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Cross-cultural comparison of risk perceptions: Research, results, relevance

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Abstract:

In risk perception research, psychologists, sociologists and political scientists investigate how individuals judge and evaluate hazards related to working conditions, private activities, technological developments, residential settings, environmental hazards and global ecological changes. The main issues are: subjective concepts underlying risk judgments, the determinants of perceived risk magnitude and risk acceptance, and differences between societal groups or countries and cultures. Most studies are based on a 'psychometric' approach, i.e., risk sources are scaled according to a set of substantive risk criteria.

The presentation will illustrate why risk is a multi-facetted concept, how interpretations of risk issues tend to clash when looked at from conflicting worldviews, and which factors determine how people think about risks and make judgments about hazards, using data collected in 3 'western' and 3 'eastern' countries, including Australia, Canada, China, Germany, Japan, and Singapore.

Social-scientific research on risk perception has explicated the strong influence of socio-psychological factors and the cultural quality of risk evaluations. How the magnitude of risks is rated, and to what extent people are prepared to accept a risk, is dependent on the type of hazard, on personal experiences, beliefs and attitudes, and on diverse societal influences. Judgments are more negative for technology-induced than for natural hazards, and involuntary than self-chosen (controllable) risk exposure. Fear associations, unfamiliarity, catastrophic potential and long-term health impacts are stronger influences than assumed probability to die. Clearly, 'technical' and statistical risk characteristics cannot explain risk acceptance data. While individual and particularly societal benefits counterbalance risk concerns for occupational and private risks, this is less true for large-scale technology risks. Regarding personal characteristics, attitudes such as environmental concern, scepticism about technology usage and ‘post-material’ value orientation are significant determinants (while socio-demographic factors have only restricted effects). Those attitudes are embedded in a wider cultural and political context; therefore, societal (sub-)groups differ widely in risk acceptance. Also, acceptance or defiance of risks is not determined by knowledge (or lack thereof) - value disparities are the key factor.

Such findings are valuable for a better understanding of people's attitude toward risk and societal risk controversies. They can be utilized for designing comprehensive risk communication - which is an indispensable component of effective risk management.

Selected publications:

Rohrmann, B. Perception of risk - Research overview. In J. Gough (Ed.), Sharing the future - Risk communication in practice. Christchurch: CAE, University of Canterbury, 2003.

Rohrmann, B. & Renn, O. Risk perception research - An introduction; in: Renn, O. & Rohrmann, B. (Eds.): Cross-cultural risk perception research; Dordrecht: Kluwer, 2000.

Rohrmann, B.: The risk notion - epistemological and empirical considerations; in: Stewart, M.G., & Melchers, R.E. (Eds.): Integrative risk assessment; Rotterdam: Balkema, 1998.

Rohrmann, B. Risk perception of different societal groups: Australian findings and cross-national comparisons; Australian Journal of Psychology, 46, 150-163, 1994.

In preparation:

Rohrmann, B. Perception and appraisal of risks in 'Eastern' and 'Western' countries - A cross-cultural empirical study.

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Note: tables and figures -- which were used in the presentation -- are at the end of this text

1 CONCEPTS AND APPROACHES

Risk perception has been a vivid area of both societal debate and scientific research for two decades now. In this interdisciplinary area, psychologists, sociologists and political scientists investigate how individuals judge and evaluate hazards related to working conditions, private activities, technological developments, residential settings, environmental hazards and global ecological changes. Researchers of particular backgrounds as well as the various groups within 'the public' often differ in their understanding and use of risk-related terminology; therefore this text begins with a brief discussion of main concepts and approaches.

1.1 Hazards and risks

Without question "risk" is a highly topical term. To illustrate this: an internet search for "risk" in May 2001 produced an amazing number of hits, namely 10254835 or 8573640 or 5514845 by three search engines. However, there are many meanings of this concept, in terms of both denotations and connotations. One reason for this is that hazards, the sources of risks, are very heterogenous, as the taxonomy presented in *Box 1* elucidates.

{Box 1}

From a socio-psychological perspective, it is important to be conscious of differences between physical and psychological phenomena, and to distinguish between judgments, attitudes and behaviors in respect to risk situations. In *Box 2* a set of definitions for relevant risk terms is outlined.

A hazard is a physical entity while risk is not; it is an inference about the implications of a hazard for people (or nature, or assets) exposed to it. In most contexts “risk” refers to a danger of unwanted *negative* effects; however, in some fields “risk” is treated as a *neutral* term (equating to uncertainty about the outcomes of choices), and there is also a *positive* connotation, such as ‘desired risk’ (e.g., 'getting a thrill' by acting in a risky manner). Clearly risk is a multi-facetted concept.

{Box 2}

Risk perceptions are interpretations of the world, based on experiences and/or beliefs. They are embedded in the norms, value systems and cultural idiosyncrasies of societies. Every human is busy with risk perception most of the time, whether driving a car or thinking about health care or worrying about upcoming bad weather and so on. Strictly speaking risks cannot be “perceived” (like a size or speed or the weather). However, risk perception has become the standard label of the respective research topic.

It is important to note that most people have views about every risk, regardless of whether they are exposed to it or not. Also, neither perceptions of nor attitudes towards risk should be taken as equivalents of *actual* behavior.

Risk perceptions can be quantified by socio-psychological scaling and survey techniques (e.g., the psychometric approach, cf. section 1.4). In other words, while risk perception is subjective in nature, the data describing it are as objective as other scientific findings.

Relevant texts for this section:
Drottz-Sjoeberg 1991, Fischhoff, Watson & Hope 1984, Lupton 1999, Renn 1992-a, Rohrmann 1998, Short 1989, Vlek 1996,Yates & Stone 1992.

1.2 Perceived versus "real" risk

The understanding of "risk" in natural and social sciences tends to clash. For example, quite often the term "real" or "actual" risk is used as counterpart to "perceived risk". Epistemologically this does not make much sense though. All statements about risk, whether rough guesses or highly quantitative data-based computations, are only depictions of the “reality” in question (cf. *box 3* for an illustration).

{Box 3}

It appears more appropriate to label results from Quantitative Risk Assessments (which can be seen as a model-based estimate of the “real” risk) as, e.g., “statistical” -- which then may be contrasted to perceived risk.

Relevant texts for this section:
Hudrey 1996, Rohrmann 1998, Slovic 1996.

1.3 Risk acceptance

The concept *risk acceptance* refers to statements about the acceptability of a risk in individual or societal terms, i.e., whether it is evaluated as being tolerable or not. *Principal* acceptability is the normative, and *actual* acceptance the empirical aspect.

In strict terms "acceptance" would need to be based on a deliberate decision; however, if people do not choose or refuse a risk situation intentionally, defacto acceptance results.

Relevant texts for this section:
Fischhoff et al. 1982, Fischhoff 1994, Handmer et al. 1991,Vlek & Cvetkovich 1989.

1.4 Approaches to study human perception of hazards and risks

Both quantitative and qualitative research methods have been used extensively to study and explain risk perception. In the first phase, pertinent studies were interested in general principles of risk perception. More recently, the focus is on cultural differences within and across societies.

The dominating approach, often labelled "psychometric paradigm", is based on four intentions:

◇ 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 statistical procedures such as factor analysis, multi-dimensional scaling or multiple regression.

This approach was developed by B. Fischhoff, S. Lichtenstein and P. Slovic, the "Oregon Group". Many researchers followed their approach, most of them in the USA and European countries.

The subjective meaning of risk concepts, evaluation of risk sources and determinants of risk acceptance have also been investigated by means of qualitative approaches.

Psychometric studies are based on individual or group responses to risk issues. However, the process of risk perception in society has been thoroughly analyzed from a 'macro-sociological' perspective as well. Sociologists have particularly stressed that the evaluative process of risk perception is determined by the norms, value systems and cultural idiosyncrasies of societies. According to the "cultural theory" approach, risk is a "social and cultural construction" - not an 'objective' entity to be measured independently of the context in which hazards occur.

Most of the research conducted so far follows the psychometric paradigm. Some researchers have attempted to bridge the gap between psychological and sociological conceptualizations of risk perception research.

Relevant texts for this section:
Arabie & Maschmayer 1988, Beck 1992, Boholm 1998, Dake 1992, Douglas & Wildavsky 1982, Earle & Lindell 1984, Fischer et al. 1991, Fischhoff et al. 1978, Fischhoff et al. 1997, Guerin 1991, Johnson & Covello 1987, Luhmann 1990, Marris, Longford & O'Riordan 1998, Pigeon et al. 1992, Rayner 1992, Renn 1990, Rohrmann 1999b, Slovic et al. 1980, Slovic 1992, Tyszka & Goszcsynska 1993, Wildavsky 1988.

2 FINDINGS FROM RISK PERCEPTION STUDIES

Risk perception research is a large and flourishing area, with studies from at least two dozen countries. Only few examples of empirical results can be presented here. For a substantive discussion of main findings see authors such as Slovic, Renn, Pidgeon; a comprehensive review and documentation of this body of research is provided by Rohrmann (1999).

2.1 Main research questions

The core interest of risk perception research is to understand how people subjectively assess hazards and how the manifold aspects of risk judgments are related. This interest is linked to several further research issues, as outlined in *Box4*.

{Box 4}

Cultural differences in risk perception can be investigated from several perspectives, based on intra-national group comparisons or cross-national studies, as listed in *Box 5*.

{Box 5}

2.2 Design of a cross-cultural project

In the following paragraphs a few results from the author's longterm Project CRC, "Comparison of risk perception in different countries and cultures" will be presented, because this is the only risk perception study conducted in a large set of cultures (including Australia and New Zealand). The 'problem space', with the three facets: hazards, risk features, respondents, is summarized in *Box 6.*

{Box 6}

The project actually consists of two sub-projects, both cross-national, with data collections in 3 and 6 countries; the respective samples are listed in *Box 7.*

The principal interest of CRC-1 was
◇ to analyze the cognitive structure of subjective hazard evaluations,
◇ to identify differences between societal groups of distinctive professional background;

the main focus of CRC-2 was
◇ to compare two culturally different sets of countries ('western' versus 'eastern'),
◇ to look at differences between scientists and students.

{Box 7}

The principal psychometric approach and the underlying conceptual model is the same for both sub-projects. Final comparative data analyses are currently underway.

Relevant texts for this section:
Rohrmann 1994, 1996, 1999, 2000.

2.3 Risk magnitude ratings for hazard types

A first interest is which hazards are rated highest on riskiness scales. As an example, in *Box 8* the result for New Zealand are given, these are mean judgments (including all 8 groups) for 24 risk sources.

{Box 8}

Overall, the following risks get the most negative evaluations in terms of perceived risk magnitude <RM>, assumed probability of dying <PD> and health impacts <HI>: long-term heavy smoking, working in asbestos production, living in polluted urban areas, and living near a nuclear power plant. These risk sources also induce the most fear associations <FA>. Not surprisingly, catastrophic potential <CP> is seen as highest for nuclear power (much higher than for earthquakes - which might surprise, given the enormous death toll which many earthquakes incur).

The personal risk exposure <PR> is rather low for most risk sources; the highest scores are for smoking, overeating and the earthquake hazard. Obviously smokers know as well as non-smokers about the risk: smoking clearly ranks highest in all three pertinent aspects <RM, PD, HI>.

Relevant texts for this section:
Rohrmann 1996.

2.4 Judgments of individual & societal risk acceptance

Box 8 also contains the results for benefit and acceptance ratings, both measured with regard to an individual and a societal viewpoint. Regarding the risk for oneself <IA>, again nuclear power, asbestos production, and polluted urban areas get the most negative ratings. Regarding risks for society at large <SA>, smoking, tranqillizers and nuclear power are seen as least acceptable. (By the way, there are no nuclear power stations in NZ, nor in Australia).

Less adverse ratings are given to skiing, flying an emergency helicopter, coal power plants and living in electric storm areas. For sporting activities, a positive individual benefit <IB> is seen, and for public service professionals (e.g., fire fighters) both individual and societal benefits <SB> are highly valued. Commonplace technical facilities (e.g., airports, chemical industry) are accepted as fairly beneficial as well.

The set of hazards investigated in this project was based on a taxonomy of risk sources, allowing for the comparison of defined hazard types. The results - cf. *Box 9,* taken from the German sample illustrate the following:

◇ Hazard impacts: Judgments of fatality rates are higher for risks comprising an acute danger (i.e., accidents/catastrophes); in comparison, health impacts are judged higher for chronic risk exposure.

◇ Benefits: for both occupational and private risky behaviors, people perceive benefits for themselves (even smoking or working with dangerous tools); however, benefits for the society relate to occupational activities only.

◇ Acceptance: Individual risk acceptance tends to be higher for private activities (e.g., sport or consumption risks), societal risk acceptance clearly is higher for occupational hazards. Regarding residential environmental risks, risk acceptance is higher for natural hazards from both a societal and an individual perspective. On average, risky activities are more accepted than risks related to residential hazards - voluntariness might be the crucial factor for this difference.

Differences in risk magnitude are small and were neither expected nor even intended, given the selection rationale for the risk sources considered in this project.

{Box 9}

What determines whether risk sources are accepted or not? The principal model assumes that acceptance is decreased by risk magnitude and increased by benefits associated with the risk source, and that attitudes and 'worldviews' people held are co-determinants ('moderators') of this judgmental process. Conceptions like this can be analyzed by multiple regression and especially structural/causal modelling, e.g., the LISREL approach. Its purpose is to identify "linear structural relationships" among constructs on the basis of a hypothesized theoretical model. One such analysis is shown in *Box 10.* It was computed with both Australian and German data (cf. values on the right and the left in the graph) .

{Box 10}

This model was developed by introducing overarching constructs, namely, "adverse impacts" (with probability of dying <PD> and concern about health impacts <HI> as indicators) and "risk as threat" (determined by risk magnitude <RM>, fear associations <FA> and catastrophic potential <CP>); these variables represent the negative evaluation of hazards. Societal risk acceptance <SA> is introduced as a final dependent variable. In terms of risk sources, six technological hazards (N/O/P/T/U/V; cf. Box 8) are used and aggregated into sum variables. The result is well in line with the basic claims of the project's theoretical framework and it particularly affirms the significance of the "threat" aspect in risk perception.

This model also demonstrates the considerable influence of ecological attitudes, here measured as a composite of environmental concern <AEC>, worry about the impacts of technology <AIT> and 'post-material' societal values <ASV>: the stronger these attitudes, the more likely technological hazards are seen as threats and the less likely are benefits associated.

Together these findings elucidate the socio-psychological factors contributing to the 'intuitive' risk concept which people use for risk evaluations and their significance for risk acceptance.

Relevant texts for this section:
Joereskog & Soerbom 1988, Rohrmann 1994.

2.5 Differences between societal groups

The sampling approach of this project is based on the assumption that people with a specific professional and/or ideological background ("worldviews" or "cultural biases") differ in their evaluation of risks. A comparison of the respective subgroups (cf. Box 7, above) confirms this expectation. The findings for the countries included in project CRC-1 (NZ, Australia, Germany) are similar and can be summarized as follows:

◇ People with an "ecological orientation" as well as those involved in "feminist" issues evaluate risks much more critically than the other two groups. For example, for most risk sources, their ratings on all riskiness scales <RM, PD, HI, CP> and feelings of anxiety <FA> are higher, while benefit judgments <IB, SB> and risk acceptance <IA, SA> are lower. By comparison, those with a "technological orientation" show the lowest risk ratings, see more benefits and are more ready to accept risks. The judgments of the "monetarian" group fall in between the extremes.

◇ This pattern is most obvious for technology-induced risks, as shown in *Box 11*. The largest group differences occur with "living near a nuclear power plant" or "chemical industry" (which in fact are the most debated large-scale technologies anyway).

◇ There are some interesting exceptions to the general pattern. For example, with respect to 'consumption risks' such as smoking, tranquillisers and overeating, engineers and technology students give the lowest acceptance ratings while the "monetarian" and "feminist" groups yield surprisingly high scores.

{Box 11}

Group differences with respect to employees vs. students were also analyzed. The effects were smaller than expected and insignificant for most risk sources and risk aspects; therefore the groups were pooled.

In sub-project CRC-2, significant group differences were found too, but they are less clear-cut. It appears that "geography" students are the most and "technology" students the least concerned about environmental hazards. Individual risk acceptance is lower for the "scientists" group than for students; this is strongest for 'lifestyle' risks.

Altogether the societal groups looked at in this research differ considerably and systematically in their risk perception. Interestingly, at least for the three countries looked at in project CRC-1, disparities between societal groups tend to be stronger than cross-national differences, particularly regarding technology-induced risks. This is in line with the strong influence of environmental and societal attitudes on risk acceptance shown above (Box 10).

Relevant texts for this section:
Dake 1991, Thompson 1990

2.6 Cross-national differences

A cross-national comparison for the three countries from Project CRC-1 is given in *Box 12,* containing mean judgments for risk aspects. Significant differences include: NZ and Australian respondents reveal more acceptance <IA, SA> for sport-related risks (e.g., car racing or skiing) and unhealthy private behaviors (e.g., smoking, overeating), and they give lower risk ratings <RM, PD, HI, CP> for 'conventional' technologies (e.g., airports, coal power plants). In contrast, risk-exposed occupations (even those of high social benefit <SB>, e.g., fire fighting), environmental pollution and large-scale technology such as nuclear energy get more negative evaluations than from the German respondents. However, given the highly critical views on nuclear power in Australia and especially NZ, the latter difference is not as large as expected.

The results from NZ and AU are much the same, apart from some disparities regarding earthquakes, a hazard more familiar to New Zealanders.

{Box 12}

For results from Project CRC-2, a comparison of risk perception in "Western" and "Eastern" countries, as expected, differences are considerably larger than those among the three countries included in Box 12; see *Box 13* with data regarding perceived risk magnitude and individual risk acceptance for 6 countries.

{Box 12}

A further issue for cross-national studies is to analyze whether the described disparities between societal groups are valid across countries. Respective comparative tables cannot be included here, but the findings indicate this:

◇ The 'pattern' of disparities between groups with a "technological" or "monetarian" versus "ecological" or "feminist" orientation" is quite similar;

◇ inter-group differences are stronger for the German data, while group polarization is lower for the Australian and NZ groups.

Altogether the cross-cultural differences found in this project form a rather complex pattern, reflecting an interplay of group attitudes, national ideosyncracies and cultural factors in general.

Relevant texts for this section: Rohrmann 1999, Rohrmann 2003.

3 INTEGRATION AND APPLICATION

After twenty years of intensive research, risk perception can be seen as a 'mature' field. The rich body of findings has many implications for other areas as well, especially for risk information and management.

3.1 A structural model of the subjective evaluation of risks

Numerous psychological and sociological studies on the factors underlying risk perception have clarified that a multitude of factors influence how humans perceive, evaluate and handle risks. In *Box 14* the relevant findings - particularly those from structural/causal modelling - are 'condensed' into an influence diagram.

{Box 14}

The structure shown in this model is gained from analyses using a variety of risk sources and populations. The principal message of this model is that neither perceived risk magnitude nor acceptance of risks - the two core issues of risk perception - can be sufficiently explained by quantitative features such as event probabilities or expected damage. However, for specific risks and social groups the result could be quite different. For example, a variable such as 'catastrophic potential' seems to be relevant mainly for risks beyond individual control while 'probability of dying' might be considered for personal voluntary activities, general value orientations particularly influence judgments of technology-induced hazards while risk-taking propensity is most pertinent in financial risks contexts, and so on. Indeed, each individual may have a personal influence pattern for the relevance of variables in this model. This begins with the intuitive risk definition a person employs and ends with the importance of societal attitudes not specific to the risk source.

Relevant texts for this section:
Fischhoff 1995, Renn 1998, Rohrmann 1995, Rohrmann 1999.

3.2 The meaning of risk perception findings

The studies presented here have explicated the socio-psychological and culture-bound quality of risk evaluations. How the magnitude of risks is rated, and to what extent people are prepared to accept a risk, are dependent on the type of hazard, on personal experiences, beliefs and attitudes, and on diverse societal influences. Judgments are more negative for technology-induced hazards than for natural ones, and for involuntary rather than self-chosen (controllable) risk exposure. While individual, and particularly societal benefits, counterbalance risk concerns for occupational and private risks, this is less true for large-scale technology risks. Fear associations, unfamiliarity, catastrophic potential and worry about long-term health impacts are stronger influences than fatality statistics. Scepticism about complex mega-technologies (such as nuclear power) can become part of a country's cultural identity.

Clearly, statistical risk characteristics cannot explain risk acceptance data. As has been discussed by various psychologists, sociologists and some engineers as well, the 'technical'/'quantitative' approach of risk analysis is inadequate to reflect the complex pattern of individual risk evaluations. The way humans think about the magnitude and the acceptability of risks, and the way in which they make their respective judgments and decisions is influenced by a variety of 'qualitative' consequences of risky activities or living conditions that are not reflected in hazard scenarios, accident probabilities, death rates and so on. As people's attitudes towards risks are embedded in a wider cultural and political context, societal (sub-)groups differ widely in their risk evaluation. Also, acceptance or defiance of risks is not determined by knowledge (or lack thereof) - value disparities are the key factor.

How did such a situation evolve, and why have so many people strong views on risks even if they never personally encountered the respective hazards? To understand the complex picture of risk perception, both psychological and social processes need to be considered. In a theoretical framework developed by Kasperson's research group (1988), the "social amplification of risks" is seen as a core phenomenon. They particularly stress the influence of factors such as political/environmental movements or media coverage, which either intensify or attenuate the perception and interpretation of risk-related events. The enormous (but quite selective) public attention paid to some risks over the last decade is indeed salient. As all individuals are part of social 'arenas' they will inevitably be influenced by current societal debates.

Furthermore, individual styles in judgment and decision making need to be seen as culture-bound as well. The significance of personal characteristics such as risk-taking versus avoidance, 'rationality', and group adherence differs considerably across the cultures included in risk perception studies so far - in this respect risk perception research is rather at its beginning.

Relevant texts for this section:
Beck 1992, Dake 1991, Jungermann & Slovic 1993, Lopes 1992, Morgan 1993, Peters & Slovic 1996, Renn 1992-b , Renn 1998, Rohrmann 1995, Sjoeberg 1999, Stern & Dietz 1994, Trimpop 1994, Tweeddale 1994, Weber & Hsee 2000.

3.3 The relevance of risk perception for risk communication

Risk perception research is not just an academic enterprize - its findings are of substantial value for many tasks of *risk communication* - a social process by which people become informed about hazards, are influenced towards behavioral change and can participate in decision-making about risk issues. In *Box 15*, main reasons for utilizing knowledge about risk perception are summarized.

{Box 15}

Socio-psychological expertise on risk judgments and acceptance of risks is particularly relevant for a better understanding of conflicts about risk evaluation and can be applied to improving communication among the various parties involved in risk issues. Interactive communication and co-operative conflict resolution must be based on mutual knowledge and acceptance of the actor's way of thinking about risk.

Finally, the increasingly cross-cultural nature of risk perception research - providing knowledge about universal *and* culture-specific factors of subjective risk evaluation - can help to better adapt risk communication efforts to the needs of specific communities within their cultural context.

Relevant texts for this section:
Covello et al. 1989, Fischhoff et al. 1997, Kasperson & Stallen 1990, Lundgren & McMakin 1998, Renn 1992-b, Rohrmann 1991, Sjoeberg 1998.

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Bernd ROHRMANN

Cross-cultural comparison of risk perceptions: Research, results, relevance

BOXES:

1 Taxonomy of risk sources
2 Core concepts in risk research
3 Perceived, "real", modelled risk
4 Issues of risk perception research
5 Notions of "cross-cultural" risk perception research
6 Project CRC: Problem space
7 Project CRC: Sampling- groups of respondents
8 Hazard appraisal: Means for 24 hazards and 11 risk aspects - data: NZ
9 Mean judgments for different types of risk - German data
10 Evaluation of environmental hazards: Structural analysis
11 Ratings for technological hazards by different groups - German groups
12 Hazard appraisal: Cross-national comparison for 3 risk aspects, 3 countries (*CRC-1)*
13 Risk ratings: Country comparison - 6 countries -(*Project CRC-2)*
14 Subjective evaluation of risks: Structural model
15 Utility of risk perception research

Please note:
Boxes in "Courier" font
MUST be handled that way,
otherwise their layout falls apart!

Box 1:

TAXONOMY OF RISK SOURCES

Subject of risk:

```
 /  Risks for the state of the environment
:
 \  Risks for human's health, well-being and their assets
```

Types of personal risk exposure:

```
                              /  occupational
  Individual activities      :
 /                            \  private
:
 \                            /  natural hazards
   Residential conditions    :
                              \  technology-induced hazards
```

Kind of effects:

```
 / physical         / acute      / local       / present
 - financial        :            - regional    - next generation
 \ social           \ chronic    \ global      \ future
```

Box 2:

CORE CONCEPTS IN RISK RESEARCH

HAZARD
A situation, event or substance that can become harmful for people, nature or human-made facilities

RISK
The possibility of physical or social or financial harm/detriment/loss when exposed to a hazard

RISK PERCEPTION
People's judgments and evaluations of hazards they (or their facilities, or the environment) are or might be exposed to

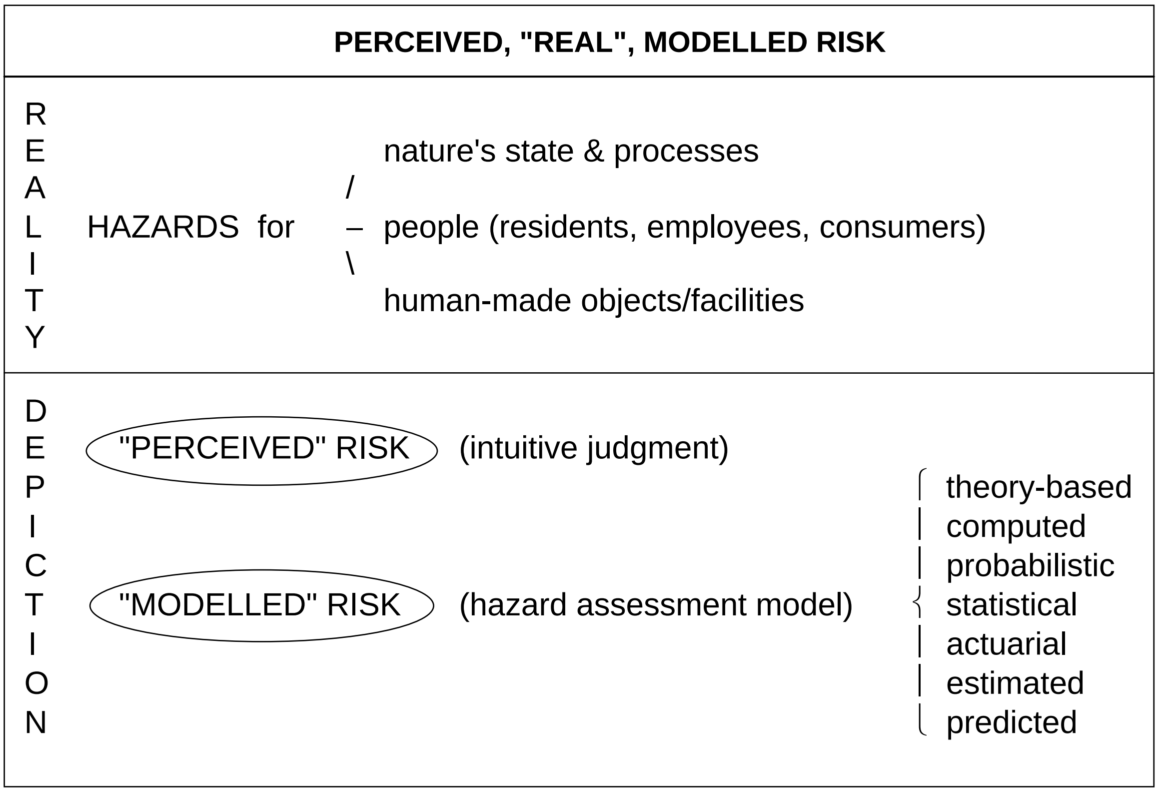
PERCEIVED RISK MAGNITUDE
A person's judgment (belief) about how large the risk associated with a hazard is

RISK ACCEPTANCE/REFUSAL
Decisions about the acceptability of risks in individual or societal terms (principal or de-facto)

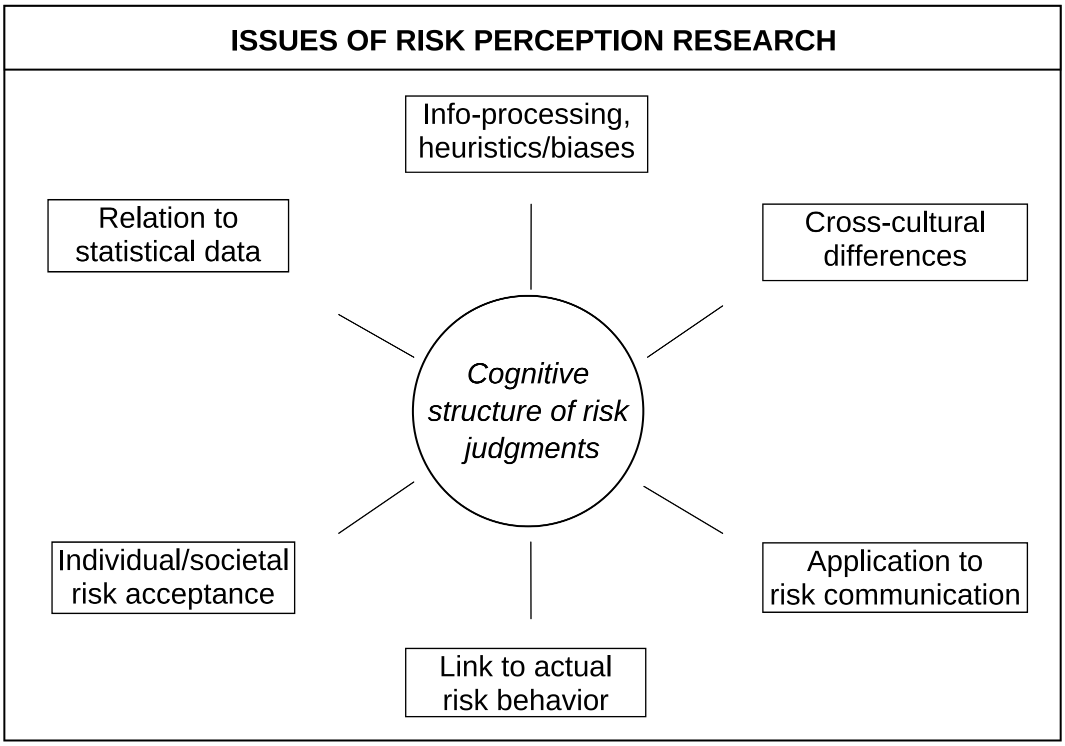
RISK PROPENSITY
An attitude towards taking a risk when deciding how to proceed in situations with uncertain outcomes

RISK BEHAVIOR
The actual behavior of people when facing a risk situation

Box 3:


PERCEIVED, "REAL", MODELLED RISK
REALITY
HAZARDS for
nature's state & processes
people (residents, employees, consumers)
human-made objects/facilities
DEPICTION
"PERCEIVED" RISK
(intuitive judgment)
"MODELLED" RISK
(hazard assessment model)
theory-based
computed
probabilistic
statistical
actuarial
estimated
predicted

Box 4:


ISSUES OF RISK PERCEPTION RESEARCH
Info-processing, heuristics/biases
Relation to statistical data
Cross-cultural differences
Cognitive structure of risk judgments
Individual/societal risk acceptance
Application to risk communication
Link to actual risk behavior

Box 5:

NOTIONS OF "CROSS-CULTURAL" RISK PERCEPTION RESEARCH		
Level of comparison	*intra-national*	*inter-national*
Units of study	professional or ideological sub-groups of society	countries or cultures
Core variables	beliefs & attitudes towards perceived risk sources	culturally embedded values regarding safety & risk

Box 6:

PROJECT CRC : PROBLEM SPACE			
FACET	*Included:*	*Conceptual basis*	*Example*
Hazards:	24 risk sources	hazard taxonomy	earthquake
Risk features:	12 evaluation aspects	causal model of risk perception	rated magnitude
Respondents:	(A) 8 countries (B) 4 societal groups	'western' vs. 'eastern' professional & political affiliations	NZ, Singapore engineers

Box 7:

Project CRC: SAMPLING - GROUPS OF RESPONDENTS

CRC-1

Country:	Australia	Germany	NewZealand	
Sub-Group:				
<T> "Technological orientation"	*65*	*40*	*65*	*170*
<T-e> Engineers	28	20	34	
<T-s> Students in techn. sciences	37	20	31	
<E> "Ecological orientation"	*73*	*40*	*65*	*178+94*
<E-e> Environmentalists	32	20	26	
<E-s> Students in (env.) psychology	41+67	20	39+27	
<F> "Feminist orientation"	*72*	*60*	*67*	*199*
<F-e> Members of fem./women groups	40	30	47	
<F-s> Students in women's studies	32	30	20	
<M> "Monetarian orientation"	*62*	*77*	*54*	*193*
<M-e> Accountants/Finance managers	33	36	26	
<M-s> Students in economics/finance	29	41	28	
Sum: N =	272+67	217	251+27	*834*

(*Not included here: "Psychology-1 students" in Switzerland, N=67)*

CRC-2

	"Western" countries			*"Eastern" countries*			
	Australia	Canada	Germany	China	Singapore	Japan	
S t u d e n t s							*1024*
T-s Technology/Engineering	60	46	46	90	57	70	
G-s Geography	50	45	47	52	44	42	
P-s Psychology	60	50	58	74	52	84	
S c i e n t i s t s							*171*
X-e Technical & Social Sciences	33	--	84	54	--	--	
Sum: N =	203	141	235	270	153	196	*1195*

Box 8:

HAZARD APPRAISAL: MEANS FOR 24 HAZARDS AND 11 RISK ASPECTS - DATA: NZ

Risk Aspect:

RM = Overall risk magnitude rating
PD = (Assumed) Probability of dying
HI = (Danger of) Health impacts
CP = Catastrophic potential
FA = Feelings of anxiety about risk
IB = Individual benefit (of activity)
SB = Societal benefit (of activity)
IA = Individual risk acceptance
SA = Societal risk acceptance
PR = Personal rel. to risk
DM = Desire to move

Hazard:	RM	PD	HI	CP	FA	IB	SB	IA	SA	PR	DM	
A	6.0	3.5	2.9		6.6	7.4	2.2	7.8	6.2	3.2		Parachuting
B	6.6	4.1	3.9		5.9	7.4	2.5	7.6	5.7	2.5		Car racing
C	5.2	2.5	3.3		4.9	7.5	2.6	8.0	6.7	3.5		Skiing
D	8.3	5.4	7.4		7.9	3.2	3.3	3.5	2.6	1.1		Asbestos production
E	5.8	2.7	4.9		4.8	5.5	7.2	5.4	6.8	2.1		X-ray lab
F	5.8	2.3	5.4		5.0	3.9	5.5	4.9	5.6	2.3		Compressor tools
G	8.9	6.4	8.5		8.4	2.8	0.9	5.2	1.4	4.2		Smoking
H	8.1	5.2	7.5		8.0	2.9	1.6	5.0	2.0	2.4		Tranquilizers
I	7.6	5.0	7.2		6.4	3.2	1.6	5.7	3.0	4.6		Overeating
K	6.3	3.7	4.7		5.8	7.1	8.6	6.7	8.5	1.9		Fire fighter
L	6.1	3.6	4.7		5.7	4.9	5.7	5.7	5.8	1.2		Blaster
M	5.5	3.9	3.4		5.6	8.0	8.7	7.0	8.8	1.3		Emerg. helicopter
N	4.7	2.2	4.3	4.1	4.2		5.9	4.6	4.9	2.2	5.7	Coal power plant
O	4.9	2.2	4.3	4.3	4.4		6.5	4.6	4.8	1.6	6.1	Metal production
P	4.6	1.7	3.6	5.1	4.5		7.1	5.2	5.2	2.8	6.8	Airport
Q	6.8	3.6	3.1	5.4	5.8			5.2	3.9	1.2	6.6	Avalanche area
R	6.3	3.1	2.9	7.0	5.2			5.7	4.9	5.3	5.3	Earthquake area
S	4.8	2.5	2.6	3.9	4.0			6.0	5.5	2.2	4.4	Electricstorms area
T	6.1	3.1	3.4	6.0	6.0		3.7	4.0	3.4	0.9	6.9	Explosives factory
U	7.7	4.0	5.5	9.1	8.3		3.7	3.2	2.3	1.0	8.8	Nuclear power plant
V	6.6	3.3	4.8	6.9	6.6		6.0	3.8	3.5	1.6	7.6	Chemical industry
W	7.2	3.6	6.3	6.4	6.9			3.9	3.0	3.5	8.2	Polluted urban area
X	6.5	3.2	5.8	5.5	6.2			4.6	3.8	2.8	7.6	Unhealthy climate
Y	6.9	3.5	5.6	5.9	6.4			4.3	3.4	1.4	7.2	Natural radiation
	6.4	*3.5*	*4.8*	*5.8*	*6.0*	*5.3*	*4.6*	*5.3*	*4.7*	*2.4*	*6.8*	*(Mean, all hazards)*

NOTES:
N=278 respondents (N=224 for variables PR and DM). Empty cells: n/a

Box 9:

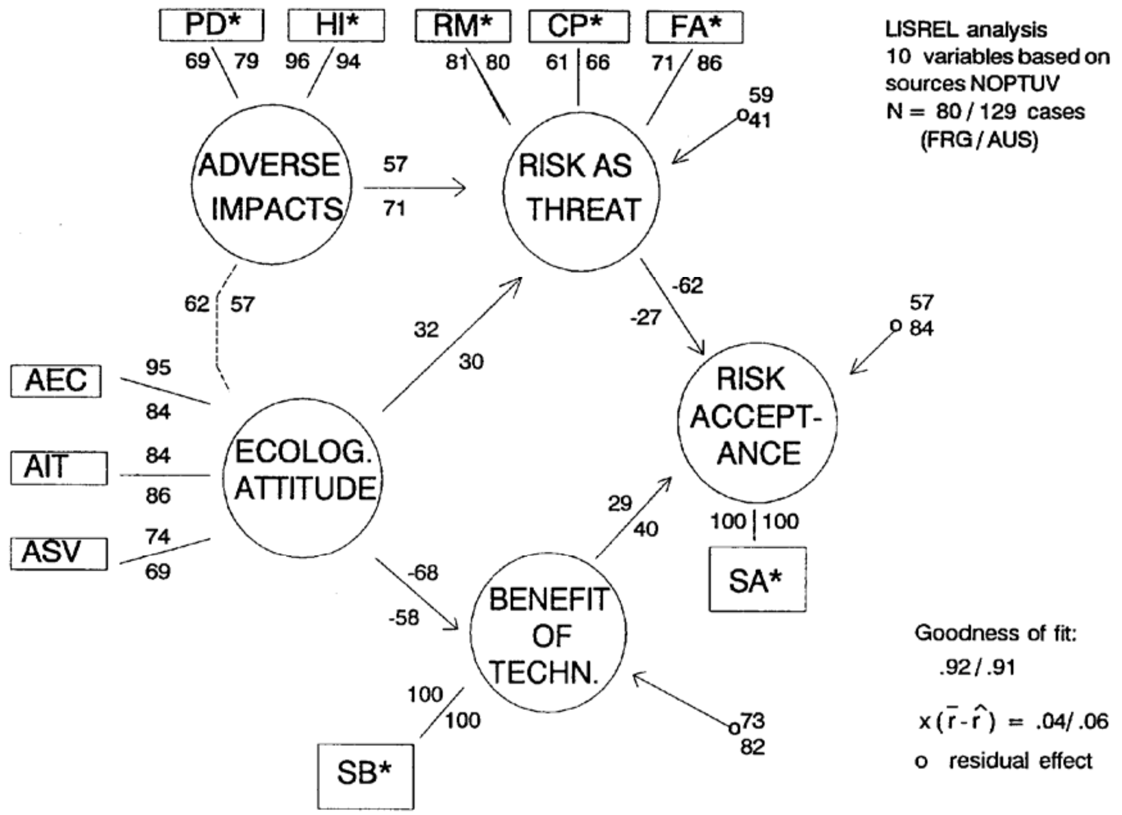
MEAN JUDGMENTS FOR DIFFERENT TYPES OF RISK - GERMAN DATA

Type:	Kind of Hazard			Effect			Activities			Env. Cond.		
	Act.		*Env.Cond.*	*Acute*		*Chronic*	*Priv.*		*Occup.*	*Nat.*		*Technol.*
n =	12		12	12		12	6		6	6		6
Risk Aspect:												
PD Probability of Dying				2.7	*	2.4						
HI Health Impacts				4.4	*	4.9						
IA Indiv. Risk Acceptance	5.8	*	4.4				6.4	*	5.4	5.1	*	3.7
SA Societal Risk Accept.	4.9	*	4.6				3.2	*	6.6	5.0	*	4.1
IB Individual Benefit							6.1	*	5.6			
SB Societal Benefit							1.3	*	6.7			

Notes:
N=217; * indicates significant difference; "n=" number of hazards for that type;
Hazards: "Act." = activities, "Env.Cond." = environmental conditions

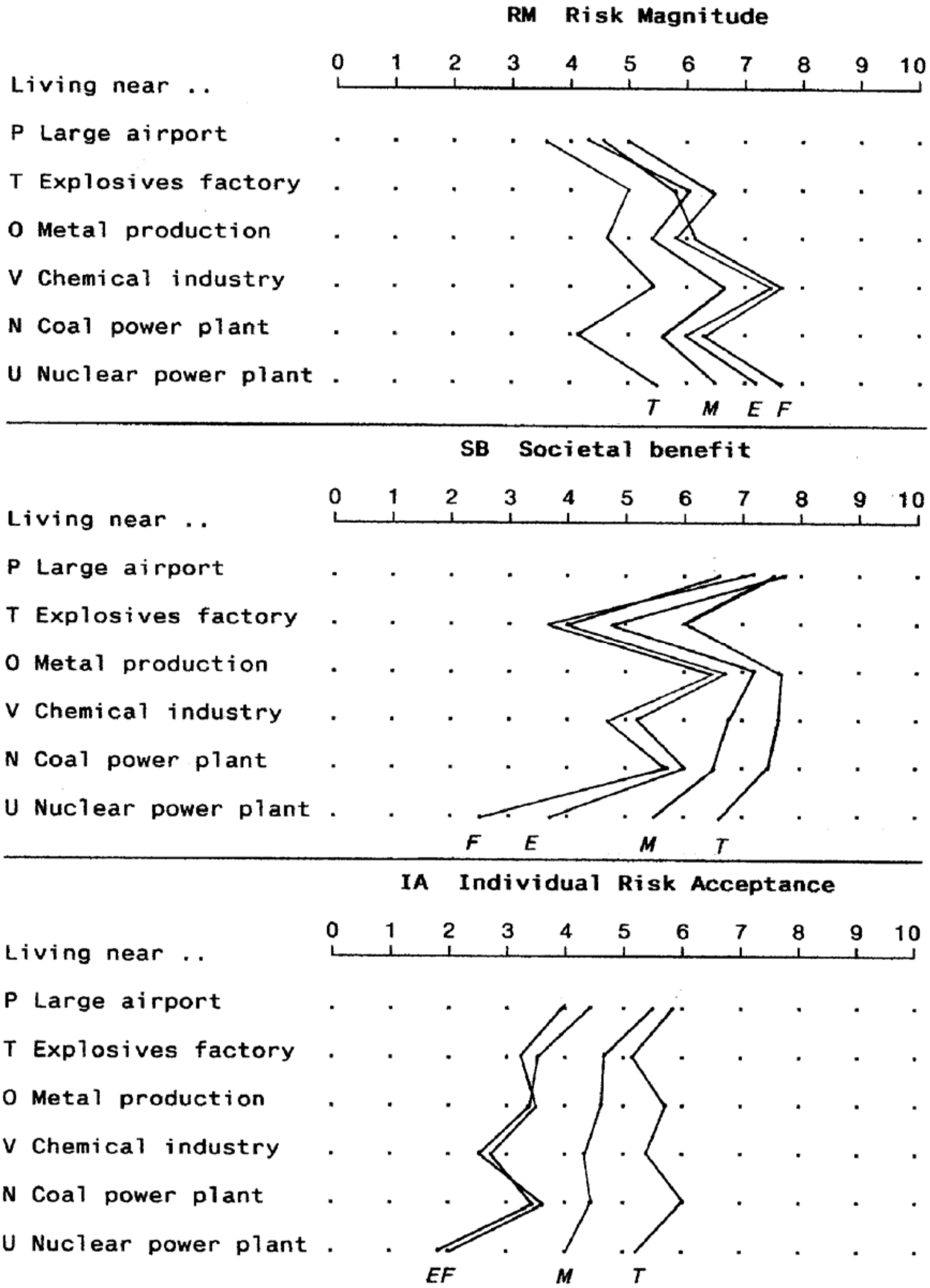
Box 10:

EVALUATION OF ENVIRONMENTAL HAZARDS: STRUCTURAL ANALYSIS



Box 11:

RATINGS FOR TECHNOLOGICAL HAZARDS BY DIFFERENT GROUPS - GERMAN DATA



Groups: T = 'Technological', M = 'Monetarian', E = Ecological', F = 'Feminist' orientation; N = 40+77+40+60 = 217 respondents

Box 12:

HAZARD APPRAISAL: CROSS-NATIONAL COMPARISON FOR 3 RISK ASPECTS
Data from 3 countries -- Project CRC-1

Hazard:	**RM** Overall Risk Magnitude GER	AUS	NZL	**SB** Societal Benefit GER	AUS	NZL	**IA** Individual Risk Acceptance GER	AUS	NZL	
A	5.5	6.5	6.0	1.2	2.2	2.2	7.2	7.5	7.7	Parachuting
B	7.5	6.9	6.6	1.4	2.7	2.4	6.3	7.4	7.6	Car racing
C	5.4	5.4	5.1	1.7	3.0	2.6	7.2	7.8	8.0	Skiing
D	8.2	8.6	8.3	3.6	3.0	3.3	3.3	3.1	3.5	Asbestos production
E	6.3	6.1	5.7	7.2	7.2	7.3	5.3	5.0	5.4	X-ray lab work
F	6.7	5.9	5.9	5.4	6.0	5.6	4.1	4.9	4.9	Compressor tools
G	8.4	9.0	8.9	1.0	0.9	0.7	4.3	5.2	5.2	Smoking
H	8.2	8.0	8.0	1.1	1.6	1.6	4.0	4.9	5.0	Tranquilizers
I	7.6	7.4	7.6	1.3	1.4	1.5	4.5	5.6	5.6	Overeating
K	4.8	6.1	6.3	8.9	8.7	8.7	7.9	6.6	6.7	Fire fighter
L	4.8	6.0	6.0	6.0	6.0	5.8	6.8	5.6	5.7	Blaster
M	4.1	5.2	5.6	9.0	8.7	8.7	8.2	6.9	7.0	Emerg. helicopter
N	5.9	5.6	4.7	6.6	6.3	6.0	4.0	4.3	4.5	Coal power plant
O	5.9	5.6	4.9	7.2	6.8	6.5	4.0	4.2	4.5	Metal production
P	5.8	4.3	4.7	6.6	7.1	7.0	3.7	4.9	5.0	Airport
Q	5.8	7.0	6.7				4.8	5.1	5.2	Avalanche area
R	6.3	6.8	6.1				4.8	5.1	5.7	Earthquake area
S	3.1	4.5	4.7				7.1	6.1	6.0	Electr. storms area
T	5.3	5.8	6.1	4.0	4.4	3.7	4.0	4.0	3.9	Explosive factory
U	6.8	7.6	7.6	5.0	4.3	3.8	3.3	3.2	3.1	Nuclear power plant
V	6.7	6.8	6.6	6.4	5.9	6.1	3.4	3.6	3.8	Chemical industry
W	6.8	6.6	7.3				3.6	4.5	3.8	Polluted urban area
X	5.4	5.8	6.6				5.1	5.1	4.6	Unhealthy climate
Y	5.3	6.7	6.8				5.2	4.6	4.3	Natural radiation
	6.1	*6.4*	*6.4*	*4.6*	*4.8*	*4.6*	*5.1*	*5.2*	*5.3*	*(Mean, 24 hazards)*

Notes:
GER=Germany, AUS=Australia, NZL=NewZealand; N=217/272/224. Data based on overall samples (i.e., sub-groups merged). For results of significance tests for countries cf. Rohrmann 1994.

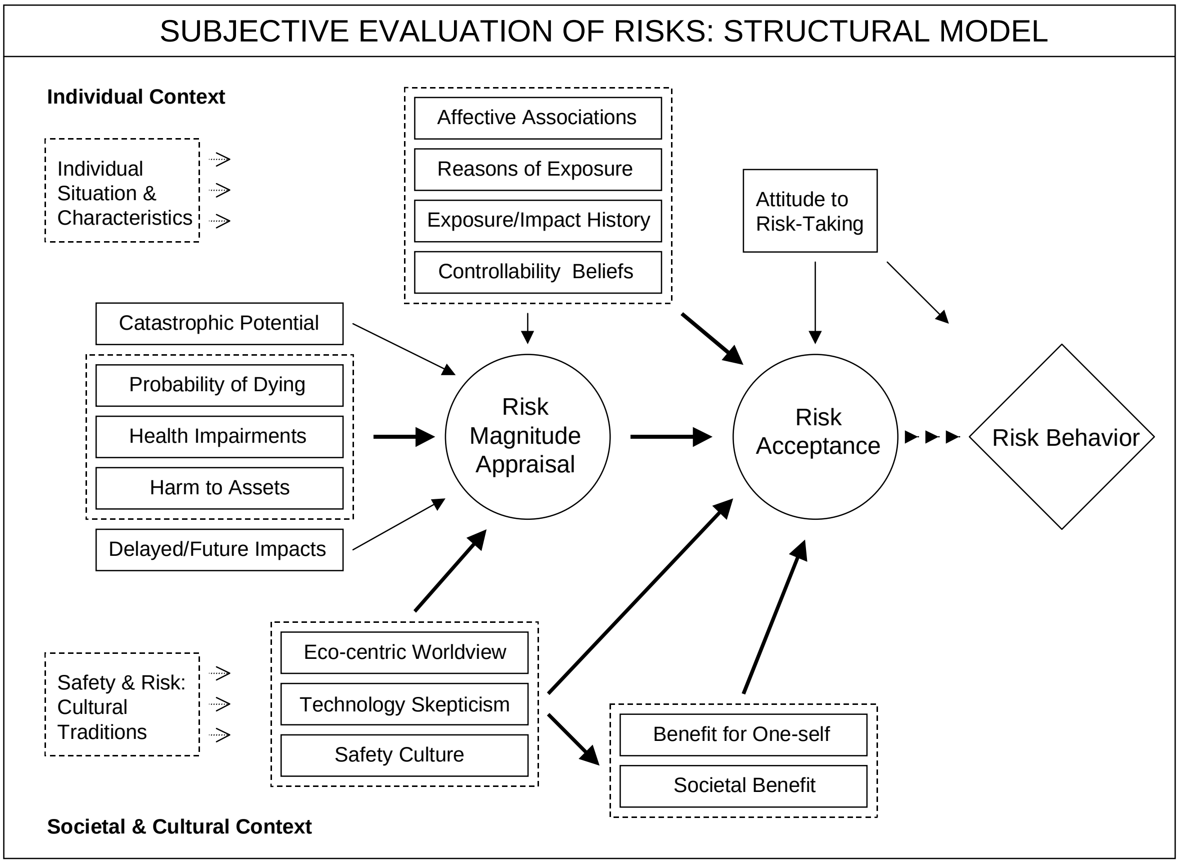
Box 13:

RISK RATINGS: COUNTRY COMPARISON -- *Project CRC-2*
CHINA / JAPAN / SINGAPORE / AUSTRALIA / CANADA / GERMANY

Response scale: 0...10
Risk aspect: RM — Perceived risk magnitude; IA — Individual risk acceptance

	Country:	***Chi***	***Jap***	***Sin***	***Aus***	***Can***	***Ger***		***Chi***	***Jap***	***Sin***	***Aus***	***Can***	***Ger***
Hazard														
Z1	Urban cycling	3.5	5.6	6.9	6.3	6.2	6.1		7.0	6.0	5.6	6.7	6.8	6.1
Z2	Car driving	4.5	3.4	4.2	4.0	3.8	4.4		7.6	6.6	7.7	7.9	8.2	6.5
C'	Dangerous beaches	7.2			6.6	6.9			3.3			5.6	5.6	
G	Smoking	6.6	7.8	8.8	8.8	9.0	8.4		2.6	6.2	2.7	4.8	4.7	3.4
J'	Unsafe sex	7.6	7.8	8.6	8.2	8.4	7.8		2.3	5.8	2.7	5.0	5.0	3.3
I'	Sun-bathing	4.9		7.3	7.7	7.2	7.5		3.0		3.7	5.3	5.4	4.1
I	Overeating	4.9	6.5	7.3	6.5	6.5	7.2		3.9	6.1	4.2	5.7	5.7	4.2
H'	Hallucinogenicdrugs	8.7	9.4	8.9	7.7	6.9	8.0		1.4	5.5	2.0	5.0	5.0	3.4
K	Firefighting	5.1	5.9	6.4	6.0	6.2	5.0		5.8	6.8	5.6	7.0	7.4	7.5
E	X-ray lab work	6.0	5.7	6.3	5.0	4.7	5.1		5.4	6.5	5.4	6.7	7.0	6.6
E'	Nucl. waste transport		7.8							6.5				
L'	Underground miner	6.4	7.2	7.8	6.6	6.3	5.7		4.8	6.5	4.4	6.1	6.2	6.0
Z3	Mobile phone		3.2			3.0	3.8			5.6	5.3		6.5	
$1	Giving up job	2.8	4.3	4.5	3.8	3.9	4.3		6.7	5.8	6.6	7.7	7.7	6.9
$2	Gambling	7.5	6.3	6.6	5.8	5.8	4.3		1.7	5.7	3.4	5.8	6.1	5.5
$5	Unsure investment		7.1	6.8		5.6				5.6	5.3		6.5	
R	Earthquakes	5.7	6.8	7.8	6.8	5.7	6.2		4.3	6.4	3.8	6.2	7.2	5.0
Q'	Storms/hurricanes	6.2	6.9	7.9	6.6	6.0	6.7		4.0	6.2	3.6	6.2	6.8	4.8
S'	Floods	6.2	7.2	7.4	6.2	6.2	6.3		3.7	6.1	3.8	6.2	6.6	4.7
R'	Fire areas	6.7	6.8	7.7	6.4	6.0	5.2		2.9	6.1	3.5	6.0	6.6	5.0
Y'	Radongas exposure		7.0							6.0				
X'	Air pollution	7.1	7.4	7.9	6.2	5.9	6.7		2.5	5.8	2.9	5.0	5.6	3.6
X	Unhealthy climate	5.9		7.3	5.5				3.5		3.1	5.7		
P	Airport	6.2	5.1	5.3	4.2	2.9	5.2		3.5	5.8	5.2	6.0	7.1	4.5
N	Coal power plant	5.8	4.9	6.7	5.3	4.9	5.0		3.4	5.9	4.0	5.4	5.6	4.6
U	Nuclear power plant	6.7	6.6	8.5	7.1	6.2	6.5		3.8	6.0	2.7	4.6	5.1	3.5
O'	Power lines		5.1		4.6	4.5	4.2			5.8		6.0	6.3	5.7
V	Chemical industry		6.1	7.7	6.2	5.7	6.1			5.6	3.6	5.2	5.4	3.8
$3	Thieve places	6.0		7.4	5.8		5.0		2.4		2.7	5.0		4.3
$7	High-crime area		7.8			7.1				5.8			4.7	
(Mean)		*6.0*	*6.4*	*7.2*	*6.2*	*5.8*	*5.9*		*3.9*	*6.0*	*4.1*	*5.9*	*6.2*	*5.0*
	Hazards: m =	*23*	*26*	*24*	*25*	*26*	*24*		*23*	*26*	*24*	*25*	*26*	*24*

Box 14:



Box 15:

UTILITY OF RISK PERCEPTION RESEARCH

Findings about socio-psychological risk perception processes are relevant for

> analyzing discrepancies between statistical risk data and subjective judgments

> understanding the influence of professional and societal orientations ('worldviews')

> clarifying the roots of controversies about risky technologies

> identifying core needs for risk communication and disaster preparedness programs

> designing risk information in line with people's thinking about hazards

> recognizing reasons for shortcomings of safety campaigns

> considering cultural differences in conceptualizing and conducting risk communication

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