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Risk perception in China and Australia: an exploratory crosscultural study

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Abstract

Perceptions and subjective evaluations of risky activities and environmental conditions were explored in several 'Western' and 'Eastern' countries, based on a socio-psychological approach. The aim of these crosscultural studies is to analyse the cognitive structure of judgments about the magnitude and acceptability of risks to which individuals are exposed: to compare risk judgments across countries of different cultural background in which risk issues in general as well as particular risk sources (e.g., industrial facilities or natural hazards) have distinct salience, and to examine disparities between societal groups which differ in their professional background. In the current project, fully comparable data were collected in China ($N = 270$) and Australia ($N = 203$), utilizing psychometric instruments. The sampling in both countries focused on 3 groups of students (i.e., geography, psychology, engineering) and a group of scientists/researchers. Participants were asked for judgments on 25 hazards (based on a taxonomy) according to 12 risk aspects (derived from a structural risk perception model). Data comparisons for countries, for societal groups and for types of risks yield a complex picture. Crosscultural disparities are evident in two ways: there is considerable crossnational variation in risk perception, and groups affiliated with particular professional orientations differ in their judgment and evaluation of hazards as well. A major disparity between the two country data is that the Chinese respondents seem to be less prepared than the Australian ones to accept risks in principal (while there is no difference in the mean of risk magnitude ratings). Regarding specific hazards, the largest differences emerge for hazards related to politically or morally 'banned' activities, such as gambling, using hallucinogenic drugs or unsafe sex. With respect to the 'cognitive structure' underlying risk evaluations, the main influences are similar for the compared samples. Altogether the results demonstrate the strong influence of socio-psychological variables and the cultural context on risk evaluations. However, the empirical basis for the findings gained so far is still small and generalizability restricted. A wider range of cultures needs to be looked at in order to clarify further the influence of cultural factors on the cognition and evaluation of risks. Such research is under way.

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1. Research issue

1.1. CROSSCULTURAL RISK PERCEPTION RESEARCH

Understanding the cognitive structures and sociopsychological influences which underlie people's judgments and appraisals of hazards to which they are or might be exposed is at the core of risk perception research. Beginning with the seminal work of Slovic *et al.* (1980, 1985), a large number of findings have been presented by psychologists and other social scientists, mostly based on psychometric approaches to data collection and analysis (for reviews cf. Pidgeon *et al.*, 1992; Slovic, 1992; Fischhoff *et al.*, 1993; Brehmer 1994; Rohrmann, 1999).

Over the present decade, *crosscultural studies* have evolved as the major interest in risk perception research, questioning the concept that risk perception can be treated in terms of 'communalities' or 'universals'. Macrosociological, anthropological and philosophical literature (Douglas and Wildavsky, 1982; Rayner, 1992; Schuez, 1990; Schwarz and Thompson, 1990; Dake, 1992; Wildavsky, 1995) has been very influential in widening the scope of risk perception research. In particular the cultural approach to risk research provided an enriched theoretical background for empirical risk perception studies (overview in Rayner, 1992; see also Cvetkovich and Earle, 1991 or, critically, Sjoeberg, 1997). According to this perspective, the evaluative process of risk perception is determined by the norms, value systems and cultural idiosyncrasies of societies or societal (sub)groups. Consequently each society or social group is likely to have its own specific set of risks with which it is particularly worried.[1]

A crosscultural focus has obvious consequences for the design of respective studies, in particular the selection of target groups and the sampling of respondents (for a discussion of methodological considerations cf. McDaniels and Gregory, 1991; Rohrmann and Renn, in press).

1.2. OVERVIEW OF PREVIOUS STUDIES

Some selected studies – which are relevant in the context of the present project – are listed in Table 1 (for a documentation and review of field studies see Rohrmann 1999; laboratory studies are not considered here). While the majority of risk perception studies is restricted to student samples, most of the authors listed in Table 1 have looked at several specified groups. The table also identifies sample sizes, number of hazards included and the number of risk aspects presented for evaluating risk sources. For most of these studies, the psychometric paradigm is the main approach.

Crossnational comparisons are mostly restricted to two countries. Most research was conducted in North America and Europe; only a few studies are available from Australasian countries.

[1] It is important to note that crosscultural differences can be studied from two perspectives (cf. Rohrmann, 1995). In comparative crossnational studies, data from different nations (e.g., France versus Germany) or types of countries (e.g. industrialized versus developing ones) are compared. In intranational 'cross-group' comparisons, differences in risk evaluation between societal groups (defined according to social/political views or membership in interest groups, etc.) would be analyzed. While the latter study type is still rare, quite a number of empirical investigations have looked at crossnational distinctions. The research reported here combines the two approaches.

Table 1. Risk perception studies – selection.

Author(s)/Year	*N*	*Groups*	*Hazards*	*Aspects*
Studies comparing 'Western' and 'Eastern' countries				
HINMAN/ROSA/etc. 1993 (Japan/USA)	290/747	1	30	5
KLEINHESSELINK/ROSA 1991 (USA/Japan)	62/69	1	70	7
<this study> (Aus/Germ/China/Sing)	203/151/270/180	4	24	11
Studies in Australia and New Zealand				
ROHRMANN 1994	339	2 × 4	24	11
ROHRMANN 1995	278	2 × 4	24	11
Studies in Hong Kong and China				
KEOWN 1989	65	1	30/15	2/6
JIANGUANG 1994	238	1	20	5
XIAOFEI 1996	229	3	46	8
Studies investigating group differences				
ROHRMANN/BORCHERDING 1985 (Germany)	80	4	24	11
GOSZCYNSKA/TYSZKA/SLOVIC 1991 (Poland/USA)	140	4	40	1/15
KUYPER/VLEK 1984 (The Netherlands)	220	7	10	12
MARRIS/LANGFORD/ORIORDAN 1996 (England)	131/70	3	13	9
NYLAND 1993 (Brazil/Sweden)	144/119	5	100/33	1/1
PILISUK/PARKS/HAWKES 1987 (USA)	429	3	10	1
ROHRMANN 1994 (Australia/NZ/Germany)	339/217/278	2 × 4	24	11
SJOEBERG/DROTTZ-SJOEBERG 1991 (Sweden)	236	10	16	3
SOKOLOWSKA/TYSZKA 1995 (Poland/Sweden)	601/1488	9	6/11	2
TIEMANN/TIEMANN 1985 (USA)	42/361	6	30/17	9

Notes: *N* is Number of respondents; Groups is Number of (substantive) subgroups within the study's sample; Hazards is Number of risk sources to be judged; Aspects is Number of judgments per risk.

1.3. OBJECTIVES OF THE PROJECT

The study to be reported here is part of the project 'Crosscultural Comparison of Risk perception' (CCR), a set of homologous studies in six countries (cf. Rohrmann, in press). The objectives of the investigation are:

- to design the study according to a conceptual framework for hazards, risk aspects and respondents;
- to analyse the structure of judgments about the magnitude and the acceptability of hazards to which individuals are exposed and the underlying psychological factors;
- to specify the relevance of hazard characteristics for the perception and evaluation of risks;
- to compare risk judgments across cultural contexts, looking at both the influence of professional and societal orientations within a country and disparities between different countries.

The focus is a comparison of risk perception data from what will be referred to here as 'Western' and 'Eastern' countries.

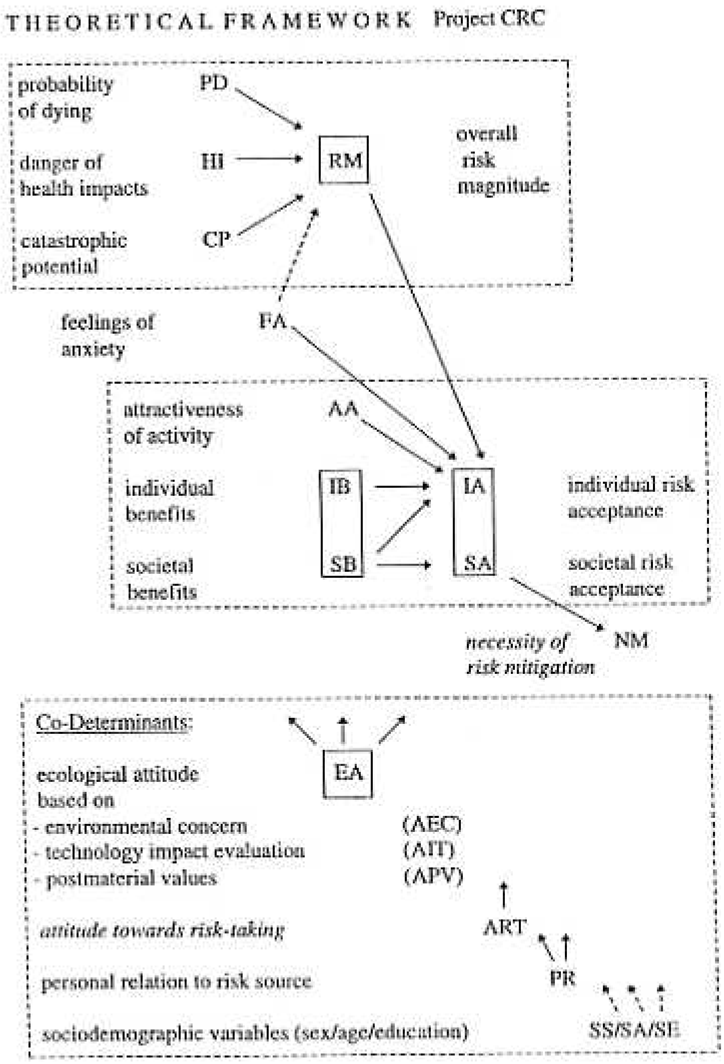

Fig. 1. Framework for variables and their structural relations.

2. Project design

2.1. CONCEPTUAL FRAMEWORK

Studying risk perception means, to look at the cognitive structure of people's beliefs, feelings and appraisals regarding hazards. The substantive basis of this project is the theoretical framework developed in Rohrmann and Borcherding (1985) and Rohrmann (1994). In a first step, relevant concepts for the subjective evaluation of risky activities and residential conditions were selected; in step 2, structural relations between the variables representing the respective cognitions have been hypothesized; these can be analysed empirically. This framework is shown in Fig. 1.

Perceived risk magnitude (defined as the perceived overall 'riskiness' attributed to a hazard) and acceptance of risk are seen as the key aspects of evaluating hazards. It is assumed that these variables are influenced by other characteristics of the studied hazards, negative impacts on the one hand and benefits on the other, and that ecological attitudes as well as socioeconomic characteristics are relevant codeterminants. For both risk acceptance and benefits of risky enterprises, a distinction is made between the individual perspective and the societal viewpoint. This has to be recognized in the operationalization of the concepts and the subsequent statistical analyses. The other two facets of the 'problem space', i.e., risks sources (hazards) and respondents, were treated according to a specific framework as well; see below.

2.2. HAZARD EVALUATION QUESTIONNAIRE

In order to study risk perception empirically, the concepts outlined in the theoretical framework above need to be measured with regard to actual hazards. As the risk type could have a strong influence on risk judgments, the selection of hazards for this project was based on a taxonomy distinguishing several aspects: (1) activities/professions versus residential/environmental conditions; (2) physical or financial risks; (3) acute versus chronic impacts; (4) for activities: occupational versus private; (5) for residential conditions: natural versus technology-induced hazards. It should be noted that for each hazard the relation to humans is specified, e.g., working as . . . or living near . . . while general terms (such as cars, asbestos, nuclear power, climate) were avoided. In the first series of studies, each risk type was represented by three hazards. For the current study, this setup was modified (by exchanging some hazards) in order to suit data collection in Asian countries. These hazards can be seen from Tables 4 to 7. Each hazard was rated according to each of the risk aspects included into the theoretical framework (cf. Fig. 1); the response scale was 0–10 (anchored as extremely low and extremely high).

The resulting Hazard Evaluation Questionnaire (HEQ), a fully standardized instrument, also contains measures of attitudes towards the environment, technology, societal values, risk-taking; and a demographic section.

For the Chinese substudy, the HEQ was translated into Chinese language. The translation was thoroughly checked via back-translations by three bilingual scientists. The main variables and all instructions are identical to the English version, however, a few hazards occur only in specific countries. Some attitude scales were disregarded in the Chinese version as they seemed to be inappropriate for the Asian context.

2.3. PLAN OF DATA COLLECTION

The general approach is to measure risk aspects with respect to a heterogeneous set of hazards and to collect such data for distinctive societal groups (combining an intranational and crossnational approach).

2.3.1. Countries

While in Part I of the project CCR some industrialized 'first-world' countries – Germany, Australia and New Zealand – had been studied, the rationale for Part II is to compare risk perception in Western and Eastern countries. The general plan is outlined in Table 2, looking at 2×3 countries.

Table 2. Sampling: overall design and present groups of respondents.

	AUSTRALIA	*CHINA*	*Total*
Students Technology, Geography, Psychology	60 + 50 + 60	90 + 52 + 74	396
Scientists Technical and Social Sciences	33	54	87
Total	203	270	473

In phase A, two substudies were conducted, one in Australia (AUS) and one in China (CHI); in phase B, data from Germany, Canada, Singapore and Japan will be added (data collection mostly completed).[2]

2.3.2. Groups

Sampling of the population as a whole was impossible for obvious reasons. Rather, the study is based on a contrast group design in order to compare groups with specific societal, professional, and cultural orientations (in Dake, 1991 or Douglas and Wildavsky, 1982 the term worldview is used). Under the given constraints, it was not feasible to target respondents outside universities. Instead, specific groups of university scientists and students were targeted. Regarding students, 'engineering/technology' and 'psychology' students were sampled (as in project CCR Part I).

It is obvious from the political debates about hazards, particularly those related to the use of technologies, that the professional socialization of the proponents leads to distinct evaluations of risk issues. (This notion relates to the group aspect of Douglas' grid/group concept of sociality; cf. also Thompson *et al.*, 1990.) The literature on controversies about risks shows that groups such as engineers/technicians, professionals geared towards human health and well-being, and, of course, environmental movements are important proponents of this discourse (see, e.g., Edwards and Winterfeldt, 1987; Slovic, 1997).

In Project II, a group of 'geography' students was included also. As there is more attention on hazards within the natural environment in CCR Part II, the risk perception of people studying geography is particularly interesting.

The Chinese data were collected in Beijing. The respective group setup was completely repeated in Australia (data collection in Melbourne).[3] The available samples (total $N = 473$) are summarized in Table 2.

Some demographic characteristics of the respondents are listed in Table 3. Mean age and the female/male proportion of the Australian and Chinese samples are fairly similar. Note however that sex and profession are (inevitably) confounded in this sampling (thus

[2] It should be noted, however, that representative samples of these groups and countries were neither possible (due to limited resources) nor even intended. While both countries have a somewhat dominant 'main culture' they are also very complex multicultural societies (which to reflect is far beyond the current research). Certainly the project does not claim to compare Australians with Chinese. The idea, rather, is to use societal distinctions in order to elucidate typical intracultural and crosscultural differences in risk evaluation.

[3] *A brief note on the two countries:* China is 9.6 and Australia 7.7 million square kilometres in area, but China's population density is 60 times higher. More importantly, there are huge disparities in cultural, political and economic terms: China is very different in its fundamental social and religious philosophies, it has not adopted a democratic

Table 3. Some demographic characteristics of the respondents.

Country:	*Australia*				*China*			
Subgroup:	*Psych.*	*Geog.*	*Tech.*	*Scient.*	*Psych.*	*Geog.*	*Tech.*	*Scient.*
Age (mean)	19.1	20.6	21.5	40.6	21.1	21.1	21.0	39.5
Sex (% Male/Female)	15/85	32/68	53/47	82/18	31/69	25/75	54/46	59/41
Students/Scientists (%)		(84)		16		(80)		20
Attitudes (means) towards								
Impacts of technology (AIT)	3.4	3.7	3.0	3.2	2.8	2.7	2.7	2.4
Environmental concern (AEC)	4.5	4.6	4.2	4.6	–	–	–	–
Societal values (ASV)	4.8	5.2	4.7	4.8	–	–	–	–
Risk propensity (ARSP)	4.9	4.6	4.7	4.8	5.1	4.8	4.5	4.3
Risk avoidance (ARSA)	4.0	4.3	3.7	4.0	4.2	4.2	4.7	4.5

Note: The attitude scores are based on 9/7/5/6/6 items which were measured on 7-point scales (1..7). AIT and ASV were not included in the Chinese study.

gender effects cannot be analysed). Regarding attitudes, there are some differences in technology scepticism, environmental concern and societal (nonmaterial) orientation between the groups of Geography students (highest scores) and Technology students (lowest scores). Interestingly, technology scepticism is considerably lower for all Chinese groups. Risk avoidance tends to be slightly higher with respondents from China; across groups, risk propensity seems to be highest for the Psychology sample.

2.4. PROPOSITIONS

Because of the three-dimensional structure of the 'problem space', hypotheses can refer to risk aspects and their contingencies, to types of hazards and to differences between respondents in terms of subgroups or countries. The main propositions are briefly summarized below.

2.4.1. Determinants of risk evaluations

For the cognitive structure of beliefs, feelings and value orientations which underlay the subjective evaluation of risks the following is hypothesized:

Proposition 1: Qualitative risk aspects, more than (estimated) fatality rates, determine risk magnitude judgments.

Proposition 2: The structure of risk evaluations is dependent on the type of the risk source.

Proposition 3: Attitudes towards environment, technology and society significantly influence risk ratings and acceptance.

political system as most 'western' countries, and it is less industrialized and far poorer than Australia. The level of public debate about risks, safety and environmental issues found in the west is not fostered. China appears to have a rather rigid social hierarchy, where people are expected to respect their superiors without much question. Governmental censorship procedures, the low proportion of non-Chinese residents and the lack of opportunities to visit other countries or learn about them through media is highly likely to restrict the dissemination of foreign ideas as well as international scientific findings about risks and to reduce the ideological and political diversification which occurs in Australia's multicultural society.

(Note that for each risk aspect the proposed influences are specified in the theoretical framework; cf. Fig. 1.)

2.4.2. Specific risk sources

With respect to the taxonomy of hazards, the following was predicted:

Proposition 4: Perceived risk magnitude is higher for occupational than private or technology-induced than natural hazards.

Proposition 5: Probability-to-die ratings are higher for acute risks, ratings of health impacts higher for chronic risks.

Proposition 6: Risk acceptance lowest for involuntary (such as occupational and technology-induced) hazards.

Proposition 7: Most negative risk judgments for controversial large-scale technologies (e.g., nuclear energy).

2.4.3. Risk perception in cultural sub-groups

Propositions regarding the impact of professional background include:

Proposition 8: Respondents with a technological orientation show less negative risk evaluations and more acceptance of risks than the psychology or geography groups, and the judgments of the geography people will be more in line with statistical risk regarding natural hazards.

Proposition 9: Students give more unfavourable risk evaluations than scientists.

2.4.4. Differences on country level

In general, it is expected that cross-national differences are salient for the appraisal of particular hazards rather than regarding the cognitive structure of the investigated risk judgments. Also, the differences in risk perception across societal groups were assumed to be similar for the countries looked at. Disparities expected for the current study include:

Proposition 10 — *Risk ratings in general*: Risk acceptance (IA/SA): CHI > AUS – but no principal difference in perceived risk magnitude (RM).

Proposition 11 — *Specific hazards*: More tolerance for specific risk sources if these are part of own culture or political values. Examples: Occupational hazards: CHI > AUS; Financial/social risks: AUS > CHI; Health and lifestyle risks, 'immoral' activities: AUS > CHI; natural hazards: CHI > AUS; Large-scale technologies: CHI > AUS.

Proposition 12 — *Group polarization*: Heterogeneity among groups: AUS > CHI.

Proposition 13 — *Relevance of general attitudes*: Influence on risk evaluation and acceptance: AUS > CHI.

Of course these considerations are not hypotheses in a strict sense but rather conjectures (and lack of space impedes a full discussion). They mainly originate from informal discussions with social scientists who have some idea about the countries and societal groups looked at in this project. Pertinent speculations include: That Chinese people in principal are more prepared to accept hardships than Australians (and that they would be more concerned about social/ethical than physical risks); that values and moral imperatives held by the 'superiors' (family or governmental authorities) are more respected in China; that the Chinese public has less opportunity to learn about hazards and disasters because of the strong media control; that in China the drive for economic progress might restrain anxiety about ecological and health risks; that cultural disparity, plus political differences in the extent of pressure from those in power, might allow the variance in risk acceptance to be higher with Australian respondents, as well as the extent to which political and attitudes moderate risk judgments; whereas the desire (or the political demand) for consensus in societal issues might prevail more in China.

3. Empirical findings

3.1. OVERVIEW OF DATA ANALYSES

The study data form a 4-dimensional data box, with hazards (24), judgmental aspects (11), respondents (3 + 1 groups), and countries (2). Consequently, the statistical analysis of these data yields a very large volume of results.

In this paper, mainly two types of results are presented: mean ratings and differences of group means for various sets of respondents (given for all or selected hazards and risk aspects) (cf. Sections 3.2 to 3.4); and selected analyses of the cognitive structure of risk evaluations, based on correlations among risk sources (cf. 3.5 to 3.6).

3.2. JUDGMENTS ABOUT RISKS AND BENEFITS OF HAZARDS

First, means for country samples are considered (merging the respective sub-groups): Table 4 presents Chinese results, i.e., mean judgments in 11 risk aspects for 24 hazards. In terms of risk magnitude (RM), fear associations (FA) and (lack of) acceptance (IA, SA), the use of hallucinogenic drugs, unsafe sex, regularly gambling and living in an air-pollution area are seen as worst hazards. (In the Australian sample, smoking ranks first, and living near a nuclear powerplant would be evaluated as high risk as well.) The catastrophic potential (CP) is rated highest for a natural hazard, earthquakes, and a technological risk source, nuclear power plants. Almost no societal benefits (SB) are seen for drugs, unsafe sex, smoking, overeating, beaches, sunbathing, and for gambling. However, to all these activities rather high individual benefits (IB) are attributed, particularly hallucinogenic drugs, unprotected sex and gambling (this seems to be in line with some stereostypes about old-time China).

It is noteworthy that the majority of respondents rate their personal risk level (PR) low for most risk sources; the main exceptions are (not surprisingly) cycling and to some degree smoking and living in a polluted urban area. Consequently hazard familiarity is unlikely to have a crucial impact on the judgments studied here (except for cycling and smoking).

Regarding hazard types, the results indicate the following:

- Hazard impacts: Judgments of fatality rates are higher for risks comprising an *acute* danger (accidents/catastrophes; cf. hazards such as Z1, Z2, C′, K, E, R, Q′, S′, P, U). In comparison, health impacts are judged higher for *chronic* risk exposure (i.e., hazards such as G, I, I′, X, X′, L′, N).

Table 4. Hazard ratings: means for 11 risk aspects – Chinese sample ($N = 270$).

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)
AA = Attractiveness of activity
IA = Individ. risk acceptance
SA = Societal r. acceptance
PR = Personal relation to risk source

Var.	RM	PD	HI	CP	FA	IB	SB	AA	IA	SA	PR	
Haz.												
Z1	3.5	2.9	2.5		3.3	3.5	4.0		7.0	6.3	6.1	Urban cycling
Z2	4.5	4.1	3.3		3.9	4.5	4.8		7.6	6.9	1.8	Car driving
C′	7.2	6.4	4.6		6.6	7.2	1.9		3.3	4.0	1.7	Dang. beaches
G	6.6	5.7	7.7		6.3	6.6	2.1		2.6	3.2	3.1	Smoking
J′	7.6	5.5	7.2		7.0	7.6	2.1		2.3	3.0	1.3	Unsafe sex
I′	4.9	4.1	6.3		5.4	4.9	1.9		3.0	4.3	1.5	Sun-bathing
I	4.9	4.0	6.1		4.9	4.9	2.5		3.9	4.9	2.5	Overeating
H′	8.7	7.4	8.4		8.1	8.7	1.3		1.4	1.6	0.9	Halluc. drugs
K	5.1	5.0	4.7		5.2	5.1	8.2		5.8	8.1	0.9	Firefighting
E	6.0	4.8	6.2		5.9	6.0	7.6		5.4	7.7	1.1	X-ray lab
L′	6.4	5.7	5.9		6.4	6.4	7.8		4.8	7.6	1.1	Undergr. miner
$3	2.8		2.6		3.6	2.8	4.8		6.7	6.4	2.0	Giving up job
$1	7.5		5.9		6.9	7.5	1.0	4.3	1.7	1.7	1.4	Gambling
$2	6.0		4.3		6.5	6.0			2.4	3.3	2.0	Thieve places
R	5.7	4.9	3.4	7.4	5.7				4.3	5.0	2.7	Earthquakes
O′	6.2	5.0	4.0	6.3	6.0				4.0	5.0	1.5	Hurricanes
S′	6.2	4.9	4.2	6.2	5.7				3.7	5.0	2.1	Floods
X′	7.1	5.1	7.4	6.5	6.8				2.5	3.4	3.6	Air pollution
X	5.9	4.2	6.7	5.3	5.8				3.5	4.6	2.9	Unhealthy climate
P	6.2	3.8	6.4	4.9	5.7		7.6		3.4	4.6	1.0	Airport
N	5.8	4.0	6.1	5.3	5.5		7.3		3.8	4.9	1.2	Coal power plant
U	6.7	4.8	5.9	7.5	6.3		8.3		3.5	4.5	0.7	Nucl. power plant
	6.0	4.9	5.4	6.2	5.8	5.8	4.6	*4.1*	3.9	4.8	1.9	*(Mean)*

Note: The 24 hazards appear in the same order as in the questionnaire. Empty cells: not measured. The hazards 'chemical facilities' and 'forest fires' were not included in the Chinese study.

- Benefits: for both *occupational* and *private* risky behaviours, people perceive benefits for themselves (even smoking); however, benefits for the society relate to occupational activities only.
- Acceptance: Individual risk acceptance tends to be higher for private activities (e.g., lifestyle risks), societal risk acceptance clearly is higher for occupational hazards. Regarding residential environmental risks, risk acceptance is slightly

higher for *natural* than technology-induced hazards, from both a societal and an individual perspective.

The Chinese data are mostly in line with propositions 4–6. It is also widely assumed that voluntary risks (such as all activities in the upper half of the hazard set) are better accepted than involuntary ones (such as the residential risks in the lower half of the hazard set). However, this does not show much in the Chinese data, because of the very low acceptance of drugs, unsafe sex, smoking and gambling.

Finally, it is obvious that some hazards are perceived as either more perilous (e.g., nuclear power or dangerous beaches) or less severe (e.g., airports) than epidemiological risk data on health impairments and fatalities would suggest. Such findings are quite in line with the cultural approach (Douglas and Wildavsky, 1982; Thompson *et al.*, 1990; Dake, 1991) to risk issues which claims that hazard appraisals are social constructions and strongly driven by worldviews, while statistical data or other quantitative evidence is not seen as sufficient by itself for evaluating risks.

3.3. COMPARISONS OF CHINESE VERSUS AUSTRALIAN MEAN RATINGS

The next Table 5 presents a selection of mean judgments for Australian (AUS) and Chinese (CHI) respondents, differentiating between the student and the scientists samples (cf. Table 8 below for a summary of significance tests). Looking at cross-national differences first, major disparities in risk perception are apparent.

Table 5. Mean risk ratings: selected comparisons Australia/China, N = 203/270.

Variable	*RM* *Risk Magnitude*				*SB* *Societal Benefit*				*IA* *Ind. Risk Acceptance*			
Country:	*AUS*	*CHI*	*AUS*	*CHI*	*AUS*	*CHI*	*AUS*	*CHI*	*AUS*	*CHI*	*AUS*	*CHI*
Group:	*Stu*	*Stu*	*Sci*	*Sci*	*Stu*	*Stu*	*Sci*	*Sci*	*Stu*	*Stu*	*Sci*	*Sci*
Hazard:												
Z1 Urban cycling	6.2	3.4	6.6	4.0	6.2	3.5	7.2	5.7	6.8	7.1	6.3	6.4
Z2 Car driving	3.9	4.4	4.5	5.1	3.9	4.6	3.7	5.3	7.9	7.7	7.8	6.8
G Smoking	8.8	6.6	8.9	7.1	2.0	2.1	1.3	2.0	4.7	2.8	5.2	1.9
J′ Unsafe sex	8.5	7.7	7.5	7.7	1.9	2.2	2.0	1.8	4.9	2.4	5.9	1.4
H′ Halluc. drugs	8.2	8.6	7.4	8.9	2.3	1.2	1.8	1.1	4.9	1.6	5.9	0.6
K Firefighting	6.6	5.2	5.8	4.8	8.4	8.2	8.3	8.7	7.1	6.0	6.6	5.3
$3 Giving up job	3.7	2.9	3.8	2.7	4.3	4.7	4.5	5.0	7.7	6.7	7.9	6.7
$1 Gambling	5.9	7.5	5.6	7.4	3.0	1.1	1.8	0.6	5.7	1.7	6.3	1.1
R Earthquakes	6.8	5.6	6.3	6.4		(n.a.)			6.1	4.5	6.6	3.2
S′ Floods	6.3	6.1	5.6	6.3		(n.a.)			6.2	3.9	6.2	2.9
P Airport	4.0	6.0	4.8	5.5	7.5	7.5	7.1	8.1	6.1	3.5	5.6	2.8
N Coal p.plant	5.4	5.9	5.4	5.4	6.9	7.2	7.2	7.9	5.3	3.8	5.4	3.2
U Nucl.p.plant	7.4	6.6	5.9	7.2	5.5	8.3	4.6	8.6	4.5	3.6	4.8	2.5
(Mean)	6.3	6.0	6.0	6.1	4.9	4.5	4.7	4.8	5.9	4.0	6.0	2.3

Note: Student results based on equally weighted means of the psychology, geography and technology student samples. (For results of significance tests for countries cf. Table 8.)

- Chinese risk magnitude judgments (RM) are significantly lower for cycling and lifestyle health hazards (e.g., smoking, overeating), except for drugs; and clearly higher than the Australian means for gambling.
- There is only one large difference in perceived societal benefits (SB), namely for nuclear power plants where the Chinese view is far more positive (thus proposition 7 only holds for the Australian data).
- Very large differences emerge for individual risk acceptance (IA). The hypothesis 10 had been, higher (IA) in China (based on the – perhaps naive – proposition that Chinese people are more tolerant to hardships and better prepared to endure adversity). However, with the exception of cycling, Chinese (IA) means are lower for all hazards.

To check for general scale-use effects, the overall means (across 24 hazards) are listed in Table 6. The results demonstrate that this is a principal difference and not hazard-dependent; note that the overall means for important variables such as risk magnitude (RM) or societal benefit (SB) do not differ, and that the mean *societal* risk acceptance is identical for the Chinese and Australian data. Interestingly, for most Australian respondents (IA) is higher than (SA), on average by 1.2; for Chinese respondents it's the other way round, (SA) has higher means than (IA).

These results points at a general cultural difference: consenting to significant risks within one's life – whether in the personal or the occupational sphere – seems to be unacceptable for most of the Chinese respondents. Also, people in China are far less likely to be individualistic but rather think in terms of their family; if a hazard threatens the family's welfare or status it might be intolerable in any case.

- The difference in individual risk acceptance (IA) is particularly high for gambling and consuming hallucinogenic drugs, two activities which have quite a history in China but are now branded as illegal and seriously penalized. (There might be a 'social (un-)desirability' effect here as well.)
- Expected differences regarding occupational hazards, large-scale technologies and natural environment hazards did not become manifest: both risk and benefit perceptions are rather similar in both country samples.

Altogether the propositions expressed in proposition 11 were only partly confirmed.

As further illustration of country disparities, Fig. 2 shows a scattergram according to risk magnitude (RM) and societal benefit (SB). The dotted lines depict the differences between mean judgments for Chinese samples (shown in italics) and Australian samples.

Table 6. Overall mean differences across country data.

	Aspect										
Country	*RM*	*PD*	*HI*	*CP*	*FA*	*IB*	*SB*	*AA*	*IA*	*SA*	*PR*
CHINA											
Mean of M's	6.0	4.9	5.4	6.2	5.8	5.8	4.6	4.1	3.9	4.8	1.9
Mean of sd's	2.2						2.4		2.8		
AUSTRALIA											
Mean of M's	6.2	3.8	4.8	5.6	5.9	4.7	4.9	4.1	5.9	4.7	2.4
Mean of sd's	2.7						2.4		3.0		

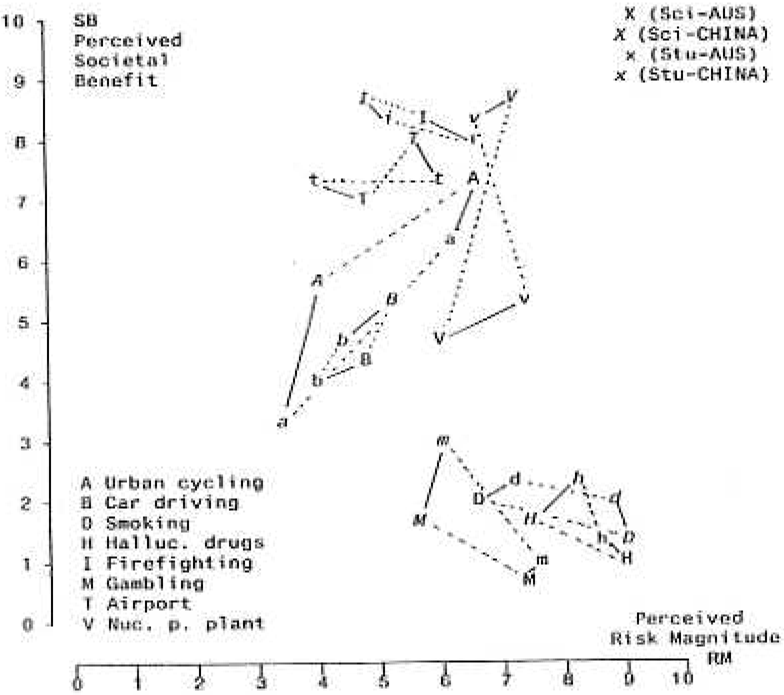

Fig. 2. Risk magnitude and societal benefit for eight hazards: Australian versus Chinese data for students and scientists.

Table 7. Mean risk ratings: selected subgroup data AUSTRALIA/CHINA.

Variable:	*RM* *Overall Risk Magnitude*						*IA* *Individual Risk Acceptance*					
Country:	*Australia*			*China*			*Australia*			*China*		
Group:	*Psy*	*Geo*	*Tec*	*Psy*	*Geo*	*Tec*	*Psy*	*Geo*	*Tec*	*Psy*	*Geo*	*Tec*
Hazard:												
Z1 Urban cycling	5.9	6.2	6.6	3.8	3.6	2.9	6.6	6.9	6.8	7.5	6.6	7.2
Z2 Car driving	3.8	4.2	3.8	4.5	4.5	4.2	7.6	8.1	8.1	7.9	7.1	8.0
G Smoking	8.8	8.8	8.9	6.4	6.9	6.4	4.9	5.1	4.1	3.3	2.2	2.8
H' Halluc. Drugs	8.1	8.7	7.9	8.2	9.1	8.6	4.7	5.9	4.1	1.8	1.0	1.9
I Firefighting	6.4	6.5	5.9	5.4	5.2	5.0	7.5	7.4	6.5	6.8	5.8	5.3
$3 Giving up job	4.1	3.3	3.8	2.6	3.0	3.0	7.9	8.1	7.2	7.0	6.7	6.4
$1 Gambling	6.1	5.4	6.1	7.1	8.1	7.4	5.7	5.8	5.6	2.2	0.9	2.0
R Earthquakes	7.0	6.4	7.1	5.5	6.3	5.0	5.9	6.6	5.9	5.1	3.6	4.8
S' Floods	6.9	5.9	6.2	5.9	6.6	5.9	6.0	6.6	6.0	4.6	3.1	3.9
T Airport	4.4	3.8	3.9	6.2	5.7	6.0	6.2	6.0	6.1	3.9	3.5	3.2
N Coal p.plant	5.5	5.4	5.2	6.2	6.1	5.5	5.5	4.9	5.6	4.0	3.3	4.2
U Nucl. p.plant	7.4	7.8	7.0	6.4	7.0	6.3	4.9	3.8	4.9	3.7	3.0	4.2
(Mean all haz's)	6.4	6.3	6.1	5.9	6.3	5.8	5.9	6.0	5.7	4.4	3.5	4.1

Table 8. Significance and Eta's for selected mean differences for groups (Psy/Geo/Tec/Sci) and countries (AUS/CHI) for hazard types <ANOVAs>.

	RM			*SB*			*IA*		
Effect (Group, Country):	*G*	*C*	*G×C*	*G*	*C*	*C×G*	*G*	*C*	*C×G*
Dangerous work places (E K L')	*/02	–	–	*/01	–	–	**/03	**/06	–
Lifestyle risks (G J' I H')	–	**/07	*	*/02	–	–	–	**/20	*
Technology hazards (P N U)	–	**/02		–	**/10	*	*/02	**/12	*
Natural hazards (R Q' S')	–	–	–	/	/	/	–	**/21	*
Z1 Urban cycling	–	**/26	*	**/05	**/15		–	–	–
X' Air pollution	–	**/05	–	/	/	/	*/02	**/20	–
$1 Gambling	–	**/10	–	**/04	**/11	*	*/01	**/36	*

Notes: Eta's given for significant main effects only; decimal point omitted.
"/": not appl. For abbreviations cf. Table 1 and 4, for number of cases cf. Table 2.

Urban cycling and gambling are examples of hazards which are rated quite differently on both dimensions.

3.4. DIFFERENCES AMONG PROFESSIONAL GROUPS

For both the Chinese Australian data, a subgroup of scientists is available; selected results are shown in Table 5 and Fig. 2, as well as subgroup means according to the subject area of the students, cf. Table 7. In Table 8, group and country effects were analysed through 2-way ANOVAs. Eta-coefficients indicate the strength of effects. At least for the two countries looked at here, disparities between societal groups tend to be smaller than cross-national differences.[4]

While existing, the differences in risk perception between student groups and students/scientists are not very large and (contrary to proposition 12) often similar for the Australian and Chinese data. A sampling based on academic sources might not grasp enough variability in worldviews to clarify the hypothesized effects of professional and ideological orientations.

3.5. SUBJECTIVE DETERMINANTS OF HAZARD EVALUATIONS

An important part of the project are propositions about the influence of risk features and attitudes on the two core variables, perceived risk magnitude and risk acceptance (cf. Fig. 1). These were analysed through multiple regression models; see Table 9 for results from Australian and Chinese data.[5]

[4] This contrasts with results from Phase I of this research looking at three western industrialized nations (Germany/Australia/New Zealand; cf. Rohrmann, 1994). There the differences between professional groups with 'technological' or 'monetarian' or 'ecological' orientation were far larger than country differences, particularly regarding technology-induced risks; however, in that project the sampling was not restricted to students, enabling a better realization of the intended group characteristics.

[5] It should be noted that the necessary correlation matrices can be (and have been) determined in several ways: *across risk sources*: the respective correlation matrix could be computed for each respondent or for mean data sets (either means of the whole sample or for means of specific subgroups); *across respondents*: an analogous matrix could be computed for each risk source or mean ratings based on defined sets of risks. (In this case, person-related variables, particularly attitude measures, can be included in the analysis, which is not possible if correlations across risk sources are used.)

Table 9. Single and multiple correlations for risk judgements.

CHINESE DATA

Criterion: RM = Risk Magnitude		*PD Probability of Dying*		*HI Health Impacts*		*CP Catastrophic Potential*		*PR Personal Relevance*		*AIT Att. anti Technology*		
Hazard Set	*Group*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*multR*
Lifestyle	XS + XE	0.39	0.28	0.38	0.26			0.01	−0.01			0.45 *
Dang. Jobs	XS + XE	0.30	0.16	0.34	0.25			0.03	−0.03			0.37 *
Technologies	XS + XE	0.43	0.18	0.50	0.33	0.40	0.16			−0.08	−0.09	0.56 *
Technologies	XS	0.4	0.17	0.47	0.29	0.40	0.17			−0.10	−0.10	0.53 *
Technologies	XE	0.5	0.18	0.63	0.45	0.44	0.14			0.01	−0.04	0.66 *
Natural H.	XS + XE	0.50	0.28	0.46	0.22	0.40	0.18					0.57 *

Predictors

Criterion: IA = Individual Risk Acceptance		*RM Risk Magnitude*		*IB Individual Benefit*		*SB Societal Benefit*		*FA Feelings of Anxiety*		*AIT Att. anti Technology*		
Hazard Set	*Group*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*multR*
Lifestyle	XS + XE	−0.32	−0.22	0.10	0.13	0.34	0.30	−0.33	−0.21			0.51 *
Dang. Jobs	XS + XE	−0.16	−0.10	0.19	0.19	0.20	0.21	−0.19	−0.18			0.36 *
Technol.	XS + XE	−0.42	−0.25			−0.04	0.00	−0.44	−0.30	−0.12	−0.15	0.51 *

AUSTRALIAN DATA

Predictors

Criterion: RM = Risk Magnitude		*PD Probability of Dying*		*HI Health Impacts*		*CP Catastrophic Potential*		*PR Personal Relevance*		*AIT Att. anti Technology*		
Hazard Set	*Group*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*multR*
Lifestyle	XS + XE	0.30	0.12	0.34	0.26			−0.15	−0.09			0.41 *
Dang. Jobs	XS + XE	0.42	0.22	0.42	0.21			−0.08	−0.10			0.47 *
Technologies	XS + XE	0.37	0.10	0.51	0.43	0.26	0.03			0.11	0.05	0.52 *
Natural H.	XS + XE	0.41	0.17	0.31	0.10	0.20	0.20					0.46 *

(continued)

Table 9. (concluded)

Criterion: *IA = Individual Risk Acceptance*		*Predictors:* *RM* *Risk Magnitude*		*IB* *Individual Benefit*		*SB* *Societal Benefit*		*AA* *Attractiveness of Activity*		*FA* *Feelings of Anxiety*		*AIT* *Att. anti Technology*		
Hazard Set	*Group*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*rPC*	*Beta*	*multR*
Lifest.	XS + XE	–0.04	–0.05	0.23	0.30	0.08	0.12	0.13	0.06	–0.02	0.05			0.25 *
Dang. Job	XS + XE	–0.16	–0.17	0.13	0.04	0.05	0.06	0.19	0.18	–0.17	–0.07			0.27 *
Technol.	XS + XE	–0.03	0.06			0.25	0.24			–0.14	–0.16	–0.11	–0.04	0.29 *

Note: rPC is single correlation between predictor and criterion; multR is multiple correlation; for aggregated hazards cf. Table 5. for groups (and number of cases) cf. Table 2. * is multR significant ($p < 0.05$).

The analyses were conducted for different sets of risk sources (which were aggregated as additive sum scores in case of sufficient homogeneity) and partly for subgroups as well. The results demonstrate the following:

- As assumed, the (subjective) probability of dying (PD), concern about health effects (HI) and the catastrophic potential of risk sources (CP) – if applicable – are all predictive of perceived risk magnitudes (RM).
- For hazards with the risk of acute impacts, e.g. natural hazards, the probability of dying (PD) has higher weight than health effects (HI). However, for technological risks, health impacts (HI) is evidently a better predictor than the 'classical' risk indicator (PD), and catastrophic potential (CP) is relevant as well.
- The proposed framework assumes that individual risk acceptance (IA) is significantly determined by risk magnitude (RM), social benefit (SB) and feelings of anxiety (FA). This model does not work well for all types of risks though. Altogether anxiety is the best predictor.
  The attitude towards impacts of technology (AIT) is not predictive. (Note: The overall ecological attitude (EA), composed of AIT plus environmental concern (AEC) and societal value orientation (ASV), shows significant influence on AI for Australian respondents but is not available for the Chinese data.)
- The main correlations are roughly similar for each of the considered subgroups (due to space limitations, results are given for one risk set only).

The results indicate the significance of qualitative factors (as expected in proposition 1) and confirm differences for types of hazards – sensu Proposition 2 while previous results on the importance of attitudes (Rohrmann, 1994, 1996) were not fully repeated.

The correlation pattern has also been utilized to learn about the similarities among hazards, applying MDS, cluster or FA procedures. In Fig. 3A and B, results of hierarchical cluster analyses are presented which are based on the intercorrelation of mean ratings across hazards.

For the Australian data, at level 9 five main clusters evolve: lifestyle risks, natural environmental risks (with air pollution and unhealthy climate being a subcluster), technology-induced risks, occupational risks, and financial risks; they account for 19 hazards while 4 hazards do not merge. (Note that nuclear power plant does not join the technologies set, and that dangerous beaches seems misallocated). The structure for the Chinese data, is roughly similar, however, socially 'banned' lifestyle risks (gambling, hallucinogenic drugs) don't go together with the other ones, while nuclear power plants becomes part of the technology risks cluster.

Altogether the cluster structure reflects the (predefined) set-up of hazards on which the project is based. This indicates that the hazard features chosen for this taxonomy, such as natural versus technological, or private versus occupational, indeed operate as determinants of risk appraisals.

3.6. STRUCTURAL DISPARITIES BETWEEN CHINESE AND AUSTRALIAN DATA

When comparing the two sets of results, are similarities or differences more salient? It seems that the principal structure of contingencies between hazard evaluation aspects is roughly corresponding, in spite of obvious disparities in the salience of hazards.

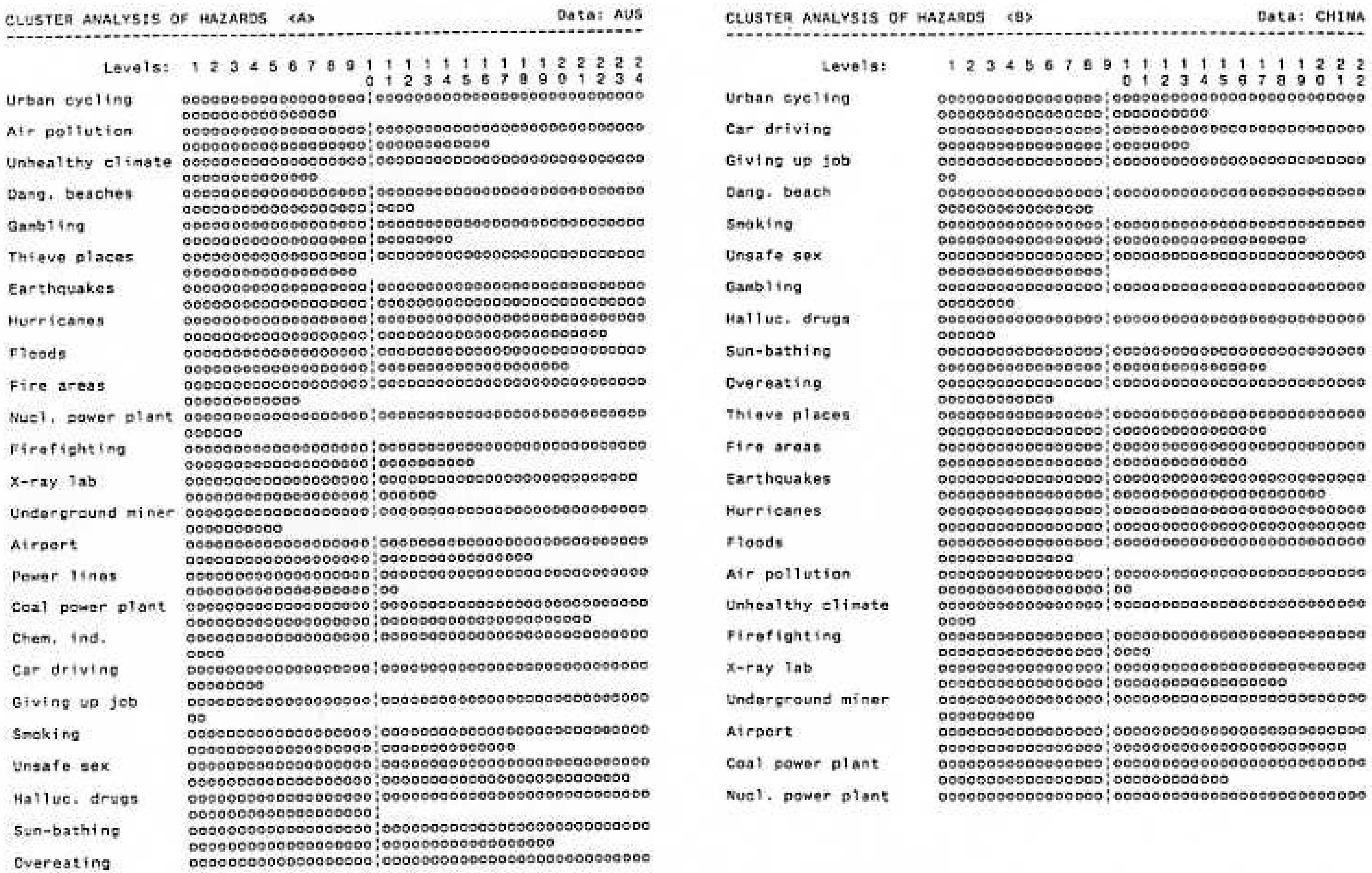

Fig. 3. (A) Similarity structure for 26 hazards, based on Australian risk judgments; (B) Similarity structure based on Chinese risk judgments.

Examples are the relevance of health impacts (HI), catastrophic potential (CP) and feelings of anxiety (FA), as well as the lack of influence of personal exposure (PR) or the (anti-)technology attitude (AIT). However, there is a considerable difference: risk magnitude (RM) and acceptance (IA) are *not* correlated in the Australian data. This result is hard to interpret though, as it clearly clashes with theoretical considerations. Also, this correlation exists in the previous studies, e.g., the German or the New Zealand data (cf. Rohrmann, 1994, 1996). Analyses of the upcoming data of the current project (i.e., Canada, Singapore, Germany-II, Japan) might clarify this issue.

4. Final considerations

4.1. INTERPRETING CROSS-CULTURAL FINDINGS

The results gained from the Australian and Chinese data reveal significant *crossnational* variation in risk perception and indicate some differences between *professional groups* in the judgment and evaluation of hazards as well.

To understand the complex picture of risk perception, various psychological and social processes can be considered (cf. the review in Rohrmann and Renn, in press). Theoretical frameworks developed or utilized in this context include the 'social amplification' of risks (Kasperson *et al.*, 1992) which focuses on the influence of public discourse and the media; avoidance of 'cognitive dissonance' (Festinger, 1964) when dealing with heterogeneous risk information; or the notion of 'worldviews' or 'cultural biases' (i.e., culture-based orientations towards perceiving the world; Douglas and Wildavsky 1982; Thompson *et al.*, 1990; Dake, 1991); and the role of personal value perspectives and societal attitudes (e.g., Feather, 1991; Stern and Dietz, 1994).

While it might be tempting to draw from the above considerations one has to keep in mind that they are based on social processes typical for 'Western' countries. Thus such theories might be applied to the Australian or German data of this project – yet it cannot be assumed that the same is valid for countries which are less industrialized and wealthy, less exposed to public debates and mutiple independent media, less based on individual achievements and careers and so on – such as many of the 'Eastern' nations.

Consequently, the comparative interpretation of findings from the Chinese data set is far more difficult because of the vast differences in political, economic and cultural terms (see, e.g., Hofstede, 1980; Triandis, 1989; Bond, 1996). The eminence of social motivations and particularly family considerations seems to be the most important factor (stereotypically: Chinese collectivism versus Western individualism). Management studies indicate that Chinese business is well networked but slow to decide because of the underlying social complexity. With regard to judgments and decisions, authors such as Yates and Lee (1996) conclude that risk is especially repugnant to Chinese decision-makers, that high-risk options are likely to be rejected and that risk aversion is common. This notion of cautiousness is in line with the notably low risk acceptance scores found in this project.

There are more factors to be considered though. Given the high power distance in Chinese society, the strong respect for status and authority, and also the apparent national pride, social-desirability effects seem to have influenced the risk judgments as well.

Taken together, the outcomes of these studies clearly elucidate the crucial role of sociopsychological factors (rather than technical features) in the risk evaluation process

– yet these factors seem to be very different in the two cultural contexts looked at in this project. Clearly, on-going research is necessary to achieve a sound understanding of risk perception in China.

4.2. PERSPECTIVES FOR FURTHER STUDIES

To extend risk perception research to a crosscultural approach is a complex enterprise. Each single investigation is necessarily confined in many resects. Despite a large body of studies, our knowledge is still patchy cf. Rohrmann and Renn, in press). In *substantive* terms, important issues include:

- In order to fully examine the relevance of intra-national versus crossnational cultural differences in risk perception, a wider range of both countries and societal groups needs to be reflected in the design of studies (certainly student samples are not a sufficient basis for clarifying this issue). Also, the possible interaction of gender effects (Cutter *et al.*, 1997; Slovic, 1997) and national differences needs to be considered.
- For a comprehensive analysis of cultural influences on the interpretation of risks and risk acceptance, more sociopsychological and sociological data are necessary (cf. McDaniels and Gregory (1991) for a research framework).
- There is still a lack of studies regarding Asian countries, and almost nothing is known with respect of South American or African cultures.
- Actual risk-taking is influenced by many factors (cf., e.g., Horvath and Zuckerman, 1992; Shoemaker, 1993; Trimpop, 1994); however, the role of risk perception and the risk attitude-behaviour link have not yet been systematically researched. Also, whether the same kind of contingency is valid for 'Western' and 'Eastern' cultures requires careful attention.

From a *methodological* viewpoint, the empirical basis of the presented results is obviously limited. The project is still in a 'pilot study' phase, and generalizability restricted. Larger and more broadly defined samples are the most important means to increase validity. Another aim is to widen the scope of data collection approaches (cf. Rohrmann and Renn, in press), in particular, to combine 'quantitative' and qualitative techniques (e.g., Marris *et al.*, 1996) in order to get a richer understanding of how people feel and think about hazards and what their mental models (Bostrom *et al.*, 1992) of hazards are.

Collaboration between researchers across countries would help to resolve these demanding tasks. The findings gained so far are certainly promising enough to justify continuing crosscultural risk studies – at least if both conceptual and methodological rigour is maintained.

Risk perception research is relevant not only to theoretical questions but also valuable and applicable to *practical* issues of risk information, risk education and risk communication. Crosscultural risk research in particular can help with problems such as hazard information for ethnic subgroups (cf. Vaughan, 1995) or societal risk conficts which are bound to a specific cultural context (Edward and Winterfeldt, 1987; Renn, 1992). In fact any kind of interaction and negotiation among people from different cultures – whether opponents or collaborators – would gain from awareness of cultural factors in risk appraisal and decision-making (Tse *et al.*, 1988; Yates and Lee, 1996).

The more societies become multicultural the more important mutual understanding of people's 'worldview' will be.

In summary, the perspective adopted in this research – that crosscultural differences require to study distinctions of both, societal groups and nations – turned out to be constructive for investigating risk perception. The exploration of Chinese hazard evaluation in this study gained from such an approach. Incorporating more countries (as currently under way) into the analysis will help to further clarify the influence of cultural factors on the cognition and evaluation of risks in 'western' and 'eastern' countries.

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References

Bond, M.H. (Ed.) (1996) *The Handbook of Chinese Psychology*, Hong Kong: Oxford University Press.

Bostrom, A., Fischhoff, B. and Morgan, M.G. (1992) Characterizing mental models of hazardous processes: a methodology and an application to radon, *Journal of Social Issues*, **48**, 85–100.

Brehmer, B. (1994) Psychological research related to risk, in B. Brehmer and N. E. Sahlin (eds) *Future Risks and Risk Management*, Dordrecht: Kluwer.

Cutter, S.L., Soecki, W.D. and Tiefenbacher, J. (1997) Gender differences in the perception of technological risks, *Risk Analysis*, **6**, 5–22.

Cvetkovich, G. and Earle, T.C. (guest eds) (1991) Special Issue: Risk and Culture, *Journal of Cross-cultural Psychology*.

Dake, K. (1991) Orienting dispositions in the perception of risk – an analysis of contemporary worldviews and cultural biases, *Journal of Cross-cultural Psychology* **22**, 61–82.

Dake, K. (1992). Myths of nature: culture and the social construction of risk, *Journal of Social Issues* **48**, 21–37

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

Edwards, W. and Winterfeldt, D.V. (1987) Public values in risk debates, *Risk Analysis* **7**, 141–58.

Feather, N.T. (1991) Human values, global self-esteem, and belief in a just world *Journal of Personality* **59**, 83–106.

Festinger, L. (1964) *Conflict, Decision and Dissonance*, Stanford: Stanford University Press.

Fischhoff, B., Bostrom, A. and Quadrel, M.J. (1993) Risk perception and communication, *Annual Review of Public Health*, **14**, 183–203.

Goszczynska, M., Tyszka, T. and Slovic, P. (1991) Risk perception in Poland: a comparison with three other countries. *Journal of Behavioral Decision Making*, 179–193.

Hinman, G.W., Rosa, E.A., Kleinhesselink, R.R. and Lowinger, T.C. (1993) Perception of nuclear and other risks in Japan and the United States, *Risk Analysis* **13**, 449–56.

Hofstede, G.H. (1980) *Culture's Consequences*, Beverly Hills, CA: Sage.

Horvath, P. and Zuckerman, M. (1992) Sensation seeking, risk appraisal and behaviour, *Personality and Individual Differences* **14**, 41–53.

Jianguang, Z. (1994) Environmental hazards in the Chinese public's eyes, *Risk Analysis* **14**, 163–69.

Kasperson, R.E., Kasperson, J.X. and Renn, O. (1992) The social amplification of risk: progress in developing an integrative framework, in S. Krimsky and D. Golding (eds) *Theories of Risk*, pp. 153–78, New York: Praeger.

Keown, C.F. (1989) Risk perception of Hong Kongese versus Americans, *Risk Analysis* **9**, 401–7.

Kleinhesselink, R.R. and Rosa, E.A. (1991) Cognitive representation of risk perceptions – a comparison of Japan and the United States, *Jounral of Cross-cultural Psychology* **22**, 11–28.

Kuyper, H. and Vlek, C. (1984) Contrasting risk judgements among interest groups, in K. Borcherding, B. Brehmer, C. Vlek and W. Wagenaar (eds), *Research Perspectives on Decision Making under Uncertainty*, pp. 205–218, Amsterdam: North-Holland.

Marris, C., Langford, I. and O'Riordan, T. (1996) *Integrating Sociological and Psychological Approaches to Public Perceptions on Environmental Risks: Detailed Results from a Questionnaire Survey*, Norwich: University of East Anglia.

McDaniels, T.L. and Gregory, R.S. (1991) A framework for structuring cross-cultural research in risk and decision making, *Journal of Cross-cultural Psychology* **22**, 103–28.

Nyland, L.G. (1993) *Risk Perception in Brazil and Sweden*, Stockholm School of Economics: Centre for Risk Research.

Pidgeon, N., Hood, C., Jones, D., Turner, B. and Gibson, R. (1992) Risk perception, in T. R. Society (ed.), *Risk Analysis, Perception and Management*, pp. 89–134. London.

Pilisuk, M., Parks, S.H. and Hawkes, G. (1987) Public perception of technological risk, *The Social Science Journal* **24**, 403–13.

Rayner, S. (1992) Cultural theory and risk analysis, in S. Krimsky and D. Golding (eds) *Social Theories of Risk*, pp. 83–116. Westport: Praeger.

Renn, O. (1992) Concepts of Risk: a classification, in S. Krimsky and D. Golding (eds) *Social Theories of Risk*, pp. 53–82, London: Praeger.

Rohrmann, B. (1994) Risk perception of different societal groups: Australian findings and cross-national comparisons, *Australian Journal of Psychology* **46**, 150–63.

Rohrmann, B. (1996) *Perception and Evaluation of Risks: Findings for New Zealand and Cross-cultural Comparisons* (Information paper No. 55). Canterbury/NZ: Centre for Resource Management, Lincoln University.

Rohrmann, B. (1999) Risk perception research — Review and documentation. Research Center, Jülich: *Studies on Risk Communication* **68**. http://www.kfa-juelich.de/mut/hefte/heft_69.pdf

Rohrmann, B. (in press) Cross-cultural studies on the perception and evaluation of hazards. In O. Renn & B. Rohrmann (eds), *Cross-cultural risk perception*. Rotterdam: Kluwer.

Rohrmann, B. and Borcherding, K. (1985) Die Bewertung von Umweltstressoren unter Risikoaspekten, in D. Albert (ed.) *Bericht ueber den 34. Kongress der DGfP in Wien 1984*, pp. 851–54. Goettingen: Hogrefe.

Rohrmann, B. and Renn, O. (in press). Risk perception research – an introduction, in O. Renn and B. Rohrmann (ed.), *Cross-cultural Risk Perception*, Dordrecht: Kluwer.

Schoemaker, P. J. H. (1993) Determinants of risk-taking: behavioral and economic views, *Journal of Risk and Uncertainty* **6**, 49–73.

Schuez, M. (1990) Werte und wertewandel in der risikobeurteilung, in M. Schüz (ed.) *Risiko und Wagnis*, pp. 217–43. Pfullingen: Günther Neske.

Schwarz, M. and Thompson, M. (1990) *Divided We Stand*, New York: Harvester Wheatsheaf.

Sjoeberg, L. (1997) Explaining risk perception: an empirical evaluation of cultural theory, *Risk Decision and Policy* **2**, 113–30.

Sjoeberg, L. and Drottz-Sjoeberg, B. (1991) Knowledge and risk perception among nuclear power plant employees, in B. Drottz-Sjoeberg (ed.) *Perception of Risk*, pp. 141–62. Stockholm: Center for Risk Research.

Slovic, P. (1992) Perception of risk: reflections on the psychometric paradigm, in D. Golding and S. Drimsky (eds) *Theories of Risk*, pp. 117–523. London: Praeger.
Slovic, P. (1997) Trust, emotion, sex, politics, and science: surveying the risk-assessment battle-field, in M. Bazerman, D. Messick, A. Tenbrunsel and K. Wade-Benzoni (eds) *Environment, Ethics, and Behavior*, pp. 277–287. San Francisco: The New Lexington Press.
Slovic, P., Fischhoff, B. and Lichtenstein, S. (1980) Facts and fears – understanding risk, in R.C. Schwing and W.A. Albers (eds) *Societal Risk Assessment*, pp. 181–218. New York: Plenum.
Slovic, P., Fischhoff, B. and Lichtenstein, S. (1985) Rating the risks: the structure of expert and lay perceptions, in V.T. Covello, J.L. Mumpower, P.J.M. Stallen and V.R.R. Uppuluri (eds) *Environmental Impact Assessment, Technology Assessment, and Risk Analysis*. Berlin: Springer.
Sokolowska, J. and Tyszka, T. (1995) Perception and acceptance of technological and environmental risks: Why are poor countries less concerned? *Risk Analysis* **15**, 733–44.
Stern, P.C. and Dietz, T. (1994) The value basis of environmental concern, *Journal of Social Issues* **50**, 54–84.
Thompson, M., Ellis, W. and Wildavsky, A. (1990) *Cultural Theory, or, Why All That is Permanent is Bias*, Boulder: Westview Press.
Tiemann, A.R. and Tiemann, J.J. (1985) Cognitive maps of risk and benefit perceptions, in C. Whipple and V. T. Covello (eds) *Risk Analysis in the Private Sector*, pp. 451–68. New York: Plenum Press.
Triandis, H.C. (1989) The self and social behavior in differing cultural contexts, *Psychological Review* **96**, 506–20.
Trimpop, R.M. (1994) *The Psychology of Risk Taking Behavior*, Amsterdam: New Holland.
Tse, D.K., Lee, K., Vertinsky, I. and Wehrung, D.A. (1988) Does culture matter? A cross-cultural study of executives' choice, decisiveness and risk adjustment in international marketing, *Journal of Marketing* **52**, 81–95.
Vaughan, E. (1995) The socioeconomic context of exposure and response to environmental risk, *Environment and Behaviour* **27**, 454–89.
Weber, E.U. and Hsee, C. (1997) *Cross-Cultural Differences in Risk Perception, but Cross-Cultural Similarities in Attitudes Towards Perceived Risk*, Ohio: Department of Psychology, Ohio State University.
Wildavsky, A. (1995) *But is it True?* Cambridge, MA: Harvard University Press.
Xiaofei, X. (1996w) Risk perception study in mainland China. Manuscript, presented at the *Asia and Africa Psychology Conference*, Guangzhou.
Yates, J.F. and Lee, J.W. (Eds) (1996) Chinese decision making, in M. H. Bond (ed.), *Handbook of Chinese Psychology*, pp. 338–51. Hong Kong: Oxford University Press.