the licensing of industrial facilities is concerned, the decisions about industrial sites or threshold values - but also when political legitimization threatens to become problematic because the population feels that imminent dangers are not at all or insufficiently discussed and dealt with by politicians. In these and similar cases it can be important to learn about the fears and anxieties, but also about the hopes and expectations of the citizens. Furthermore, it can be even more important to reach decisions and compromises supported by all in a participative process. Ultimately the question of what funds should be invested in the prevention and management of which risks is not a trivial matter, considering the largely empty public coffers. At this point it may become significant as to which risks people are particularly aware of, which are feared but also which mental resources, measures and arguments are developed to subjectively evaluate risks.

Answers to these questions are particularly relevant for two reasons: for one, people perceive scientists frequently being unable to provide unambiguous facts about the frequency and seriousness of harmful events or insidious hazards. Uncertainty communicated by public persons and thus insecurity experienced by the public can promote the process of subjective opinion formaing regarding the peoples' ›life-world‹. For another, risk surveys are frequently based on politically relevant topics, such as the question of whether the German public is prone to be averse to technology and being risk-shy. Considering the political and economic significance of the innovative ability of a hi-tech Germany, technological risks easily become the focus of a survey. But does this really touch the heart of what people associate with ›risk‹, or does one ›shoot past‹ the lay public's perception of risk? In the constructivist disposition