A Quantitative Test of the Cultural Theory of Risk Perceptions: Comparison with the Psychometric Paradigm

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This paper seeks to compare two frameworks which have been proposed to explain risk perceptions, namely, cultural theory and the psychometric paradigm. A structured questionnaire which incorporated elements from both approaches was administered to 129 residents of Norwich, England. The qualitative risk characteristics generated by the psychometric paradigm explained a far greater proportion of the variance in risk perceptions than cultural biases, though it should be borne in mind that the qualitative characteristics refer directly to risks whereas cultural biases are much more distant variables. Correlations between cultural biases and risk perceptions were very low, but the key point was that each cultural bias was associated with concern about distinct types of risks and that the pattern of responses was compatible with that predicted by cultural theory. The cultural approach also provided indicators for underlying beliefs regarding trust and the environment; beliefs which were consistent within each world view but divergent between them. An important drawback, however, was that the psychometric questionnaire could only allocate 32% of the respondents unequivocally to one of the four cultural types. The rest of the sample expressed several cultural biases simultaneously, or none at all. Cultural biases are therefore probably best interpreted as four extreme world views, and a mixture of qualitative and quantitative research methodologies would generate better insights into who might defend these views in what circumstances, whether there are only four mutually exclusive world views or not, and how these views are related to patterns of social solidarity, and judgments on institutional trust.

KEY WORDS: Risk perceptions; cultural theory; psychometric paradigm.

1. INTRODUCTION

Two distinct approaches have been proposed to explain risk perceptions. One is the psychometric paradigm, developed by psychologists[1] and the other, cultural theory, has been proposed by anthropologists and sociologists.[2,3] Until recently, these two perspectives have been promoted largely within disciplinary boundaries and in isolation from each other, though re-searchers such as Rayner[4] and Slovic[5] have seriously addressed the scope for more integration.

Fischhoff, Slovic, and their colleagues showed, as early as 1978, that lay people and experts do not use the same definitions of "riskiness" when assessing risks: experts focused on quantitative assessments of likelihood and consequences, whereas the general public incorporated a number of additional "qualitative" dimensions such as "dread," "involuntariness," "controllability," "lack of knowledge to those exposed" and "catastrophic potential."[1,6] The method, approach, and results of these researchers have been very influential, and have became known as the "psychometric paradigm."[7] These have made an important contribution to the understanding of risk perceptions, but have been sub-

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ject to two main criticisms. The first objection was that the paradigm treated the "qualitative risk characteristics" as inherent attributes of the hazards themselves, rather than as constructs of the respondents. A number of authors have argued that whether one feels in control of the consequences of a risky event, whether one feels that exposure to a risk is voluntary, or whether one believes that knowledge is available to those exposed to risks are all, at least in part, related to social, cultural, and institutional processes.[4,8]

The second (and related) criticism leveled at the psychometric paradigm was that it did not, at first, distinguish between different groups of respondents other than experts and laypersons. The classic factor space diagrams generated by psychometric studies were supposed to represent the "personality profiles" of hazards (Ref. 7, p. 121), but these were based on aggregate data. Several studies have now shown that individual respondents can differ in their ratings of the same risk-issue on the same "qualitative risk characteristic." Such studies have stimulated an important debate about the relative value and significance of aggregate as opposed to individual data analysis.[7,9–12]

Some later psychometric studies have investigated the relationship between risk perceptions and standard sociodemographic variables such as gender, age, occupation, nationality or place of residence, but these no longer incorporated any analysis of the "qualitative risk characteristics" which formed the original basis of the so-called psychometric paradigm (reviewed in Refs. 7,13, and 14). The correlations observed in these studies have tended to be very weak. Furthermore, even when correlations were identified, this approach provided little insight into *why* some types of people (e.g., women) perceive risks differently. The influence of factors such as gender, age, or nationality apparently relate to underlying dimensions that were not clearly revealed in these quantitative cross-sectorial studies. A more interesting study was that of Flynn et al.,[15] which explored the influence of gender and race on risk perceptions, and found that Black men rated risks in much the same way as White (or Black) women. Most of the gender (and race) difference observed was due to a small subset of White males who perceived risks to be low, and who shared a particular view of the world characterized by "trust in institutions and authorities and by anti-egalitarian attitudes, including a disinclination toward giving decision-making power to citizens in areas of risk management" (Ref. 5, p. 17).

Thus, risk perceptions may not be so much related to the "personality profiles" of hazards as to the characteristics of the people who perceive the risks, and to

notions of trust and accountability in risk management. Proponents of the psychometric paradigm appear to have increasingly accepted this point and some of their more recent studies have used psychometric methods to explore underlying social dimensions such as trust, blame and accountability.[5,7]

In recent years, a number of sociologists have looked at the social processes which underly risk perception.[16–20] They point out that individuals and groups reframe their interpretations of the context of a hazard stress according to a series of communication procedures, in which the media are also involved. We learn from this that risk perceptions are amplified or attenuated according to a variety of social stimuli and experiences, and that the original formulation of "lay persons" is now far too sweeping to be of use. Hence, our interest here in both the individualistic and the cultural framing of risk perceptions.

We felt that it might be possible to extend this bridging of the psychometric paradigm with a more sociological approach by investigating the possible contribution of cultural theory. We did so because cultural theory focuses specifically on differences between people in their reactions to risk, and because the theory claims to provide a framework for identifying underlying patterns of worldviews which go beyond standard sociodemographic variables.

Cultural theory consists of two components.[2–4,21,22] The first is the functionalist belief that adherence to specific patterns of social relationships generates distinctive ways of looking at the world, referred to as "cultural biases," and *vice versa*, that adherence to a particular world view legitimizes a corresponding type of social relations. The second component is the claim that there are only four viable "ways of life," defined by the strength of the "grid" and "group" characteristics of their social relations: hierarchy (high-grid and high-group), egalitarianism (high-group but low-grid), individualism (low-group and low-grid), and fatalism (high-grid but low-group). Thompson et al.[3] described these variables as follows: "*Group* refers to the extent to which an individual is incorporated into bounded units. The greater the incorporation, the more individual choice is subject to group determination. *Grid* denotes the degree to which an individual's life is circumscribed by externally imposed prescriptions. The more binding and extensive the scope of the prescriptions, the less of life that is open to individual negotiation" (Ref. 3, p. 5).

Cultural theory has attracted its fair share of critics. Two of the more notable are Boholm[23] and Sjöberg.[24] One problem with cultural theory is that there appear to be (at least) two different versions of the theory.[4,23] The

first, or "stability," version maintains that individuals will choose to attach themselves to institutions with the same type of social organization in different spheres of their lives (e.g., at home, at work, in leisure activities) and will therefore adhere consistently to the same cultural bias whatever the social context. This version also implies that individuals will conform to the same cultural bias over time and therefore tends to treat cultural biases as innate attributes of individuals. In contrast, the second, or "mobility," version of cultural theory suggests that individuals might attach themselves to institutions with different grid and group characteristics in different spheres of their lives, or over time, and argues that they will adopt different cultural biases as they move from one type of institution to another. Maybe, Boholm (Ref. 23, p. 78) muses, "subjects may even change their way of life during the course of an interview or the task of filling out a questionnaire."

This ambiguity among cultural theorists has serious implications for developing methodologies to test the theory empirically, because it is unclear whether the unit of analysis should be individuals or institutions. Proponents of the mobility version of cultural theory argue that questionnaire surveys cannot tap into the relevant dimensions of social relations and promote the use of qualitative methods set in specific social settings.[25-27] Proponents of the stability version of cultural theory, however, think it is legitimate to use questionnaire items to elicit the cultural bias of individuals without reference to any specific social context. Dake, for example, has devised a "Cultural Biases Questionnaire" which consists of a set of "agree–disagree" statements about society and claims that these can be used to measure cultural biases.[28-30]

The second major problem with cultural theory is the supposed link between the grid-group dimensions and cultural biases. Boholm (Ref. 23, p. 68) argues that there is no intellectual rigour in the claim that "outlooks on the world" or "ways of life" are influenced by patterns of social relations. Even proponents of cultural theory admit that it has been difficult to operationalize grid-group analysis, especially in any quantifiable way.[4]

The study reported here essentially replicates the quantitative survey methodology developed by Dake even though we are aware of the criticism that questionnaires composed of general and context-free questions fail to incorporate any analysis of social relations and cannot, therefore, truly tap into the grid-group dimensions of cultural theory (Ref. 23, p. 78, Ref. 31, p. 54).[4,13,32] If questionnaires are to be used at all, respondents should be chosen according to their adherence to particular institutions with distinctive grid and group

characteristics. Our study incorporated a sample of respondents selected in this way, but the results are not presented here.[33] In addition, the questionnaire survey reported here was followed up with focus group interviews which will be reported separately in a forthcoming paper.[38]

This study used methodologies derived from both the psychometric paradigm and cultural theory in order to investigate:

1. Whether cultural biases can be measured using a questionnaire instrument of psychometric nature (Sect. 3);

2. Whether cultural biases or the "qualitative risk characteristics" of the psychometric paradigm are the better predictor of risk perceptions (Sect. 4);

3. Whether cultural biases were associated with distinct *patterns* of risk perceptions (Sect. 5);

4. Whether the qualitative risk characteristics generated by the psychometric paradigm are interpreted and evaluated differently within the different worldviews (Sect. 6);

5. Whether distinct views on trust, liability and consent can be identified and how these might relate to cultural biases (Sect. 7).

2. METHODS

A questionnaire was administered through face-to-face interviews conducted in the respondents' homes. Four locations in Norwich were chosen by housing type to provide a range of residents with differing sociodemographic characteristics, and a selection of households were visited on at least three occasions at different times of day in each location. We note here that we used a strategy of randomly sampling households within preselected geographical areas identified by different housing type. Four areas were chosen consisting of housing classified as: public authority, semidetached private, terraced private, and very large detached houses.

A total of 430 houses were selected: 57% of these households refused to be interviewed, 13% were never at home, and 30% completed the questionnaire, giving a total of 129 respondents. Given the length of the interview (the mean time was 57 minutes), we regard this as a reasonable response rate. In any case, the aim of the sampling strategy was not to obtain a statistically formal representative sample of the population. Rather, we were seeking sufficient variation on a number of socioeconomic characteristics for reliable between-group comparisons to be made. In this respect, a good spread of incomes, social classes and levels of education was

Table I. Cultural Bias Items

Hierarchy (six items)

I think there should be more discipline in the youth of today.

I would support the introduction of compulsory National Service.

I am more strict than most people about what is right and wrong.

I think it is important to carry on family traditions.

I value regular routines highly.

I think being on time is important.

Individualism (five items)

In a fair system people with more ability should earn more.

A free society can only exist by giving companies the opportunity to prosper.

If a person has the get-up-and-go to acquire wealth, that person should have the right to enjoy it.

It is just as well that life tends to sort out those who try harder from those who don't.

Making money is the main reason for hard work.

Egalitarianism (ten items)

If people in this country were treated more equally we would have fewer problems.

The government should make sure everyone has a good standard of living.

Those who get ahead should be taxed more to support the less fortunate.

I would support a tax change that made people with large incomes pay more.

The world could be a more peaceful place if its wealth were divided more equally among nations.

Racial discrimination is a very serious problem in our society.

What this country needs is a "fairness revolution" to make the distribution of goods more equal.

Most of the meals I eat are vegetarian.

Health requirements are very important in my choice of foods.

I prefer simple and unprocessed foods.

Fatalism (seven items)

There is no use in doing things for people—you only get it in the neck in the long run.

Cooperating with others rarely works.

The future is too uncertain for a person to make serious plans.

I have often been treated unfairly.

A person is better off if he or she doesn't trust anyone.

Most people make friends only because friends are useful to them.

I feel that life is like a lottery.

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obtained overall, even though there was a bias toward the higher socioeconomic groups compared to the population of the city as a whole. Gender was the only variable which was controlled for in the sampling strategy: there were 47% males in the sample.

The sample bias toward a higher social class and more educated respondents than is typical of the population as a whole would create difficulties if we sought to generalize our findings for Norwich as a whole. But statistical representativeness was not a critical issue since we were only looking for sufficient variability in

the sample for individuals to be categorized on the basis of sociodemographic characteristics. This particular aim, we believe, was achieved (full details of the sociodemographic characteristics of the sample are available from the authors).

The questionnaire consisted of three main sections. The first section of the questionnaire measured risk perceptions. Respondents were asked to rate (on a 5-point scale) 13 technologies, products, and activities on five different definitions of risk perception, namely: "Riskiness" ("how much risk do you think is associated with. . .?"), "Fatalities" ("how many people do you think die every year as a consequence of. . .?"), "Injuries" ("how many people do you think are injured or become ill as a consequence of. . .?"), "Environmental Harm" ("how much harm do you think is done to things other than people as a consequence of. . .?"), and "Unacceptability" ("how acceptable do you feel the current risk is for. . .?"). Throughout the rest of this paper, the terms Riskiness, Fatalities, Injuries, Environmental Harm, and Unacceptability are used as abbreviations for responses to these questions.

The second section of the questionnaire asked respondents to rate the same 13 risk issues on a set of nine risk characteristics proposed by Slovic et al.[1]: "dread," "severity," "delayed effects," "harm to future generations," "catastrophic potential," "involuntariness," "unfairness," "lack of knowledge to scientists," and "lack of knowledge to those exposed." The third section of the questionnaire was a modified version of the "British Edition" of "Dake's Cultural Biases Questionnaire"[28] and the full set of items used is shown in Table I. Each item was scored on a 5-point scale from 1, "disagree strongly," to 5, "agree strongly." Respondents were also asked to rate ten different institutions on a 4-point scale from "never trust" to "always trust" "to tell you the truth about risks" (see Table VI), and to respond to a set of items adapted from Dake and Thompson[34] and Jenkins-Smith[35] designed to measure attitudes toward the environment (see Table VII).

3. MEASURING CULTURAL BIASES

Our first objective was to see whether cultural biases could be measured using the questionnaire developed by Dake. Four cultural bias scores were calculated for each respondent. An individual's responses to each of the items attributed to a cultural bias were added up and divided by the number of items used for that cultural bias. This procedure which resulted in a score between 1 and 5 for each cultural bias for each respondent. If

cultural theory worked well at the level of individuals, and if Dake's questionnaire instrument was an effective tool for measuring cultural biases, respondents would be expected to have a high score for one particular cultural bias and a low score for the other three biases. We decided that in order to be allocated to a particular cultural bias, respondents had to have one score above the mean for the sample, and the other three scores below the mean. Using this system to categorize individuals, the sample consisted of 22 egalitarians, nine individualists, five hierarchists, and five fatalists. Eight respondents had no cultural bias at all (all four scores below the mean), and the remaining 80 respondents were of mixed cultural bias (more than one score above the mean). Thus, only 41 respondents (32% of the sample) could clearly be allocated to a single cultural bias. These results suggest that cultural biases are not innate attributes of individuals which can be measured using the kind of questionnaire items listed in Table I.

These results also suggest that the sample may have been biassed toward egalitarians. However, Brenot and Bonnefous[36] using a much larger and more statistically representative French sample, also experienced this phenomenon. We believe that this is inherent in the Dake cultural bias questionnaire, a view shared by Sjöberg (Ref. 37, p. 15), in his comparison of Swedish and Brazilian respondents. Our mean scores compare favorably with similar mean scores from these analysts to the point where there is no statistical difference in the evidence.

The remainder of this paper discusses results obtained using the spectrum of scores obtained by individuals on each of the four scales. Thus respondents with, for example, high egalitarian scores are compared to those with low egalitarian scores, regardless of their scores on the other three scales. For these analyses, individuals were *not* divided into cultural bias categories. Using Dake's Cultural Biases Questionnaire in this fashion was, however, still problematic, because the scales were not independent from each other. The individualism scale, in particular, correlated quite strongly with all three other scales (0.53 with hierarchy, −0.42 with egalitarianism, and 0.25 with fatalism). The hierarchy scale also correlated, to a lesser extent, with the fatalism (0.21) and egalitarian (−0.16) scales, while the correlation between fatalism and egalitarianism was low (0.07). In point of fact, we had used a modified version of the (British) Dake questionnaire since we noted the cautions of Sjöberg[37] and Brenot and Bonnefous[36] that the original Dake items did not produce independent cultural biases, but even then we found that we had not produced an independent measure of outlook.

The four scales also showed noticeably varying degrees of internal consistency. The fatalism and individualism scales had Cronbach's alpha coefficients of 0.73 and 0.72, which are respectable values. The egalitarianism and hierarchy scales, however, had lower alpha coefficients, 0.63 and 0.57, respectively. A hierarchical cluster analysis of the cultural bias items (not shown) did identify the four scales, except that: (a) the hierarchy scale was rather poorly defined and; (b) egalitarianism split into two, with one branch containing the items on healthy eating and anti-racism.

We also found that cultural biases, as measured using this instrument, were not independent from standard sociodemographic variables. When each of the four cultural bias scales were regressed against sex, age, social class, level of education, and household income, the multiple (adjusted) R^2 values obtained were 0.23, 0.16, 0.16, and 0.07, respectively, for fatalism, hierarchy, individualism, and egalitarianism, indicating that the first three scales in particular correlate to some degree with standard sociodemographic variables ($p < 0.001$). Respondents with higher fatalism scores tended to be men, have less formal education, and lower incomes; those with higher hierarchist scores tended to be older, have less formal education, and lower incomes; those with higher individualism scores tended to be older and have less formal education; and those with higher egalitarian scores tended to be women and have higher educational qualifications.

4. PREDICTING RISK RATINGS

Our second objective was to see whether cultural theory or the psychometric paradigm was the better predictor of risk perceptions. Multiple regression analyses were performed using either the four cultural bias scales or the nine qualitative risk characteristics as independent variables. Table II lists the percentage of variance in risk perceptions explained by each of these two types of variables. With the exception of war, the nine qualitative risk characteristics were able to explain a significant proportion (14–41%) of the variance in risk perceptions. In contrast, the four cultural bias scales could only explain, at most, 12% of the variance, and in most cases (eight out of 13 risk-issues) the correlation was not statistically significant ($p > 0.05$). Indeed, the amount of variance explained by the cultural bias scales was no higher than that explained by standard sociodemographic variables. Regression analyses were also performed on the psychometric and cultural bias scales with sociodemographic variables included, but this made very little difference to

Table II. Regression Analysis of Risk Perceptions[a]

	Qualitative risk characteristics[b]	Cultural bias scales[c]	Sociodemographic variables[d]
Food colorings	0.41***	0.12**	0.00
Nuclear power	0.34***	0.02	0.02
Genetic engineering	0.32***	0.03	0.00
Mugging	0.31***	0.05*	0.14**
Microwave ovens	0.27***	0.05*	0.12**
Car driving	0.26***	0.00	0.03
Sunbathing	0.25***	0.05*	0.05
Terrorism	0.22***	0.02	0.06*
Ozone depletion	0.21***	0.09**	0.03
Accidents in the home	0.17***	0.00	0.07*
AIDS	0.15**	0.01	0.05
Alcoholic drinks	0.14**	0.00	0.08*
War	0.06	0.01	0.00
Average	0.24	0.03	0.05

[a] This table lists the adjusted multiple R^2 values obtained from regression analyses of individual scores for risk perception (defined as Riskiness). Bold entries denote $p < 0.05$.

[b] All nine risk characteristics as independent variables (involuntariness, delayed effects, severity, dread, catastrophic potential, harm to future generations, lack of knowledge to those exposed, lack of knowledge to scientists, and unfairness).

[c] All four cultural biases together (individualism, hierarchy, egalitarianism and fatalism).

[d] All sociodemographic variables together (sex, age, class, education, and income).

*$p < 0.05$.

**$p < 0.01$.

***$p < 0.001$.

Table III. Hypothesized Relationship Between Cultural Biases and Risk Perceptions[a]

Risk issue	Individualism	Hierarchy	Egalitarianism
Sunbathing			+
Food colorings	−	−	+
Genetic engineering	−	−	+
Nuclear power	−	−	+
Mugging		+	
Accidents in the home	−	+	
Ozone depletion	−	+	+
Car driving	−		
Microwave ovens			+
AIDS	−	+	+
War	+	+	
Terrorism		+	
Alcoholic drinks	−		

[a] Minus signs indicate low levels of concern for specific risk issues. Plus signs indicate high levels of concern. No predictions were made for fatalism because cultural theorists have made few statements about the relationship between fatalism and risk perception.

the results (not shown). Table II refers only to risk perceptions defined as "Riskiness" but results using the other four definitions of risk were similar.[33] These results suggest that the psychometric paradigm is able to explain a much higher proportion of the variance in risk perceptions than cultural theory (but see discussion in Sect. 8).

5. CULTURAL PATTERNS OF RISK PERCEPTIONS

Our third objective was to determine whether cultural biases were associated with distinct *patterns* of risk perceptions. Cultural theory posits that each of the cultural biases is associated with more or less concern about specific types of risks, but this cannot be tested using the type of analysis shown in Table II. Egalitarians, for example, are predicted to be more concerned about large-scale environmental risks with potentially catastrophic consequences such as nuclear power and ozone depletion, whereas individualists would consider these risks to have been exaggerated, and hierarchists should be most concerned about social issues such as mugging and terrorism which threaten their sense of order and security. Table III lists 25 predictions about the relationship between cultural biases and risk perceptions for the 13 risk issues included in the questionnaire. These were derived from Douglas and Wildavsky,[2] Thompson et al.,[3] and Dake,[28] and stated before conducting the survey.[13] No predictions were made for fatalism because cultural theorists have not discussed the relationship between fatalism and risk perception in much depth.

In order to test these hypotheses, correlations between risk perceptions ratings and each of the four cultural biases were measured. Again, all the correlations were very low. The highest correlation was 0.34. On the other hand, a *high proportion* of the correlations was statistically significant. A total of 208 correlations were measured (four cultural biases × 13 risk-issues × four definitions of risk), and 77 of these (37%) were significant at the 95% confidence level. By random variation we would expect ten or 11 significant correlations (ignoring the predicted sign). In fact we achieved some seven times that, with nearly all the correlations confirming our prior hypotheses. This suggests that the correlations, though weak individually, may create a meaningful pattern if examined as a whole.

In addition, correlations between cultural biases and risk perceptions were not the same depending on which of the five definitions of risk perception (Riskiness, Fatalities, Injuries, Environmental Harm, and Unaccepta-

Table IV. Significant Correlations Obtained Between Cultural Biases and Risk Perceptions[a]

Risk issue	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	−		+ ☺	
Food colorings	− ☺	− and +	+ ☺	
Genetic engineering	− ☺	+ ⊗	+ ☺	+
Nuclear power	− ☺	− ☺	+ ☺	
Mugging	+	+ ☺		+
Accidents in the home		+ ☺	+	−
Ozone depletion	− ☺	− ⊗	+ ☺	
Car driving	− ☺	−	+	
Microwave ovens		+	+ ☺	+
AIDS		+ ☺	+ ☺	+
War	− ⊗			
Terrorism		+ ☺	+	
Alcoholic drinks	− ☺	−	+	− and +

[a] This table indicates the statistically significant correlations obtained between cultural biases and risk perceptions using any one of the definitions of "risk": Riskiness, Fatalities, Injuries, Environmental Harm, or Unacceptability ($p < 0.05$; $R > 0.14$). Minus signs indicate negative correlations (i.e., low concern). Plus signs indicate positive correlations (i.e, high concern). ☺ indicates that the hypothesis shown in Table III was proved right. ⊗ indicates that the hypothesis shown in Table III was proved wrong.

bility) was scored by the respondents. The greatest number of significant correlations were revealed when risk was defined as Riskiness, Environmental Harm, or Unacceptability, rather than in terms of Fatalities or Injuries, which suggests that cultural theory is more closely related to the concept of unacceptability than to estimates of human fatalities and injuries. Table IV summarizes these results across all five definitions of risk perception, i.e., it shows which of the correlations between cultural biases and risk perceptions were statistically significant using any one of the definitions of risk.

Comparing Tables III and IV reveals that eighteen out of the 25 predictions were proven by the data. The results presented in Table IV therefore largely supported the prior hypotheses shown in Table III. An egalitarian worldview was, as hypothesized, correlated with high risk perceptions for environmental threats of a potentially catastrophic nature such as nuclear power and the depletion of the ozone layer; and also for "unnatural" risks such as food colorings, genetic engineering, and microwave ovens. The hierarchical world view was, as expected, associated with high scores for social threats such as mugging and terrorism. The individualist world view was, in accordance with cultural theory, characterized by low concern for environmental threats (nuclear power and ozone depletion), and also low concern for risks which would be perceived, within an individualist world view, as "personal risks" (alcoholic drinks, car driving, food colorings, and sunbathing).

There were fewer statistically significant correlations for fatalism than for the other three cultural biases. Fatalism was correlated with concern about social ills such as mugging and AIDS, but not war or terrorism, which suggested that fatalism was perhaps most associated with concern about issues which were more likely to affect respondents directly. Interestingly, fatalism was the only cultural bias which revealed no significant correlations at all when risk perception was defined in terms of Unacceptability. This may indicate that accepting something, or not accepting it, is not a concept which has much meaning within a fatalist world view. This is consistent with cultural theory, which states that fatalism is associated with an experience of powerlessness and an emphasis on fate and chance. In contrast, egalitarianism correlated significantly (and positively) with Unacceptability for ten out of the 13 risk issues. These potential insights were subsequently investigated in more depth, and largely confirmed, by focus group analysis.[38]

Three results were contradictory to our prior hypotheses. These could be taken to invalidate cultural theory itself, but we believe that they highlight the problems inherent in testing cultural theory using a questionnaire of psychometric nature. For example, some cultural theorists have argued that individualists would be particularly concerned about war because it reduces the scope for bargaining and plays havoc with contract security. (Thompson, personal communication, 6/10/95). But the results from this survey showed a negative correlation between individualism and risk perception ratings for war. One possible explanation was that, at the time of the interviews (June/July 1995) the war in the Balkans, which had had little effect on economic activities in the U.K., was prominent in the British media. Furthermore, another cultural theorist has argued that competitive market institutions might well favor war of certain kinds, since it can provide opportunities for the entrepreneur (who cares little for national loyalties) to manufacture instruments of war or to step into niches

vacated by the formal economy, providing black market food or clothing (Rayner, personal communication, September 1996). This example illustrates the problems of formulating specific questionnaire items to test cultural theory predictions, since the different worldviews are not simply hypothesized to be associated with "acceptance of" or "concern about" broad and nonspecific issues such as "war." It is the justifications and arguments used to support risk perceptions which are interesting and illustrate different world views, rather than any simplistic judgment about whether those perceptions are "positive" or "negative." More qualitative methods such as focus groups allow the analysis of these underlying dimensions.

Another unpredicted result was that risk perceptions for genetic engineering, microwave ovens, and food colorings correlated positively with hierarchy. Little or no concern had been predicted for these issues within a hierarchist worldview because these technologies have all been sanctioned by experts and are controlled by official regulatory bodies. Simpson[39] has demonstrated that food colorings, genetically manipulated foods and microwave ovens are perceived as "unnatural" by many members of the U.K. public, and that this influences their perception of these risk issues. Sjöberg[24] also claims that the notion of " unnaturalness" may weight heavily on certain psychometric scales. Hierarchy therefore appeared to be associated with an aversion to "unnatural" risks. Egalitarianism, as predicted, also correlated positively with these "unnatural" issues, whereas individualism, when it correlated significantly, did so negatively.

6. CULTURAL INTERPRETATIONS OF THE RISK CHARACTERISTICS

Our fourth objective was to see whether the qualitative risk characteristics described by the psychometric paradigm are interpreted and rated differently within the four world views. In order to do this, correlations between cultural biases and ratings given to each of the 13 risk issues for each of the nine risk characteristics were measured. Again, the correlations obtained were weak (the highest was 0.32), but the number of statistically significant correlations was relatively high. A total of 468 separate correlations were measured (13 risk issues × four cultural biases × nine qualitative risk characteristics) and 103 of these (22%) were found to be statistically significant at the 95% confidence level.

"Harm to future generations" was the risk characteristic which revealed the highest number of signifi-

cant correlations. Table V shows that egalitarianism correlated positively with many of the risk issues on this scale, especially those particular risks perceived, within an egalitarian worldview, as environmental threats (nuclear power, ozone depletion, and car driving). In contrast, individualism and hierarchy correlated negatively with these issues on the "harm to future generations" scale. Indeed, the results suggested that, in accordance with cultural theory, it was social problems, rather than environmental threats, which were perceived within a hierarchical worldview as the issues with the most pervasive ill-effects on society. Thus, hierarchy correlated positively with mugging and terrorism on the "harm to future generations" (0.22 and 0.18), "delayed effects" (0.17 and 0.22) and "catastrophic potential" (0.22 and 0.27) scales, but negatively with environmental threats such as, for example, ozone depletion, on these three scales (-0.23, -0.16, and -0.17). Within the egalitarian worldview, in contrast, it was, again, issues which were thought of as environmental threats (nuclear power, ozone depletion, and car driving) which were perceived as having the greatest "catastrophic potential" (0.27, 0.16, and 0.17).

7. TRUST, NATURE AND PROCEDURES FOR DECISION-MAKING

Trust in those responsible for managing risks has been identified as a key issue by proponents of both cultural theory and the psychometric paradigm.[27,40] Our fifth objective was therefore to see whether we could identify distinct views on trust, liability and consent which were related to cultural biases. Cultural theory suggests that each of the four world views is associated with specific beliefs about the type of people and institutions who will be considered trustworthy to communicate about risks, and with preferred procedures for risk management.[27] In addition, Thompson et al.[3] have suggested that the four world views are associated with four distinct "Myths of Nature" which in turn justify specific philosophies about the appropriate measures necessary to protect natural ecosystems.

Table VI lists correlations between cultural biases and responses to the question "who would you trust to tell you the truth about risk?" and confirms many of the hypotheses of cultural theory. Thus, cultural theorists suggest that hierarchists will trust in people in positions of authority, such as the government and doctors. They should also trust scientists, who possess the "facts" necessary to manage the environment; and respect religious organizations, because of their high morals. Conversely,

Table V. Correlations Between Cultural Biases and Scores Given to "Harm to Future Generations" for Each of the 13 Risk Issues[a]

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	−0.11	0.08	**0.15***	**0.15***
Food colorings	**−0.16***	−0.05	0.07	0.02
Genetic engineering	**−0.18***	**−0.15***	−0.01	−0.11
Nuclear power	−0.13	**−0.15***	**0.24****	0.00
Mugging	0.07	**0.22****	0.06	**0.29*****
Accidents in the home	0.04	−0.05	0.07	**0.27*****
Ozone depletion	**−0.24****	**−0.23****	**0.19***	−0.11
Car driving	**−0.21****	−0.08	**0.29*****	0.12
Microwave ovens	−0.04	−0.01	0.03	0.08
AIDS	0.08	0.12	**0.16***	0.09
War	−0.07	−0.04	**0.19***	0.05
Terrorism	0.09	**0.18***	**0.17***	**0.18***
Alcoholic drinks	**−0.19***	−0.06	0.10	−0.07

[a] Bold entries denote $p < 0.05$.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

Table VI. Correlations Between Cultural Biases and Trust in Institutions[a]

	Individualism	Hierarchy	Egalitarianism	Fatalism
Trade unions	**−0.30*****	**−0.28*****	**0.29*****	−0.04
Companies	**0.27****	**0.39*****	**−0.15***	0.03
Government	**0.26****	**0.22****	−0.08	**−0.19***
Doctor	0.11	**0.23****	0.02	**0.26****
Scientists	0.07	**0.15***	0.11	−0.06
Religious orgs.	−0.02	**0.22****	**0.21****	−0.10
Family	0.13	**0.20****	0.12	**0.19***
Friends	−0.03	0.13	0.08	**0.15***
Environmental orgs.	−0.05	−0.05	0.05	**−0.15***
Media	−0.12	0.01	**0.19***	0.13

[a] This table lists correlations between the cultural bias scores obtained by each of the respondents and the trust score those same respondents gave to specific institutions. The question asked was "who would you trust to tell you the truth about risks?", and was rated on a 4-point scale where 1 corresponded to "never trust," 2 to "sometimes trust," 3 to "often trust," and 4 to "always trust." Thus, positive correlations in this table refer to high levels of trust, and negative correlations to low levels of trust. Bold entries denote $p < 0.05$.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

hierarchists would be expected to have little affinity with organizations fighting for more equality, such as trade unions. Table VI provides some level of support for all of these predictions. Egalitarians, in contrast, should place very little trust in governments, companies, and scientists, which they would perceive as being corrupted by vested interests and too much power. Egalitarian organizations such as trade unions, would, however, be perceived as acting with the best interest of their members in mind. The data revealed, as expected, a negative correlation with respect to companies, and a positive correlation for trade unions, but no statistically significant correlation was observed between egalitarianism and

trust in the government or scientists. Individualists, according to the theory, should trust companies but should be suspicious of trade unions who would be perceived as acting against economic development. Both of these predictions are supported by the data. One unexpected result, however, was that individualism correlated with trust in the government, and hierarchy with trust in companies. This is likely to be due to the fact that these two cultural biases were not clearly distinguished using Dake's questionnaire (see Sect. 3).

Cultural theorists have not made such clear cut predictions about fatalism. The results indicate that fatalism was correlated with high levels of trust in people that

Table VII. Correlations Between Cultural Biases and Attitudes Toward the Environment[a]

Statement	Individualism	Hierarchy	Egalitarianism	Fatalism
The environment is very adaptable and will recover from any harm caused by people. [Nature benign]	**0.23****	0.11	**−0.17***	0.07
With expert management, we can prevent environmental disasters. [Nature perverse/tolerant]	**0.28*****	**0.16***	0.05	−0.07
The environment is very fragile and the slightest human interference will cause a major disaster. [Nature ephemeral]	−0.08	0.07	**0.27*****	**0.20****
No matter what we do, the environment will change in unpredictable ways both for the better and the worse. [Nature capricious]	0.13	0.12	−0.05	**0.18***
Large businesses have too much influence on ordinary people	−0.13	−0.08	**0.43*****	0.14
Big corporations are responsible for most of the evil in the world.	−0.04	0.03	**0.33*****	**0.45*****
Industry left to itself will harm the environment.	−0.11	**−0.22****	**0.29*****	0.11
The misuse of technology is a serious problem in the world today.	**−0.26****	−0.06	**0.37*****	0.12
Decisions in business and government should rely more heavily on participation by members of the public.	**−0.23****	−0.03	**0.45*****	**0.19***
There are too many laws controlling technology.	**0.20***	**0.32*****	0.00	**0.24****
Concern about the environment restricts industry too much.	**0.41*****	**0.46*****	**−0.26****	**0.22****

[a] Bold entries denote $p < 0.05$.
*$p < 0.05$.
**$p < 0.01$.
***$p < 0.001$.

were known personally (friends, family and doctor); but low levels of trust for the government and environmental organizations, which were presumably both perceived as more distant. Indeed, the overall pattern for the whole sample suggested that most respondents preferred to rely on people that they knew personally. Over 70% said that they would "often" or "always" trust their doctor, their friends or their family to tell them the truth about risks (76, 80, and 87%, respectively). Environmental organizations were the only institutional source of information which was, in general, highly trusted (79%). Less than 20% of the sample said that they would trust the government, companies or the media (8, 13, and 16%, respectively).

Table VII shows that cultural biases were also related to distinct attitudes toward the environment and how it should be managed. Four questionnaire items, adapted from Jenkins-Smith,[35] were devised to reflect the individualistic, hierarchist, egalitarian, and fatalist "Myths of Nature" proposed by Thompson et al.[3] The results shown in the first four rows of Table VII reveal a significant (and positive) correlation with the appropriate cultural bias for each of these four myths. These myths, however, did not appear to be exclusive of one another since individualism also correlated positively with the hierarchist myth, and fatalism with the egalitarian myth.

The other seven items listed in Table VII relate to attitudes toward technology, industry, and decision-making procedures. As predicted by cultural theory, egali-

tarianism correlated particularly strongly with negative views about technology and private companies. Hierarchy and individualism correlated with more positive views about technology and industry and also with the opinion that "there are too many laws controlling technology" and "concern about the environment restricts industry too much." The strongest correlation observed was in relation to public participation in decision-making, which was favored within an egalitarian perspective but opposed from an individualist perspective. Overall these results tended to confirm to a limited extent the relationship between cultural biases and differing perspectives on trust, liability and consent proposed by Rayner and Cantor,[27] but it was not possible to distinguish clearly the hierarchical and individualist preferences. This, again, was likely to be due to the fact that the hierarchy and individualism scales were intercorrelated (see Sect. 3).

8. DISCUSSION

Referring back to the five objective listed in the introduction, this study has shown that:

1. Dake's questionnaire, even when modified to take into account previous research findings, could not be used to categorize individuals according to their cultural bias. It could only be used to measure worldviews at a collective level;

and even then the hierarchy and individualism scale were strongly intercorrelated, and all four scales correlated significantly with standard sociodemographic variables (Sect. 3).

2. The "qualitative risk characteristics" of the psychometric paradigm explained a far greater, but nevertheless still modest, proportion of the variance in risk perceptions than either cultural biases or sociodemographic variables (Sect. 4 and Table II).

3. Although the correlations obtained were low, each of the cultural biases was linked to concern with particular types of risks. The key point was that the pattern observed was consistent with the predictions of cultural theorists (Sect. 5 and Tables III and IV).

4. Some of the "qualitative risk characteristics" were interpreted and evaluated differently within each of the world views (Sect. 6 and Table V).

5. Distinct views on trust, liability, and consent were identified and these correlated with cultural biases (Sect. 7 and Tables VI and VII).

In all cases where they were measured, correlations between these cultural bias scales and risk perception ratings were very low. The best that can be concluded from our study is that the *patterns* observed were broadly consistent with the predictions of cultural theory. Furthermore, correlations with questions relating to choices about appropriate measures (and actors) to manage risks always produce higher correlations than risk ratings. These results are similar to those obtained by other researchers using the same method.[28,35-37] The interpretations of these results, however, varies substantially among these authors. At the two extremes, Dake[28] argues that cultural theory presents the best framework to predict risk perceptions, whereas Sjöberg[37] argues that the correlations obtained are so low that cultural theory as a whole should be dismissed. Sjöberg based his conclusion on the low R^2 values obtained for the four cultural bias scales taken together, averaged across a range of different risks, as presented here in the last row of Table II. We believe, however, that this is not the most appropriate way to analyze and interpret these data. Firstly, in order to decide which model is the best predictor for risk perceptions, one should be clear about *what* one is trying to predict, in other words, how one defines "risk perception" itself. Within the psychometric paradigm, risk perception is defined in terms of responses to questions such as "how much risk do you think is associated with" a hazardous technology, product, or activity. When defined in this way, it is not sur-

prising that factors such as "dread" ("Is this a risk that people have great dread for on the level of a gut reaction?") have high "predictive" power, since, we would argue, they are essentially measuring the same thing. Cultural biases (and sociodemographic variables), in contrast, are far more distant variables. Secondly, we believe that it is comparisons *between* the four cultural biases which provide the most interesting insights, rather than the regression analyses using all four cultural biases together. When analyzed in this way, the results presented here demonstrate that each of the four cultural biases was associated with a distinct pattern of risk perceptions (Table IV).

Thirdly, cultural theory does not really claim to explain such abstract ratings of risk. Instead, it aims to explain different views about how—and by whom—risks should be managed, and argues that opinions about risks, Nature, and the institutions and procedures involved in risk management form a coherent package which is related to how society itself is experienced. In this study, cultural biases *were* correlated with distinct views about the trustworthiness of different types of institutions involved in risk management, as well as with views about Nature, industry, technology, and public participation in decision-making. Again, although the correlations were low, the patterns observed were generally consistent with cultural theory (Tables VI and VII). Furthermore, the results presented here reveal that even the so-called "qualitative characteristics of risk" generated by the psychometric paradigm were interpreted and rated differently within each of the distinct world views (Table V). This confirmed the view, discussed in the Introduction, that the psychometric factors, rather than being inherent attributes of hazards, tend to express the respondents' views about the way in which risks are managed.

World views may therefore not be related to social organization in the functional way proposed by cultural theory. But the concept of worldviews can still be useful for the study of risk perceptions even if they are not related to "ways of life." Eiser (Ref. 41, p. 160), for example, has suggested that representations of the dangerousness or safety of any object or activity are shaped by a combination of social experiences and cognitive factors that are stored in memory as patterns of "learned associations" (Ref. 41, p. 152). These provide the basis for attitudes that can generalize across related issues, which he refers to as "attitudinal certainties." This, he argues, can account for reinforcing covariations between attitudes to different environmental or social issues and for selective interpretation of new risk information in accordance with prior attitudes. The cultural traits mea-

sured using Dake's questionnaire may reflect such "attitudinal certainties."

Referring back to the debate between the "mobility" and "stability" versions of cultural theory, our results suggest that world views are not innate attributes of individuals and/or that they cannot be measured using a psychometric instrument, since it was impossible to categorize (most) respondents according to their world view. Thus perhaps the "mobility" version of cultural theory is more pertinent and worldviews are more distinctly expressed through social interactions rather than as attributes of particular individuals. If this is the case, it would be more appropriate to use qualitative methods to analyze world views at a collective level. It may also be the case that cultural theory is wrong when it claims there are only four viable and mutually exclusive world views. Wynne et al.[42] and Zonabend[43] have shown, using focus groups and participant observation respectively, that people living in the vicinity of nuclear installations can simultaneously express very ambivalent and seemingly contradictory views about the nuclear industry. Thus, the four cultural biases may be best interpreted as extreme reference points and a mixture of quantitative and qualitative methods should generate better insights about who might use these in what circumstances, and whether there are only four mutually exclusive world views or not. We therefore agree with Boholm (Ref. 23, p. 74) that a combination of both "emic" and "etic" approaches is necessary for better investigation into risk perceptions.

Most risk perception studies have focused too much on "the public" in the aggregate and not enough on differences between individuals and groups, analyzed within specific social and institutional contexts. Such an approach has led to uniform guidance for risk communication strategies which are not necessarily adapted to the demands of different social groups. Our final message is therefore that risk communication strategies should be carefully developed with both individualistic and cultural associations in mind. We agree with Trumbo (Ref. 12, p. 437) that risk communication would benefit from a shift in attention from message construction to audience analysis. A better empathy for attitudinal certainties among the populations concerned would yield a package of different messages about risks and a diversity of procedures for regulation and governance.

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