INTEGRATING SOCIOLOGICAL AND PSYCHOLOGICAL APPROACHES TO PUBLIC PERCEPTIONS OF ENVIRONMENTAL RISKS: DETAILED RESULTS FROM A QUESTIONNAIRE SURVEY

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Claire Marris, Ian Langford and Timothy O'Riordan

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Abstract

Decision-makers often despair at what they regard as fickle and unpredictable public attitudes toward environmental risks. Research has shown, however, that public perceptions of risk are not irrational. Psychologists have developed the so-called 'psychometric paradigm', which indicates that laypeople approach the meaning of 'risk' using a more political framework than that used by experts. This includes factors such as whether or not they have control over their exposure to the risk, whether the effect will be immediate or delayed, and whether future generations will be affected. Sociologists have proposed a 'cultural theory of risk', which argues that alternative views about risk are inextricably inter-linked with the ways in which social order is perceived and experienced. Both these theories have been developed and promoted largely within disciplinary boundaries and in isolation from each other. This report argues that both perspectives play important roles in shaping, maintaining, and changing views about risks, and that these two components are inter-related in complex but predictable ways. Thus, the aim of this research was to advance our understanding of risk perceptions by integrating the 'psychometric paradigm' and 'cultural theory' approaches.

This paper reports the detailed results from a questionnaire survey (N=201) conducted in Norfolk (UK). Four distinct worldviews were identified, namely: *fatalist*, or phlegmatic over influence on outcomes; *individualistic*, or a preference for competitive procedures; *hierarchist*, or a belief in order and rules to guide decisions; and *egalitarian*, or an emphasis on fairness through justice. Each of these worldviews was associated with a specific pattern of risk perceptions in a manner which was consistent with cultural theory. Cultural theory, however, was only able to explain 14%, at most, of the variance in risk perceptions, whereas the 'psychometric paradigm' explained as much as 50% in some cases. The authors argue that the two methodologies explained importantly different dimensions of risk perceptions, and that deeper insights into the underlying rationales are obtained by using the two approaches in a complementary manner. Thus, the combined methodology provided insights into underlying social issues of trust and accountability which play an important role in shaping risk perceptions. This research suggests that social and political frameworks which influence the way environmental threats are interpreted can be identified and that a consistent theory of reactions to risks can be established.

1. Introduction

Two distinct theories currently dominate the field of risk perception. One is the so-called 'psychometric paradigm', rooted within the disciplines of psychology and decision sciences, while the other derives from cultural theory and has been developed by anthropologists and sociologists. Both theories have made important contributions to the understanding of risk perceptions, but, until recently, they have been developed and promoted largely within disciplinary boundaries and in isolation from each other. The aim of this research project was to advance our understanding of risk perceptions by integrating the 'psychometric paradigm' and cultural theory approaches. In order to do this, we felt that it was necessary to develop a new methodology that incorporated both qualitative and quantitative elements. This Working Paper reports the detailed quantitative results from a questionnaire survey of risk perceptions conducted in Norfolk, UK. Focus groups were also conducted and the qualitative results from these will be published elsewhere.

1.1 The 'psychometric paradigm'

The 'psychometric paradigm' was developed by Slovic and his colleagues (Fischhoff *et al*., 1978 and 1983; Slovic *et al*., 1980 and 1985). These researchers showed that 'experts' and 'laypeople' used different definitions of 'risk' when making their judgements. 'Experts' based their risk ratings on the expected number of fatalities. 'Laypeople', in contrast, had a richer definition of risk, which incorporated a number of more qualitative characteristics such as 'voluntariness' (whether people have a choice about being exposed to the risk), 'immediacy of effect' (the extent to which the effect is immediate, or might occur at some later time), and 'catastrophic potential' (whether many people would be killed at once). Slovic *et al*. (1985) identified and analysed eighteen character-istics of this kind using factor analysis and found that they could be resolved into three factors broadly defined as 'dread', 'unknown' and 'exposure'. Furthermore, high perceived risk was associated with issues which were rated highly on both the 'dread' and the 'unknown' factors (e.g. nuclear power, lasers, herbicides), whereas risks which were rated low on these factors (regardless of the expected number of fatalities associated with them) were perceived as being of low risk and there was little desire for additional regulation in these areas (e.g. motor vehicles, alcoholic beverages, downhill skiing).

These findings were significant because they challenged the dominant perception of 'experts' and policy makers, which was that members of the public were either irrational or ignorant (or both) when they showed high concern for issues such as nuclear power while seeming to ignore the risks associated with issues such as road accidents, which 'experts' rated much more highly. One implication of this work was that risk management strategies which focused solely on trying to 'explain the facts' more effectively to members of the public (e.g. making them understand the fatality statistics) were likely to fail to reduce their level of concern about technologies, such as nuclear power, which were rated high on both the 'dread' and 'unknown' dimensions.

One problem with this work is that Slovic *et al.* (at least initially) sought to identify attributes of risk which were shared universally by all individuals, and did not attempt to distinguish between individuals or groups of people, except 'experts' versus 'laypeople' (see, for example, Slovic *et al.*, 1982). The statistical analysis in these early studies was based on mean scores for whole samples, and therefore provided no information about how individuals might differ in their perceptions of risks. The result of the early 'psychometric paradigm' studies was to develop a taxonomy - or 'cognitive map' - of hazards, and the implication was that all individuals would assess these objects in the same manner. This approach treated risk, or rather 'risky' technologies, activities and products, as external objects with a set of pre-defined qualities and drawbacks. Later 'psychometric paradigm' studies have attempted to investigate differences between individuals, by searching for

potential correlations between perceived risk and standard socio-demographic variables such as gender, age and occupation; and also nationality or place of residence (reviewed in Marris *et al.*, 1996; Rohrmann, 1995; Sjöberg and Drottz-Sjöberg, 1994; Slovic, 1992). Very few of these variables were found to correlate consistently with risk perception. Furthermore, even when differences were identified, this approach provided no understanding about *why* different people perceive risks differently. The influence of factors such as gender, age, or nationality apparently relate to some underlying rationale that was not clearly revealed in these quantitative cross-sectorial studies.

The 'psychometric paradigm' also led to a focus on the dread-catastrophe aspect of risks, but failed to identify potentially interesting social issues such as trust, blame and accountability which, we argue, are undoubtedly tied-in with the technologies, products and activities found in the 'high dread-high unknown' quadrant of the factor space derived from the results of Slovic and his colleagues. Psychologists have more recently begun to explore the role of underlying values in shaping risk perceptions (Peters and Slovic, 1996; Sjöberg, 1995; Slovic, 1996; Slovic *et al*., 1995). Slovic has also turned his attention to factors such as stigma, trust and 'affect' (Slovic *et al*., 1991; Slovic, 1996). Although these recent developments are significant, we felt that a new approach was needed to explore the cultural context of risk perceptions, and that cultural theory provided a potentially useful framework to investigate how worldviews and other cultural factors influence risk perceptions. (See Marris *et al.,* 1996 for a fuller review and critique of the 'psychometric paradigm' approach to risk perceptions).

1.2 Cultural theory of risk

Cultural theory, in contrast to the 'psychometric paradigm', focuses on the differences between people in their reactions to risk. It argues that risk perceptions reflect the way in which society itself is perceived, and that alternative views about risks (and the world we live in) flow from patterns of social order. Cultural theorists have argued that the psychological approach, by focusing solely on abstract ratings of risks, has failed to focus on the important issues at stake in judgements about risks. More interesting questions would include: who is trusted to manage risk? who gets blamed in the case of mishap? what constitutes fairness, consent, or accountability? (Douglas, 1986).

Cultural theory was originally proposed by Douglas (Douglas, 1982; Douglas and Wildavsky, 1982), and has since been taken up and developed by others (Schwarz and Thompson, 1990; Thompson *et al*., 1990; Rayner, 1992). Cultural theory consists of two components. The first is a theoretical approach based on the belief that adherence to a certain pattern of social relationships generates a distinctive way of looking at the world, and *vice versa*: that adherence to a certain worldview legitimises a corresponding type of social relations. The second component of cultural theory is a taxonomy of viable combinations of cultural bias and social organisation, based on two dimensions (grid and group). Thompson *et al.* interpreted 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." (Thompson *et al*., 1990, p. 5). According to cultural theory, these are independent variables which can be represented as a pair of orthogonal axes. In each of the four quadrants resulting from this representation, a different archetype is situated. The four cultures are defined by the strength of their grid and group characteristics and have been labelled hierarchy, egalitarianism, individualism, and fatalism (see Figure 1.1).

Hierarchists are characterised by strong group boundaries and binding prescriptions (high grid-high group). An individual's position in the world is defined by a set of institutionalised

classifications, based, for example, on age, gender, or race. Such demarcations are deemed to be unquestionable, and are justified on the grounds that they enable people to live more harmoniously together. *Egalitarians* are also high-group, but, in contrast to hierarchists, their lives are not prescribed by role differentiation. Instead, individuals are expected to negotiate their relationship with others and no one person is granted authority by virtue of their position. *Individualists* are low in both the group and the grid dimensions. Such individuals are bound by neither group incorporation nor prescribed roles. In such a social context, all boundaries are subject to negotiation. *Fatalists* are low group but high grid. Like hierarchists, their autonomy is restricted by social distinctions. In contrast to hierarchists, however, they are excluded from membership in the institutions responsible for making up the rules, and tend to see themselves as 'outsiders' (Douglas, 1982; Douglas and Wildavsky, 1982; Jenkins-Smith, 1994; Thompson *et al*., 1990).

These four types of social relations give rise to four distinct cultural biases. Thus, according to cultural theory, hierarchists are predisposed to trust large centralised, hierarchical, institutions. In relation to risks, they will tend to trust those in authority (e.g. governmental regulatory authorities) and will show little concern for technologies which are sanctioned and managed by experts, but will be chiefly worried about threats to the social order (e.g. crime). Egalitarians, in contrast, will tend to be suspicious of anybody in a position of authority, including specialised experts. Concentration of power, especially in institutions which are seen to be centralised, secretive and not accountable for their actions violates their fundamental principle of equality. Environmental threats which are seen to emanate from such institutions (e.g. nuclear authorities or large private companies) are given most prominence, together with global catastrophes with irreversible consequences, especially if they are seen to be inequitable. For individualists, it is intrusions upon their ability to bid and bargain with others which are singled out as the most important threats. Examples might include governmental regulation of private business or the imposition of 'politically correctness'. Fatalists, as the name implies, feel powerless in the face of change, which is always perceived as being imposed from the outside. The world might produce a cornucopia of wealth, health, and safety, but it might just as readily produce disaster. The occurrence and outcome of events are thought to be subject to fate and chance (Douglas, 1982; Douglas and Wildavsky, 1982; Jenkins-Smith, 1994; Thompson *et al*., 1990).

The four types of social relations are also hypothesised to lead to preferences about decision making procedures about all issues, including risk management (Rayner, 1984). Hierarchists will choose to base management strategies on expert committees and universal safety standards. Egalitarians will favour decision making processes which encourage public participation. Individualists will promote economic factors, and in particular cost-benefit analysis as the proper basis for rational decision-making. Fatalists feel that decisions are beyond their control and will feel obliged to accept whatever is imposed upon them. Thompson also proposed that four different 'myths of Nature' could be characterised according to grid and group dimensions (Thompson *et al*., 1990). For the hierarchist, Nature is 'perverse/tolerant': forgiving to most events but vulnerable to an occasional disaster. For the egalitarian, Nature is 'ephemeral' and the slightest interference could cause an environmental disaster. For the individualist, Nature is 'benign': it is wonderfully forgiving and will return to its natural equilibrium whatever mankind does to it. For the fatalist, Nature is 'capricious' and random. Thompson states that "These myths of Nature are the simplest models of ecosystem stability that when matched to the different ways in which the managing institutions behave, render those institutions rational." (Thompson *et al*., 1990, p. 26). Thus, hierarchists must regulate against extreme occurrences, egalitarians must treat the ecosystem with great care, individualists will have a laissez-faire attitude, and fatalists will just cope with erratic events.

We believe that social and institutional constraints undoubtedly influence the behaviour and beliefs of individuals, but the two-by-two framework of grid-group taxonomy which underpins cultural theory may not be sufficient to explain all the relevant cultural factors. Furthermore, even this relatively simple framework has proved difficult to operationalise.

1.3 Quantitative tests of cultural theory

Studies using qualitative methods such as participant observation and focus groups have provided empirical support for cultural theory (e.g. Rayner, 1986; Rayner and Cantor, 1987), but recent efforts to test the theory quantitatively have been more problematic (Dake, 1991 and 1992; Wildavsky and Dake, 1990, Dake and Wildavsky, 1991). Dake devised a set of statements about society and postulated that responses to these statements would provide a measure the four cultural biases, i.e. hierarchy, individualism, fatalism or egalitarianism. Respondents were asked to rate the risks associated with a number of different activities and technologies, and the authors investigated correlations between worldviews, as defined by responses to the cultural bias statements, and the risk ratings given to the different issues. The pattern of correlations reported by Dake broadly followed that predicted by cultural theory. Thus, egalitarianism was correlated with high scores for technological and environmental risks; hierarchy was correlated with high scores for risks associated with social deviance; and individualism was correlated with high scores for risks associated with economic troubles. Furthermore, individualism and hierarchy were negatively correlated with risk scores for technological and environmental items. These correlations were statistically significant, but they were not very high. Another problem with these results was that the hierarchy and individualism scales were themselves strongly inter-correlated.

In addition to these misgivings about the quantitative results of this study, we were concerned by an important gap in Dake's theoretical approach, in that it fails to address the role of social relations in shaping perceptions of risk. An empirical test of cultural theory of risk would need to demonstrate three things. Firstly, that the four types of cultural biases described by cultural theory can be identified. Secondly, that four types of social relations (related to the grid and group dimensions) can be identified. And thirdly, that each cultural bias corresponded with the correct type of social relations, thus yielding four ways of life. Then, if risk was the theme of interest, the study would seek to identify correlations between the ways of life identified and attitudes toward risk. Dake maintains that he can measure four cultural biases, and that these are related to differing risk perceptions. Even if these claims were supported by more convincing data, they do not necessarily provide empirical support for cultural theory, because the method ignores the second and third steps outlined above, and therefore does not incorporate any functionalist analysis.

Furthermore, cultural theorists appear to disagree about whether cultural biases (let alone social relations) should ever be investigated using individuals as the unit of analysis. There appear to be (at least) two different versions of cultural theory. The first version maintains that individuals will choose to attach themselves to institutions with the same type of social organisation 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 social context they find themselves in. This version also implies that individuals will conform to the same cultural bias over time. The second version of cultural theory puts more focus on the institutional context and claims that individuals might move between institutions with different grid and group characteristics (in different spheres of their lives, or over time), and will adhere to different cultural biases as they move from one type of institution to another. Thompson is the most vocal proponent of this second 'mobility' version of cultural theory, and suggests that an analysis of the way in which individuals (or groups of individuals, such as a household or a nation) move from one cultural bias to another (over time or space) is, in itself, a rewarding subject for cultural analysis (Thompson, 1992; Thompson *et al*., 1990). Douglas, in contrast, tends to promote the more stable version of cultural theory, where

individuals adhere to the same type of institution, and the same cultural bias, throughout their lives.

This ambiguity among cultural theorists has important implications for developing methodologies to test the theory empirically. If the 'mobility' hypothesis is adopted, then the cultural bias exhibited by an individual will depend upon the social context in which it is elicited, and Dake's methodology, in which a questionnaire is administered to individuals in an abstract social setting, would not seem appropriate. Cultural biases would, instead, have to be elicited within a specific social context purposefully chosen for the study in question. Dake and Thompson (1993) propose to resolve the debate by making a distinction between the type of worldviews identified using Dake's statements and cultural biases, as defined by cultural theory: "We characterise worldviews as 'orienting dispositions' when referring to the individual level of analysis and as 'cultural biases' when referring to collectively held beliefs and values" (Dake and Thompson, 1993, p. 435). They do not, however, elaborate any further about the relationship between 'orientating dispositions' and 'cultural biases'.

Cultural theory provides a useful lesson for policy-makers, who tend to seek to base risk management decisions upon a single vision of rationality, based on universal, objective, truths (e.g. technical risk assessments based upon the best available scientific evidence, or cost-benefit analysis). Those who fail to accept such decisions are judged to be misguided, and the solution to risk controversies is seen to lie either in the education of the ignorant lay public, or the exclusion of extremist 'irrational' organisations. Such an approach has repeatedly been shown to fail to resolve controversies. Cultural theory argues that, within each worldview, attitudes about risks and how they should be managed will seem entirely rational. It therefore helps to explain why risk controversies persist, and suggests alternative approaches to risk management which might prove more productive. Schwarz and Thompson (1990), as implied in the title of their book, "Together we Stand", argue that since the four cultures define themselves in opposition to the others, society can only be viable when all four cultures are expressed. Therefore, viable solutions to societal issues, including environmental problems, will only be reached if the existence and *validity* of each of the separate cultures is acknowledged. (See Marris *et al.*, 1996 for a fuller review and critique of the cultural theory of risk).

1.4 Redefining the cultural context of risk perceptions

Both the 'psychometric paradigm' and cultural theory have contributed useful insights into the underlying dimensions involved in shaping risk perceptions. The former has been strong on methodology and empirical results, but weaker in terms of a theoretical framework to explain the findings. Cultural theory, on the other hand, proposes a potentially interesting theoretical framework, but this has not been backed up by substantive empirical studies. We argue that both culture and cognition play important roles in shaping, maintaining, and changing views about risks, and that these two components are inter-related in complex ways. We therefore decided to investigate risk perceptions using both the 'psychometric paradigm' and cultural theory approaches simultaneously.

One of the main points of contention between the psychological and cultural approaches - and indeed also among cultural theorists - is whether it is appropriate to use individuals, rather than institutions, as the unit of analysis for risk perception studies. Douglas (1986) has argued that methods which use individuals as the unit of analysis (such as questionnaire surveys) will always fail to elicit in any meaningful way the social factors involved. Since we wanted to investigate individual traits and experiences together with social and institutional constraints, we developed a methodology which focused on both levels of analysis: at the level of individuals, using a questionnaire survey, as well as at a collective level, using focus groups. In addition, and in order to investigate the relationship between grid-group

dimensions and cultural biases, some of our respondents were selected on the basis that they were associated with *institutions* with specific grid and group characteristics.

This paper reports the results from the structured questionnaire survey. Results from the focus groups will be published separately.

2. Sample A

Two separate samples were used in this survey. Sections 3 to 11 of this paper refer only to Sample A. The results from Sample B are given in Section 12.

Sample A (N=131) was a cluster sample of residents of Norwich conducted in two stages. Four locations were chosen to give a range of different types of housing and hence residents with differing socio-demographic characteristics. Each location was composed of adjoining streets with houses of one particular type, namely:

Location 1: small terraced and semi-detached houses on a council-built housing estate;
Location 2: larger semi-detached houses;
Location 3: two streets of terraced houses;
Location 4: very large houses with large gardens in a set of 'leafy avenues'.

Approximately 100 houses were identified in each location, and interviewers were instructed to knock on each door at least three times until someone in the house had either agreed to respond to the questionnaire or stated that they did not wish to be involved. In order to avoid biasing the sample towards people who tend to be at home all day, interviews were conducted only in the evenings and at week-ends. In addition, and because the questionnaire was so long (it took 57 minutes to complete on average), respondents were offered a £5 cash incentive (89% of respondents accepted this payment). The response rate varied from location to location (23% to 34%), with an overall mean response rate for the whole of sample of 30%, which fitted our expectations given the length of the questionnaire (see details below).

Number of houses selected for survey	423	(100%)
Number of homes which refused to participate	241	(57%)
Number of homes where three calls were made with no contact	55	(13%)
Number of home where at least one person was interviewed	127	(30%)

The number of respondents was actually 131, rather than 127, because: three questionnaires were unusable; in five homes two people were interviewed; and in one home three people were interviewed.

Socio-demographic profile of Sample A:

- Gender was the only variable which was controlled for in the sampling strategy, and the male to female ratio was approximately equal.
- All four locations had a spread of ages, but Location 3 had more respondents who were younger, and Location 4 more who were older middle-aged.
- The income, social class and education of the respondents were closely inter-related and a good spread was obtained overall, which was what the cluster sample was designed to do.
- The income, social class and education of respondents did vary significantly, as expected, between the four locations. Location 1 had respondents with the lowest incomes, social classes and levels of education, while Location 4 had the highest. Locations 3 and 2 were in between, with 3 being 'lower' than 2.
- Overall, the sample was biased towards higher social classes. Even in Location 1 (council-built housing estate), only 8% of the respondents were from social classes III (manual), IV and V; furthermore, only 16% of the respondents were council-tenants. This bias could be due to: (a) 'optimistic reporting' (social class was derived from the

respondent's description of their occupation or, where relevant, that of their partner); and/or (b) the reluctance of people with lower incomes, social classes and education to respond to interviews; and/or (c) a result of the cluster sample strategy and the small size of the sample; e.g. although Location 1 was council-built, most of houses in the particular streets sampled appeared to have been sold by the council, thus 50% of the respondents from Location 1 were owner occupiers, who were likely to be of higher social class than council tenants.

3. The Questionnaire

The questionnaire was composed of five sections:

1. Classic 'psychometric paradigm' questions
2. Dake's cultural biases questionnaire
3. Scenarios about trust, liability and fairness
4. Health Locus of Control questionnaire[1]
5. Socio-demographic variables

The 'psychometric paradigm' section of the questionnaire related to a set of thirteen risk issues. The selection was based on two main criteria: firstly, to include risk issues from each of the four quadrants of the classic factor space generated from previous 'psychometric paradigm' studies; and secondly, to include risks which we hypothesised would be given more or less prominence by each of the four cultural biases (see Table 3.1).

These thirteen risk issues were rated by the respondents according to nine of the risk characteristics proposed by Slovic *et al.* (1985). The selection of risk characteristics (listed in Table 3.2) was based on two main criteria. Firstly, to select characteristics which loaded heavily on each of the two factors 'dread' and 'unknown', in order to maximise our chances of reconstituting the same factor space as that described by Slovic *et al.*. Secondly, to select characteristics which we predicted might be interpreted differently, or given varying prominence, according to different cultural biases. For example, 'unfairness' and 'harm to future generations' might be given more prominence within an egalitarian bias, 'involuntariness' and 'lack of knowledge to those exposed' within an individualist bias, and 'lack of knowledge to science' within a hierarchist bias.

Analysis of the data from the questionnaire survey was designed to investigate the following questions:

- Do 'psychometric paradigm' characteristics predict risk perceptions? (see Section 5.3)
- Do cultural biases predict risk perceptions? (see Section 6.2)
- Is there a relationship between cultural biases and 'psychometric paradigm' characteristics? (see Section 7)
- Do socio-demographic characteristics predict risk perceptions? (see Section 8)
- Is there a relationship between socio-demographic attributes and the risk characteristics proposed by the 'psychometric paradigm'? (see Section 9)
- Is there a relationship between socio-demographic attributes and cultural biases? (see Section 10)
- Which of the three types of variables (risk characteristics, cultural biases, and socio-demographic attributes) predict risk perceptions best? Does the 'psychometric paradigm' or cultural theory provide the best framework to understand risk perceptions? (see Section 11)

[1] The HLOC questionnaire was included because we believed that it might correlate closely with cultural biases, and might be able to help distinguish some of them (especially the fatalist) more clearly than Dake's questionnaire alone. This data has not yet been analysed and is therefore not reported in this paper.

4. Risk Perceptions

4.1 Five different definitions of risk perception

Respondents were asked to rate thirteen risk issues on five different definitions of risk perception, namely:

Riskiness:
"On a scale of 1 to 5, how much risk do you think is associated with ... [each of the thirteen risk issues]?"

Fatalities:
"On a scale of 1 to 5, how many people do you think die every year as a consequence of... [each of the thirteen risk issues]?"

Injuries:
"On a scale of 1 to 5, how many people do you think are injured or become ill as a consequence of... [each of the thirteen risk issues]?"

Environmental Harm:
"On a scale of 1 to 5, how much harm do you think is done to things other than people as a consequence of ... [each of the thirteen risk issues]?"

Unacceptability:
"On a scale of 1 to 5, how acceptable do you feel the current risk is for ... [each of the thirteen risk issues]?"

Throughout the rest of this paper, the terms 'Riskiness', 'Fatalities', 'Injuries', 'Environmental Harm' and 'Unacceptability' are used as abbreviations for responses to these questions.

As shown in Tables 4.1 and 4.2[2], the mean risk perception ratings were different depending on which question was being answered. In particular:

- Risk issues tended to be rated higher on the Riskiness and Unacceptability scales. Ten of the risk issues had mean ratings above 3.0 (the mid-point) on the Riskiness scale, and nine of these also had mean ratings above 3.0 on the Unacceptability scale. Far fewer of the risk issues had mean ratings above 3.0 on the other three scales of Fatalities (three risk issues), Injuries (five risk issues), and Environmental Harm (four risk issues).
- Nuclear power, depletion of the ozone layer, and genetic engineering were rated, on average, fairly high on the Riskiness scale (3.7 and above), but relatively low on the Fatalities and Injuries scales (2.7 and below).
- On the other hand, food colourings and microwave ovens were rated low on all the scales.

Table 4.3 lists correlations between mean scores for the five different definitions of risk, and reveals that:

- Fatalities and Injuries were so highly correlated (0.96) that they were essentially measuring the same thing.
- Riskiness was much more highly correlated to Environmental Harm (0.63) and Unacceptability (0.69) than to Fatalities (0.33) and Injuries (0.38). This demonstrated that 'riskiness', when left undefined, did not seem to be inter-preted in relation to the expected number of fatalities and injuries. This was consistent with the results obtained by Slovic and his colleagues (e.g. Slovic *et al.*, 1982), and indicates that expert definitions of risk,

[2] These tables, and all tables in Sections 4 to 11, relate *only* to results from Sample A. Results from Sample B are described in Section 12.

which are usually based only on the expected number of fatalities and injuries, fail to take into account other dimensions of risk which are of importance to the public.

- Fatalities and Injuries were, however, closely correlated with Unacceptability, even though they were not correlated with Riskiness or Environmental Harm. Indeed, Unacceptability was highly correlated with all the other four definitions of risk, and it seems that this dimension of 'risk' was the one which encompassed the other four. Hence, the issue of unacceptability was pursued in the focus groups, and in particular the potential link between unacceptability and issues such as trust and accountability.

These results confirmed that risk can be interpreted in different ways, and that there is no single, universally accepted definition of risk. Researchers in the field of risk perception need to be aware of this, and of which definition of 'risk perception' they are using. To some extent, the 'psychometric paradigm' and cultural theory are using different definitions, and this explains their different approaches. Thus, the interpretation of risk perceptions within the 'psychometric paradigm' appears to be closely related to the concept of dread, whereas within cultural theory the concept of risk is perhaps more closely associated with unacceptability (of the risk issue itself, and also of the institutional structures associated with it).

4.2 Variability in risk perception ratings

Tables 4.1, 4.2 and 4.3 were based on mean risk ratings for the whole of Sample A, and do no indicate whether there was any variability between respondents in the risk ratings they gave to particular risk issues. Thus although nuclear power was, on average, the issue rated most highly rated on the Riskiness scale, this does not necessarily indicate that *all* respondents felt that nuclear power was the most 'risky' issue on the list. Closer inspection of the data revealed that in some cases most of the respondents agreed about whether an issue was, or was not, risky, but in other cases there was no such consensus (see Table 4.1). For example, at least 85% of respondents rated nuclear power high on the Riskiness scale (and gave it a score of 3, 4 or 5). Similarly, at least 85% of respondents rated microwave ovens low on the Riskiness scale (and gave it a score of 3, 2 or 1). On the other hand, there was no such consensus about the Riskiness rating of war, car driving or AIDS and the respondents' scores were spread right across the 5 point scale for these issues.

Microwave ovens were the only risk-issue which was rated very similarly by all respondents across all five definitions of 'risk'. For all the other risk issues, there was some variability among respondents for at least one of the risk definitions. It is, for example, interesting to note that, for nuclear power, there was consensus on the Riskiness and Fatalities scales, but not for Unacceptability. The same applied to sunbathing and genetic engineering, indicating that all respondents agreed that these issues were 'risky', but disagreed about whether this meant that the risks were acceptable or not. On the other hand, most respondents felt that the 'social ills' in the list (war, AIDS and terrorism) were unacceptable.

Variability in the scores given by respondents to the same risk issue may reflect different risk perceptions, but might also indicate that the risk issues and defi-nitions of 'risk' were interpreted differently by different respondents (see Section 7). The rest of this paper attempts to understand and explain what lays behind the variability in this data, but it is worth remembering that, in some cases, there was actually very little variation in the scores given by different respondents.

4.3 Risk targets

Responses to risk perception questionnaires also depend on 'risk to whom?'. Sjöberg and Drottz-Sjöberg (1994) argue that it is important to specify the risk target when conducting surveys about risk perception, since responses will vary according to whether people are thinking about themselves, their family and friends, people in their country, or people in the

whole world. Their studies suggest that respondents will, overall, rate 'general risk' (to people in their country) higher than 'personal risk' (to themselves), but that this does not hold for all risk issues. For example, alcohol tends to be rated lower as a personal risk than a general risk (this phenomenon is sometimes referred to as 'optimistic bias'). It is important to remember, however, that even when a question is carefully formulated to clarify the risk target, it will always be selectively interpreted by respondents. Thus, although Slovic's original survey asked respondents "to consider the risk of dying as a consequence of this activity or technology", the main finding of the study was that respondents took into account many factors other than the probability of dying, such as voluntariness, 'catastrophic potential', degree of control, etc. (Slovic *et al*., 1985). Respondents cannot be expected to answer such questions about risk in the abstract, and will of course always set them within their own social context.

This is precisely the issue which brings the 'psychometric paradigm' and cultural theory approaches to risk perception together, and is the focus of this research. The risk target was therefore left purposefully vague in our questionnaire, and the way in which respondents interpreted the questions on risk perception was explored by integrating data from the 'psychometric paradigm' and cultural theory sections of the questionnaire (see Section 7). Qualitative data was also collected during the interviews and at subsequent focus groups, and this suggested that the risk targets respondents had in mind varied from question to question. Respondents seemed to feel that some of the thirteen issues were most relevant to them personally (e.g. mugging), and rated these according to perceived risk to themselves and those close to them, while other issues were seen to be more global in nature (e.g. ozone depletion) and were rated according to perceived risk to the whole world. It must be stressed, however, that the sets of issues which were considered 'personal' or 'global' risks were not necessarily the same for each respondent. For example, AIDS was perceived by some as a personal issue related to individual behaviour, while for others, who had in mind the epidemic in Africa, it was perceived as a global issue.

5. Analysis of the 'Psychometric Paradigm' Data

5.1 Factor analysis

The questionnaire incorporated a set of classic 'psychometric paradigm' questions, adapted from Slovic *et al.* (1985). Respondents were asked to rate thirteen different risk issues (see Table 3.1) in relation to nine specific risk characteristics (see Table 3.2). In order to analyse the relationship between these nine characteristics, a factor analysis using maximum likelihood estimation was performed on the mean responses from Sample A to each of the thirteen risk issues for the nine risk characteristics. A varimax rotation was used to increase the loadings and three orthogonal factors were extracted which had statistically significant eigenvalues (i.e. greater than unity). These three factors explained 34%, 33% and 24% of the variation in the mean responses respectively. Table 5.1 lists that highest correlations between the risk characteristics and rotated factors and Figure 5.1 shows where the thirteen risk issues fall within the factor-space generated by Factors 1 and 2.

Factor 1 appeared to correspond to the *type of consequences* expected when a risk was realised, i.e. whether the effects will be delayed, will affect future generations, or harm a large number of people at once. Factor 2, in contrast, appears to correspond to the *nature of the exposure* to the risks, i.e. whether people have a choice about their exposure, and whether the risks and benefits from an activity are distributed fairly. 'Lack of knowledge to science' also fell into this factor. Factor 3 essentially consisted of the 'lack of knowledge to those exposed' characteristic, which is discussed further below. 'Dread' was significantly correlated to all three factors, and 'severity' to Factors 1 and 3; hence these characteristics could not be exclusively allocated to a particular factor. The fact that 'dread' was correlated with all the factors was neither surprising nor unusual: in the very first study using the 'psychometric paradigm' (Fischhoff *et al.*, 1978), 'dread' was also highly correlated with two of the factors.

The results from this factor analysis should, however, be viewed with caution, because the number of risk issues was small relative to the number of risk characteristics. The factors generated by factor analysis were, however, broadly confirmed by hierarchical cluster analysis (see Figure 5.2). An average linkage method was used for building the clusters, which uses the mean distance between cluster members to successively allocate the characteristics to clusters. The Y axis on the graph represents the degree of similarity between characteristics. 'Delayed effects', 'catastrophic potential' and 'harm to future generations' formed one cluster (equivalent to Factor 1); and 'involuntariness', 'unfairness' and 'lack of knowledge to science' formed a second cluster (equivalent to Factor 2), with 'severity' and 'dread' being very similar and forming a third cluster. Furthermore, the cluster analysis confirmed that 'lack of knowledge to those exposed' was relatively unrelated to the other eight risk characteristics.

Correlations between mean scores for each pair of risk characteristics are listed in Table 5.2, and these revealed a number of interesting relationships.

- Both 'dread' and 'harm to future generations' correlated significantly with *all* the other risk characteristics except 'lack of knowledge to those exposed' and' lack of knowledge to science'. 'Dread' and 'harm to future generations' were also very highly correlated to each other (0.85). This indicated that these two risk characteristics encompass key concepts which perhaps underlie all the other dimensions measured (except those relating to knowledge).
- 'Severity' and 'dread' were very highly correlated to each other (0.90), indicating that whether of not people are likely to die when a risk is realised is an important component of the 'dread' dimension.

- 'Unfairness' and 'involuntariness' were very highly correlated to each other (0.96), indicating that whether or not people have a choice about their exposure to a risk is an important component of fairness. Indeed, the strength of this correlation suggests that these two scales may actually be measuring the same thing.
- 'Lack of knowledge to science' correlated significantly only to 'unfairness' and 'involuntariness', and even these correlations were not very high, indicating that this characteristic is relatively unrelated to the other eight.
- 'Lack of knowledge to those exposed' was only correlated with 'severity', and this was the only correlation which was *negative*, indicating that the *more* knowledge the respondents felt those exposed to the risk had, the *more* severe they perceived it to be.

This last result, about 'lack of knowledge to those exposed', is contrary to results from previous studies using the same methodology (e.g. Slovic *et al.*, 1980, see Table 5.3). In our study, 'lack of knowledge to those exposed' was *negatively* correlated with all the other risk characteristics (except lack of knowledge to science), but in previous studies the correlations were *positive*. In addition, in this study, 'lack of knowledge to science' was only closely related to 'severity', whereas in studies conducted by Slovic *et al.*, it was related most closely to 'involuntariness' and 'delayed effects', and was not significantly correlated to 'severity'. The 'lack of knowledge to science' dimension therefore appears to be behaving very differently in this study.

These differences could be due to a combination of factors (but see also Section 5.2):

1. the specific selection of risk issues (and risk characteristics) chosen for our study; and/or
2. differences in perception over time between 1980 and 1995; and/or
3. differences between the UK and the USA and other countries where 'psychometric paradigm' studies have been conducted.

5.2 Variability in the ratings of the nine risk characteristics

Are the risk characteristics proposed by the ' psychometric paradigm' universal? i.e. are the concepts of 'catastrophic potential', 'involuntariness', 'dread', etc. interpreted in the same way by all respondents?

The early risk perception studies which established the 'psychometric paradigm' used only mean scores, and Slovic *et al*. (e.g. 1985) did not discuss whether (or not) there was any variability in the scores respondents gave to a specific risk issue on any one characteristic. Furthermore, the way in which the authors reported the results from their studies implied that the risk characteristics were universal. The assumption seemed to be that the characteristics were inherent features of risk and these formed the basis of the classification of risks displayed in the classic factor-space diagram. In order to examine the validity of this assumption, this section takes a closer look at the variation in individual scores given to the 'psychometric paradigm' scales.

Inspecting the scores given by individual respondents to each risk issue for each risk characteristic revealed that in some cases there *was* a virtual consensus. For example, 119 out of 131 respondents scored 1 or 2 for war on 'lack of knowledge to scientists', indicating that 91% of the respondents felt that the risks associated with war were well known by scientists. In other cases, however, there was no such consensus. For example, when scoring 'involuntariness' for 'accidents in the home', 41 respondents felt this issue was voluntary (and gave it a score of 1 or 2) but a similar number (38), felt it was *in*voluntary (and gave a score of 4 or 5). Hence, the mean score of 3.0 for this issue obscured the polarised opinions of the respondents. Table 5.4 lists the mean scores given to each risk issue for each risk characteristic, and indicates which scores were similar for all respondents and

which ones were not. Previous studies using the 'psychometric paradigm' have not presented this kind of data.

Table 5.4 demonstrated that the scores for 'lack of knowledge to those exposed', 'unfairness' and 'dread' showed great variability, while those for 'severity' and 'lack of knowledge to scientists' showed more consensus. This suggested that the more ambiguous characteristics had more variability. For example, qualitative feedback from the respondents during the interviews and the subsequent focus groups indicated that the questions relating to 'severity' and 'lack of knowledge to scientists' did not pose any difficulty to respondents, and were therefore likely to be interpreted in the same way by most respondents. One exception was in relation to 'lack of knowledge to scientists' for mugging, where some respondents felt that scientific knowledge was irrelevant, and this score did, indeed, show more variability. In contrast, many respondent found the phrasing of the question on 'unfairness' difficult to interpret (see Table 3.2), and results from the focus groups indicated that at least three different dimensions were incorporated into the 'lack of knowledge to those exposed' characteristic.

The first dimension was, as participants in the focus groups put it: "what you don't know about you don't worry", or: "ignorance is bliss until you know about it". This attitude would lead to *lower* risk ratings for risk issues associated with a lack of knowledge. Qualitative feedback during the questionnaire interviews suggested that, when rating the 'lack of knowledge to those exposed' characteristic, most of the respondents focused on the level of coverage the risk issues had received either in the media or through government sponsored public education campaigns. This "ignorance is bliss" attitude therefore supports the idea that catastrophic events or accidents, and the coverage of risk in the media, can lead to an 'amplification' of fears about risks (Kasperson, 1992). The second dimension which was expressed in the focus groups would correlate with *higher* risk ratings for risk issues associated with a lack of knowledge: participants were more concerned about things which they felt they didn't know enough about, because they felt that more knowledge gave them more choice and control about their exposure to risks. This was presumably the concept picked up in previous 'psychometric paradigm' studies, but the third dimension was almost exactly the opposite to this. Participants felt very strongly that knowledge about risks was withheld from them *deliberately*, because those who had access to adequate knowledge, mostly people in powerful positions in government and companies, had vested interests which encouraged them to hide the extent of risks from the general public. In this context, 'lack of knowledge to those exposed' was interpreted as 'knowledge about risks which affect us is being withheld from us', and was associated with *higher* risk ratings. It is important to stress that all three of these concepts were expressed in all the focus groups, and seemed to be held *simultaneously* by the participants. The structured questionnaire did not enable the respondents to express these diverse and seemingly conflicting views, and they probably shifted between the three interpretations as they rated the 'lack of knowledge to those exposed' characteristic on the thirteen different risk issues. This helped to explain the apparent inconsistency of the quantitative results obtained in relation to this characteristic, and suggested that issues such as trust, accountability and media exposure are important factors in determining individual responses to risks.

Variability in the scores given to risk characteristics does not, therefore, necessarily reflect different opinions about the importance of a particular characteristic in relation to a specific risk issue. It can also be due to different interpretations of the risk characteristics themselves. This distinction between 'opinion' and 'interpretation' is, of course, equivocal. The quantitative data, alone, revealed no information about how the questions were interpreted by respondents, but qualitative feedback from respondents during the interviews, together with subsequent data from the focus groups, did provide some insights. In addition, integration of the 'psychometric paradigm' methodology with cultural theory, discussed in

Section 7, revealed that some of the variability in the scores was related to the respondents' worldviews, indicating some differences in opinion rather than any 'misunderstanding' of the questions. Variability in the scores listed in Table 5.4 could also be due to different interpretations of the risk *issues*. Of the thirteen risk issues, food colourings, genetic engineering, mugging and car driving showed the most variability, and this was likely to be due to a combination of different interpretations of the issues themselves, as well as different opinions between the respondents (see Section 7).

5.3 Explaining risk perceptions using the 'psychometric paradigm'

Does the 'psychometric paradigm' help to explain risk perceptions? And if so, which dimensions of 'risk' does it explain best?

5.3.1 Relationship between risk characteristics and risk perceptions using mean scores

Table 5.5 lists correlations between risk perceptions and mean scores given to the risk characteristics. These results demonstrate that all but one of the risk characteristics ('lack of knowledge to scientists') helped to predict risk perception. Interestingly, most of the significant correlations were revealed when 'riskiness' was either left undefined; or defined in terms of harm to things other than people; or unacceptability. When 'riskiness' was defined in terms of the expected number of fatalities or injuries, only three of the risk characteristics appeared to have any influence: 'lack of knowledge to exposed', 'severity' (which was unsurprising since it was defined as 'likelihood of dying') and, to a lesser extent, dread. Unacceptability was the concept which correlated significantly with the highest number of the risk characteristics (7 out of 9).

'Lack of knowledge to those exposed' was the only characteristic to be *negatively* correlated with risk perceptions. This was consistent with the results discussed in the last section; thus, when people exposed to the risks have more knowledge, respondents thought it would cause more deaths and injuries, and felt that it was less acceptable. Factor 3, which consisted essentially of this characteristic, was also negatively correlated with risk perceptions (see Table 5.5). Factor 1 (type of consequences) was significantly correlated with risk perceptions, but only when defined as Riskiness or Environmental Harm, but Factor 2 (nature of exposure) was not significantly correlated with risk perceptions, regardless of the definition used. This was probably due to the fact that 'lack of knowledge to scientists', which was a component of Factor 2, was not correlated with risk perceptions.

5.3.2 Relationship between risk characteristics and risk perceptions using individual scores

In the previous section the *mean* risk perception scores for each risk issue (listed in Table 4.1) were compared to the *mean* scores for each characteristic for each risk issue (listed in Table 5.4). This approach, however, ignores variation between responses given by different individuals. For example, 131 respondents gave scores for the 'riskiness' of each of the thirteen risk issues, from sunbathing to alcoholic drinks; and also gave scores for the 'delayed effects' caused by each of the thirteen risk issues. The first cell in Table 5.5 revealed that the correlation between Riskiness and 'delayed effects' was high (0.74) and significant ($p < 0.01$), indicating that risk issues which where, on average, thought to have many delayed effects were perceived as more 'risky' than those which had fewer delayed effects (this correlation is illustrated graphically in Figure 5.3). This does not necessarily mean, however, that when an individual respondent felt that a specific risk-issue had many delayed effects, they always felt that it was very 'risky'.

Similarly, Table 5.5 demonstrated that mean scores for Unacceptability were highly correlated with mean scores for 'unfairness' (0.78), suggesting that, on average, risks which were felt to be unfair were also perceived to be less acceptable. This does not necessarily

mean, however, that when an *individual* felt that an issue, say nuclear power, was very unfair, they also perceived nuclear power as unacceptable. In fact, further analysis (described below) revealed that the first relationship described above, between Riskiness and 'delayed effects' *did* hold true at the level of individuals, but that this second example, of the relationship between Unacceptability and 'unfairness', did *not*.

In order to analyse the data at the level of individuals, correlations between risk perceptions and risk characteristics were determined using the scores given by each of the 131 respondents, instead of the mean scores, and these are listed in Table 5.6 (see Figure 5.3 for a graphical illustration of the difference between the correlations shown in Tables 5.5 and 5.6). For example, the first row of Table 5.6.1 gives the correlation between the Riskiness scores given to sunbathing by each of the 131 respondents and the scores those same respondents gave to sunbathing for each of the nine risk characteristics. The correlation for 'delayed effects' was 0.30, and was significant at the 99.9% level. This indicates that the score *an individual* gave to the Riskiness of sunbathing was significantly correlated to the score that *same individual* gave to the 'delayed effects' of sunbathing: thus, if a respondent thought that sunbathing had many delayed effects, they also tended to feel it was very 'risky'.

Many of the correlations listed in Table 5.6 were significant: out of the 585 correlations listed, 364 (62%) were significant at the 95% level, indicating that the way in which a respondent rated the characteristics of a risk-issue *was* related to their perception of the 'riskiness' of that issue. Most of the correlations between risk perceptions and risk characteristics using individual scores (listed in Table 5.6) were, however, much smaller than using mean scores (listed in Table 5.5). Lower correlations achieved statistical significance in Table 5.6 because there were 131 individual respondents, compared to only 13 risk issues (see Figure 5.3). It is important to stress that statistical *significance*, being a function of sample size, is *not* equivalent to substantive *importance*.

Overall, the correlations in Table 5.6 broadly confirm the relationships demonstrated in Table 5.5 and discussed in Section 5.3.1. For example, Table 5.6 revealed that, at the level of individuals, 'harm to future generations' was significantly correlated with risk perceptions, regardless of which risk issue was being considered and which definition of 'risk' was used (the *only* exception was in relation to fatalities caused by genetic engineering). 'Dread' was also signifi-cantly correlated with risk perceptions across most risk issues and regardless of which definition of 'risk' was used. This indicated again, in a different way, that these two dimensions appear to capture underlying concepts of great importance in the shaping of risk perceptions. 'Severity' was a third characteristics which was consistently related to risk perceptions for all thirteen risk issues when the data was analysed at the level of individuals (except when 'risk' was defined as Environmental Harm). In contrast, the individual scores for 'lack of knowledge to science' were not related to risk perceptions: the correlations were not significant for *any* of the risk issues when risk was defined as Riskiness, Fatalities or Unacceptability, and only for one or two issues when 'risk' was defined as Injuries or Environmental Harm. All these findings are consistent with those based on the mean scores and listed in Table 5.5.

Some of the results shown in Table 5.6 were, however, at odds with those shown in Table 5.5. For example, 'unfairness' and Unacceptability were highly corre-lated when the data was analysed at the aggregate level (see Table 5.5), yet, at the level of individuals, 'unfairness' was only correlated with Unacceptability for four out of the thirteen risk issues (see Table 5.6.5). The difference between the aggregated and individual analysis was, however, most striking in relation to 'lack of knowledge to those exposed'. When mean scores where used, a very strong correlation was found between 'lack of knowledge to those exposed' and risk perceptions defined as Injuries (see Table 5.5); yet when the same data was analysed at the level of individuals, this relationship did not hold true for *any* of the

thirteen risk issues (see Table 5.6.3). The same was true when 'risk' was defined as Unacceptability, and, to a lesser extent, as Fatalities. In short, 'lack of knowledge to those exposed' appeared to be very closely related to risk perceptions when the data was analysed using mean scores for all 131 respondents, but not at all related to risk perceptions when individual scores were used. As discussed in Section 5.2, the focus groups revealed that the 'lack of knowledge to those exposed' characteristic was, in fact, composed of a number of dimensions (at least three) which different respondents used at different times in relation to different issues, and this is likely to explain these seemingly contradictory results. Similarly, qualitative feedback from the interviews revealed that respondents had difficulty understanding the question about unfairness, and interpreted it in a number of different ways.

5.3.3 Relationship between risk characteristics and risk perceptions using all nine risk characteristics together

Regression analyses of risk perceptions were performed using all nine risk characteristics together as the independent variables. Table 5.7 lists the R^2 values obtained and shows that, for all risk issues except war, the nine risk characteristics explained at least 14% of the variance in risk perceptions. The highest R^2 value obtained was 50%, for the Unacceptability of ozone depletion. This indicated that, overall, the 'psychometric paradigm' did help to predict risk perceptions, but that the power of the model varied according to which risk issues, and which risk definitions, were used.

5.4 Conclusions from the 'psychometric paradigm' data

Respondents rated thirteen risk issues in relation to nine characteristics proposed by Slovic and his colleagues. These could be resolved into three factors by factor analysis, but care should be taken when interpreting this analysis because the number of risk issues was small relative to the number of risk characteristics. Despite this reservation, it was interesting to note that the first factor appeared to relate to the type of consequences expected when a risk is realised, whereas the second factor was related to the nature of the exposure to the risks. The third factor essentially corresponded to 'lack of knowledge to those exposed'.

Factors 1 and 3 were correlated with risk perceptions, but Factor 2 was not. When analysed one at a time, eight out of the nine risk characteristics were closely related to risk perceptions. The exception was 'lack of knowledge to science', which was not correlated with risk perceptions at all.

Two characteristics, 'dread' and 'harm to future generations', appeared to encompass key concepts of importance in framing risk perceptions. They correlated significantly with most of the other risk characteristics (all except the two relating to knowledge), and were highly correlated to risk perceptions (as well as to each other).

'Lack of knowledge to those exposed' was relatively isolated from all the other risk characteristics, and was the only characteristic to correlate *negatively* to risk perceptions (and to the other characteristics). Thus, all the other eight character-istics were associated with *higher* (i.e. 'worse') risk perceptions, whereas this one was associated with *lower* risk perceptions: the more knowledge available to the person exposed to the risk, the worse it is. This result was unexpected and was at odds with results from previous studies using the same methodology. The negative correlation between 'lack of knowledge to those exposed' and risk perceptions did not, however, hold when the same data was analysed at the level of individuals instead of using mean scores for the whole sample.

When the data was analysed using mean scores, the risk characteristics proposed by Slovic *et al.* were highly correlated with risk perceptions, but the correlations were much lower when the same data was analysed at the level of individuals. Furthermore, some of the

correlations observed in the aggregate analysis disappeared completely when the data was analysed at the level of individuals. There is, however, no contradiction here. The difference occurs because of the different scale of the two analyses. This is a well known statistical problem, sometimes called the ecological fallacy, which means it is wrong to say anything about the behaviour of *individuals* from results based on *aggregated* measures. A possible statistical solution to this problem is to use a recently developed technique called multi-level modelling to model both individual and aggregated levels at the same time (Goldstein, 1995). This technique has not been used in the field of risk perception before, and Ian Langford is working on developing a methodology to be applied here. Problems only occur when researchers imply that results based on aggregated measures do provide information about individuals, and it seems that this mistake may have been made in the early interpretations of results from the 'psychometric paradigm' studies (e.g. Slovic *et al.*, 1982).

Schütz *et al*. (1995) report similar disparities between individual and aggregate level analyses of data on risk perception related to consumer products and technologies in Germany. In an aggregate level analysis of nine dimensions of risk for 30 risk issues, some very high correlations were found between the dimensions, for example, a correlation of 0.93 between perceived personal risk and seriousness of injury. Further, a principal components factor analysis of the nine dimensions produced one factor which explained 64% of the variance between risk issues, and a second factor which explained a further 21%. However, when individual level analyses were performed for the 408 individuals in the study for each of the 30 risk issues, multiple R^2 values for personal risk regressed against the other dimensions ranged between only 21% and 57%, and the relationship between personal risk and seriousness of injury varied markedly between risk issues. Schütz *et al*. concluded that aggregate level analyses may obscure important aspects of the data, and that individual level analyses have greater potential for giving a true picture of how people judge risks. The results reported here also support this conclusion.

Overall, the 'psychometric paradigm' therefore appeared to be a relatively effective tool for predicting risk perceptions. Taking all nine risk characteristics together, as much as 50% of the variance in risk perceptions could be explained, but the power of the model varied according to which risk issues, and which definitions of 'risk', were investigated.

6. Analysis of the Cultural Theory Data

6.1 Measuring cultural biases

6.1.1 Selection of questionnaire items

Cultural biases were measured using items supplied by Karl Dake[3]. The basis for this part of the questionnaire was the "British Edition" of "Dake's Cultural Biases Questionnaire" (Dake, 1991). Previous studies had, however, demonstrated that this questionnaire did not provide a measure of four *independent* biases, and that, in particular, the hierarchy and individualism scales were strongly correlated (Dake, 1991 and 1992; Peters and Slovic, 1996; Sjöberg, 1995; Brenot and Bonnefous, 1995; Seifert and Torgersen, 1995). A number of adaptations were therefore made to this version of Dake's questionnaire in order to try and reduce the inter-correlations between the scales. Some items from the British Edition were removed and replaced by items from other Editions used in other countries, as well as some items developed by Dake and Thompson for a large scale survey conducted in the UK and funded by Unilever[4]. Results from the Unilever survey were used for the selection of items. The Unilever items included a set of items devised to measure four distinct 'behavioural strategies' associated with the four cultural biases (Dake and Thompson, 1993) and some of these were also included in our questionnaire[5]. The set of items selected for the questionnaire is shown in Table 6.1. Each item was scored on a 5-point scale from 1, "disagree strongly", to 5, "agree strongly".

It is worth noting that Dake's Cultural Biases Questionnaire has generally been administered either through telephone interviews or self-completed by respondents. The fact that this study used face-to-face interviews probably affected the responses, especially since the interviewers were young people who may have been perceived as 'environmentalists', and who introduced the study as being about the people's attitude to the environment. It is possible that this encouraged respondents to react in a way which they felt was more environmentally sensitive than if they had completed the questionnaire anonymously, and this may be reflected in the high mean score for egalitarianism obtained from this survey (see Section 6.1.3).

6.1.2 Cluster analysis

Table 6.2.1 lists the correlations between the four scales obtained from our data and demonstrates that all the cultural biases were inter-correlated, except egalitarianism and fatalism. Hierarchy and individualism were particularly highly correlated. As shown in Table 6.2.2, these results were, however, consistent with those reported by Dake (1991). Peters and Slovic (1995) also reported that hierarchy and fatalism were confounded.

In order to further investigate the nature of the items, hierarchical cluster analysis was performed. Figure 6.1 illustrates the results from the cluster analysis when all the cultural bias items were included, and demonstrates that most of the items from the egalitarian and fatalism scales clustered together, but those from the hierarchy and individualism scales did not. Sequential modifications were made to the set of items, by adding some of the

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[3] We thank Karl Dake for kindly permitting us to use these items.

[4] We thank Elizabeth Carter from Unilever, as well as Karl Dake and Michael Thompson, for permitting us to use these items.

[5] The 'behavioural strategy' items were not used in the manner intended by Dake and Thompson (1993), who argue that behavioural strategies and cultural biases can and should be measured independently. In this study the behavioural strategy items were used to measure cultural biases. Furthermore, the behavioural strategy items were designed for the analysis of households rather than individuals (for this study, the pronoun "we" was replaced with "I").

'behavioural strategy' items and removing some of the cultural bias items, until four more distinct clusters which still fitted with cultural theory were obtained. Figure 6.2 shows the results from the cluster analysis performed on the set of items which was selected for use in the analysis of the data. These are henceforth referred to as the 'UEA set', and are listed in Table 6.3. Table 6.2.3 demonstrates that, using this 'UEA set' of items, correlations between the four scales were lower than when using all the cultural bias items from our questionnaire. Correlations between individualism and the other three scales were, however, still high, indicating that this cultural bias was still not clearly picked out. Correlations between the other three cultural bias scales were 0.25 at most, and were not significant at the 95% confidence level, indicating that the scales for egalitarianism, fatalism and hierarchy were more reliable.

6.1.3 Identifying cultural biases at the level of individuals

Four cultural bias scores were calculated for each respondent. This was done by adding up the scores the respondent had given for all the items attributed to each cultural bias and dividing it by the number of items being used for that cultural bias. This 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 items were an effective tool for measuring cultural biases[6], respondents would be expected to have a high score for one particular cultural bias and a low score for the other three biases. The results from this survey showed that this was not the case. Most respondents had scores above 3 (the mid-point) for more than one cultural bias. Only 14% of the whole sample had only one score above 3. On this basis, Sample A (N=129[7]) would have consisted of fourteen egalitarians, three hierarchists, one individualist, no fatalists, and two respondents with no cultural bias at all (all four scores below 3), with the remaining 110 respondents being of mixed cultural bias. This indicated either that Dake's questionnaire was not an effective tool to measure cultural biases and/or that cultural theory did not work at the level of individuals.

The means for each of the cultural bias scores were not 3 (the mid-point), and were different for each cultural bias, namely: 3.4 for individualism, 3.8 for hierarchy, 3.7 for egalitarianism, and 2.3 for fatalism. This indicated either that the sample was, in general, fairly high in hierarchy and egalitarianism but low in fatalism, or pointed to some bias in the particular set of questionnaire items used for this analysis. In either case, it seemed appropriate to centre the respondents' scores around these means. Using these centred scores, three different criteria were devised to identify the cultural bias of individual respondents, and the results are shown in Table 6.4.

The first and most stringent criteria (A) stated that a respondent had to have one score well above the mean for the sample (at least 0.5 points), while the other three scores had to be below the mean. This system only enabled 21 respondents out of 129 (16%) to be allocated to one single cultural bias (the others all being of mixed or no cultural bias at all). Since a larger proportion of the sample needed to be categorised in order to select participants for the focus groups, two less stringent categorisation systems were devised.

For criteria B the respondent simply had to have one score above the mean for the whole sample, and the other three scores below the mean. This system allocated 41 out of 129 (32%) of the respondents to a single cultural bias category. Considering that only 56% of the respondents had indicated that they were willing to attend focus groups, and that 10

[6] Note that Dake never intended his questionnaire to be used in this way.

[7] The sample used for analysis in Section 6 consists of 120 respondents, rather than 131, because two respondents did not answer the full set of cultural bias items and were therefore excluded from the analysis.

participants from each cultural bias were needed for the focus groups, an even less stringent system was devised.

Criteria C included respondents who fitted criteria B, but also some who had more than one score above the mean: one score had to be well above the mean for the whole sample (at least 0.5 points) while the other three scores could also be above the mean as long as they were less than 0.5 points above the mean. This system allocated 59 out of 129 (46%) of the respondents to single cultural bias categories, and was the one used for the selection of participants for the focus groups[8].

Overall the set of questionnaire items used did not seem very effective for classi-fying individuals into one of the four cultural biases. This indicated either a weakness in the methodology used, or that most individuals cannot be categorised in such a way. It should be noted, however, that Dake never intended his questionnaire instrument to be used in this way. The remainder of Section 6 treats cultural biases as 'worldviews' (or, as suggested by Dake and Thompson (1993), 'orientating dispositions'). Thus, *for the correlations that follow, the spectrum of scores obtained by individuals on each of the four scales was used; and individuals were <u>not</u> categorised into cultural bias groups*. This is also the way in which Dake (1991 and 1992) used this questionnaire instrument.

6.2 Explaining risk perceptions using cultural theory

Do cultural biases help predict risk perception? And if so, which dimensions of 'risk' do they explain best?

The correlations between cultural biases and risk perceptions obtained are listed, for each definition of risk perception, in Table 6.5. None of the correlations between cultural biases and risk perceptions were very high. The highest correlation obtained was 0.34, which means that the R^2 value was 0.11, indicating that, at most, only 11% of the variance in risk perceptions could be explained by the worldview held by respondents. However, 77 correlations out of the 260 in Table 6.5 (i.e. 30%) were significant at the 95% confidence level. Only thirteen would be expected to be significant simply by random variation, indicating that the correlations obtained, although weak, are likely to be meaningful if examined collectively. Moreover, the pattern which emerged was distinct for each cultural bias and was consistent with the predictions of cultural theory (see below).

Correlations between cultural biases and risk perceptions were not the same depending on which of the five definitions of risk perception 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. This confirmed, yet again, that these five scales were not measuring the same thing, and suggested that cultural theory is more closely related to the concept of unacceptability rather than to estimates of human fatalities and injuries.

For the sake of simplicity Table 6.6 summarises the results across all five definitions of risk perception, i.e. it shows statistically significant correlations (between cultural biases and risk perceptions) obtained *using any one of the definitions of risk*. This table is the one used for the discussion below.

When devising this survey, twenty five predictions were made about the relationship between cultural biases and risk perceptions of the thirteen risk issues included in the

[8] Results from the focus groups indicated that respondents with 'pure' cultural biases, as determined using criteria C, did hold worldviews which corresponded strikingly to the archetypes proposed by cultural theory.

questionnaire (Marris *et al.*, 1996). The predictions were derived from Douglas and Wildavsky (1982); Thompson *et al*. (1990); Dake (1991); Jenkins-Smith (1994); and Peters and Slovic (1996) and are reproduced in Table 3.1. No prediction were made for fatalism because cultural theorists have not discussed the relationship between fatalism and risk perception in much depth. Table 6.6 shows that, out of the twenty five predictions listed in Table 3.1, eighteen were proven. Only seven of the hypothesised relationships were not proven: three of these showed no relationship at all, while the remaining four showed relationships in the opposite direction from what had been expected. Fourteen cells were left blank in Table 3.1, indicating that no relationship was expected or that the relationship was not easily predictable from the theory. Of these, five revealed no significant correlations, and the remaining nine did. The lack of correlations in these cases should not be taken as a failure, and can be considered to represent positive results.

An egalitarian worldview was, as expected, 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 risks perceived as 'unnatural' such as food colourings, genetic engineering and microwave ovens (previous research at UEA has shown that food colourings, genetically manipulated foods and microwave ovens are perceived as 'unnatural' by many members of the public, and that this influences their perception of these risk issues (Simpson 1994)). The hierarchical worldview was, as expected, associated with high scores for social threats such as mugging and terrorism . The individualist worldview was, as expected, characterised by low concern for environmental threats (nuclear power and ozone depletion), and also low concern for risks which would be perceived, within an individualist worldview, as 'personal risks' (alcoholic drinks, car driving, food colourings).
Cultural theorists have also argued that individualists would be particularly concerned about war. The results from this survey, however, showed a *negative* correlation between individualism and risk perception ratings for war, indicating that the individualist worldview correlated with *low* concern for war. This may be due to changes in the nature of wars over the last decade. Thompson says that "war (unlike mugging or terrorism) is a terrible threat for individualists, because it massively reduces the scope for biding and bargaining *and* plays havoc with contract security"[9]. While this may be true of wars such as the First and Second World Wars, it does not necessarily apply to smaller scales wars taking place away from one's country or region of residence. The war most uppermost in the respondents' minds was likely to be the current war in the Balkans[10], which had had little or no effect on economic activities in the UK.

Some interesting unpredicted relationships were also revealed by the data, for example in relation to genetic engineering and car driving. With regards to car driving, the results showed, as expected, low concern from an individualist perspective, and this was presumably because car driving was considered, within an individualist worldview, to be a personal choice and within one's control. But the results also showed an unpredicted correlation between egalitarianism and high risk perceptions for car driving. This correlation was only revealed, however, when risk was defined in terms of 'harm to things other than people' and unacceptability. This suggests that egalitarian and individualist worldviews lead to different interpretations of the risks associated with 'car driving': individualism seems to be associated with a focus on fatalities and injuries caused by road traffic accidents, whereas the egalitarian perspective focuses mostly the environmental effects of car emissions and road building. Thus, within an individualist worldview, car driving was perceived as a

[9] Letter from Michael Thompson to Claire Marris dated 6/10/95.

[10] The interviews were usually conducted when the respondents had just been watching the evening Television news, with the Balkans war as a headline. Association of 'war' with the Balkans war was also confirmed in the focus groups.

personal risk, whereas within an egalitarian worldview, it was perceived as an environmental threat[11].

Genetic engineering was expected to be selected for attention within an egalitarian worldview, because it would be considered to be 'unnatural', have potentially catastrophic environmental consequences, be controlled by untrustworthy scientists and promoted by profit-motivated commercial enterprises. In contrast, it was expected to be of little concern from the individualist and hierarchical perspectives. The results showed that egalitarianism did indeed correlate with concern for genetic engineering, but that hierarchy (and fatalism) did too. This could be due to the ethical and moral issues associated with genetic manipulation of human beings (qualitative feedback from respondents during the interviews indicated that some of them interpreted the term 'genetic engineering' mostly in relation to human genetics and reproductive technologies[12]). Hierarchy had not been expected to be correlated with concern about microwave ovens or food colourings either, yet the results showed positive correlations for these issues. It therefore seems that the hierarchy, like egalitarianism, was correlated with concern about 'unnatural' risks (food colourings, microwave ovens and genetic engineering), but, in contrast to egalitarianism, hierarchy was not correlated with concern about environmental threats (nuclear power and ozone depletion).

Ozone depletion had been expected to be of concern within a hierarchical worldview because scientific experts, national governments and international agencies have given it a lot of attention. Thus, within a view of Nature as perverse/tolerant, it could be seen as an environmental threat which went beyond the critical limits of environmental tolerance. In contrast, within an individualist worldview, this issue was expected to be seen as having been 'blown out of proportion', since Nature is perceived as being infinitely tolerant and no implicit trust is placed in scientific expertise. The results, however, revealed that *both* hierarchy and individualism were negatively correlated with risk perception for ozone depletion, indicating little concern for this issue. It is possible that the conflicting statements made by different experts on this subject has led to a higher level of distrust in scientific opinions, even within a hierarchical worldview. This result may also be due to the fact that hierarchy and individualism were not clearly distinguished.

The results from this survey showed fewer significant correlations between risk perceptions and fatalism than for the other three cultural biases, and no clear pattern emerged. Fatalism was correlated with concern about social ills such as mugging and AIDS, but not war or terrorism. This suggested that fatalism was associated with concern about things which were more likely to affect respondents directly. On the other hand, fatalism was not correlated with concern about home accidents which also affects individuals directly; but maybe accidents are simply things which 'happen' and 'one just has to put up with them'. Fatalism was not correlated with concern for environmental threats such as nuclear power or ozone depletion, but was correlated with concern about genetic engineering. Interestingly, fatalism was the only cultural bias which revealed no significant correlations at all when risk perception was defined in terms of unacceptability (see Table 6.5.5), indicating, perhaps, that accepting something - or not accepting it - it not a concept which has much meaning within a fatalist worldview. In contrast, egalitarianism was significantly correlated with high scores for Unacceptability for ten out of the thirteen risk issues.

[11] This was confirmed in the focus groups. See also Section 7: egalitarianism was the only cultural bias which was correlated with a perception of car driving as causing harm to future generations, having delayed effects, and possessing catastrophic potential.

[12] This was also confirmed in the focus groups.

6.3 Relationship between cultural biases and trust in institutions

Cultural biases were also expected to be related to the trustworthiness of institutions. Cultural theorists suggest that hierarchists place particular 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 within its tolerable limits; and respect religious organisations, because of their high morals. Conversely, hierarchists would be expected to have little affinity with organisations fighting for more equality, such as trade unions; and environmental organisations would be perceived as being outside the expert system and therefore not trustworthy either. Egalitarians, in contrast, should place very little trust in the Government, companies, and scientists, which they would perceived as being corrupted by vested interests and too much power. Egalitarian organisations such as environmental groups and trade unions, would, however, be perceived as acting with the best interest of the public and the ecosystem in mind. Individualists would be expected to trust companies, but would be suspicious of environmental organisations or trade unions, who would be perceived as acting against economic development.

Respondents were therefore asked to rate ten different institutions on a 4 point scale from "never trust" to "always trust" "to tell you the truth about risks". Table 6.7 lists correlations between cultural biases and responses to these questions about trust, and demonstrates that, as expected: individualism was correlated with trust in companies but not trade unions; and hierarchy was correlated with trust in hierarchical institutions such as the Government and religious organisations and also experts such as doctors and scientists. Hierarchy was also correlated with high levels of trust in the family. One surprising results was that individualism correlated with trust in the Government, and hierarchy with trust in companies. This may be due to the fact that these two cultural biases were not clearly distinguished.

Egalitarianism, as expected, was correlated with trust in trade unions but not companies. Surprisingly, however, egalitarianism did not correlate with a positive attitude towards environmental organisations[13], and for some reason, correlated positively with trust in religious organisations.

Fatalism was correlated with high levels of trust in people the respondents felt closest to (their friends, family and doctor); and low levels of trust for the Government and environmental organisations, which were presumably both perceived as 'outsiders'.

Some general trends are also worth noting. Figure 6.3 shows the percentage of respondents in the whole of Sample A who said that they would "always" or "often" trust a particular institution to tell them the truth about risk. Overall, the respondents showed very little trust in the Government, companies, and the media, but a lot of trust in family, friends, and environmental organisations.

6.4 Relationship between cultural biases and environmentalism (and myths of Nature)

The questionnaire also included a set of items devised by Dake and Thompson to measure 'environmentalism'; and another set adapted from Jenkins-Smith (1994) to indicate which of the four 'myths of Nature' proposed by cultural theorists (Thompson *et al*., 1990; Schwarz and Thompson, 1990) was held by the respondents. Table 6.8 indicates the correlations obtained between these items (labelled ENV 1 to ENV 11) and cultural biases. The

[13] The term 'environmental organisations' was intended to refer to institutions such as Friends of the Earth and Greenpeace, but results from the focus groups revealed that it was not necessarily interpreted in this way by all respondents. In some cases, it was interpreted as government departments dealing with environmental issues. This may explain why correlations with this item were unexpectedly low.

correlations were still not very high, but they were higher than those obtained for risk perceptions or trust in institutions (the highest was 0.46). Furthermore, many significant correlations were obtained, and the pattern was consistent with the predictions of cultural theory.

Items ENV 1, 2, 3 and 4 were devised to reflect the individualistic, hierarchical, egalitarian and fatalist myths of Nature: 'Nature benign'; 'Nature perverse/tolerant'; 'Nature ephemeral'; and 'Nature capricious', respectively. The results did, indeed, reveal a significant (and positive) correlation with the appropriate cultural bias for each of these four myths. Furthermore, egalitarianism correlated *negatively* with the individualistic myth of Nature. These myths, however, did not appear to be exclusive of one another; thus, individualism also correlated positively with the hierarchist myth, and fatalism with the egalitarian myth.
Items ENV 5 to ENV 11 related to attitudes toward technology, industry and decision-making procedures, and, interestingly, the pattern of correlations obtained for individualism was exactly the opposite to that obtained for egalitarianism. Three items suggested negative views about industry and private companies (ENV 5, 6 and 7) and all three correlated positively with egalitarianism. Item ENV 8, which suggested that "the misuse of technology is a serious problem in the world today" was correlated positively with egalitarianism and negatively with individualism. ENV 9, which advocated public participation in decision making was positively correlated with egalitarianism and negatively with individualism.

Hierarchy (like individualism) was correlated positively with items 10 and 11, which suggested that there is too much legislation to protect the environment, and negatively with the statement "industry left to itself will harm the environment". Hierarchy therefore appeared to be correlated with a very positive attitude towards industry and its ability to regulate itself, which was expected to be an archetypal individualist, rather than hierarchist, point of view. This may be due to the fact that the hierarchy and individualism scales were inter-correlated.

Fatalism showed no consistent pattern vis-à-vis environmentalism: it correlated with a preference for public participation in decision making (ENV 9), which was an archetypal egalitarian statement, but also with the opinion that there was too much environmental legislation (ENV 10 and 11), which is an archetypal individualistic view. Fatalism correlated most highly with the statement that "Big corporations are responsible for most of the evil in the world" (even more highly than egalitarians). Perhaps this reflected a particularly pessimistic outlook associated with fatalism. Qualitative feedback during the questionnaire inter-views indicated that respondents with an egalitarian worldview tended to find this statement rather 'over the top' even though they did feel that large multi-national companies were the cause of many of the world's problems.

6.5 Relationship between cultural biases and membership of groups

Table 6.9 shows the relationship between the respondents' membership of particular types of institutions and their cultural bias. The results reveal that individualism, hierarchy and fatalism were correlated with an aversion to membership of environmental organisations, whereas egalitarianism correlated positively with membership of these organisations . This confirms the results discussed in Section 6.4, suggesting that egalitarianism was closely related to environmentalism. There was also an interesting difference between membership of 'environmental organisations' and 'conservation organisations'. The former were defined as more radical institutions such as Friends of the Earth or Greenpeace, whereas the later were defined as more conservative and hierarchical institutions such as the National Trust or the Royal Society for the Protection of Birds. The results showed that egalitarianism correlated with membership of environmental organisations but not with membership of conservation organisations; while hierarchy was correlated with an aversion to membership of environmental organisations but not of conservation organisations. Individualism and

fatalism in contrast, were negatively correlated with membership of both types of organisations.

Egalitarianism was also correlated with membership of trade unions; and individualism was correlated with membership of sports clubs, whereas egalitarianism was not. For religious organisations and political parties, there was no relationship between membership and cultural biases.

6.6 Relationship between cultural biases and responses to scenarios

The questionnaire included three scenarios which were devised to address (in turn) issues of liability, fairness, and accountability.

Scenario 1 on liability

The question was: "Imagine you live near a chemical factory owned by a private company. How would you make sure the company was run safely?", and respondents were given four options:

1. "By making sure the company is liable and can be sued" (N=13)
2. "By checking that there is a regulatory authority keeping an eye on the factory" (N=83)
3. "By setting up a group of local residents with the power to influence the factory's activities" (N=30)
4. "By hoping for the best" (N=4)

Analysis of variance indicated that egalitarians were more likely to chose the third response and individualists were more likely to chose the second response.

Scenario 2 on fairness

The question was "Imagine you work for a company which has been forced by recession to make two people redundant. How do you think the managers should decide who should go?", and the four options were:

1. "The least productive workers should go" (N=58)
2. "The last two workers should go (last-in-first-out)" (N=30)
3. "The employees should be asked to decide between themselves" (N=21)
4. "Whatever happens, I won't be able to influence the decision" (N=20)

Analysis of variance indicated that egalitarians were more likely to pick response 3 and fatalists more likely to pick response 4.

Scenario 3 on accountability

The question was "Imagine you decide to go on holiday with a tour company. How would you make sure that the company is reliable?", and the four options were:

1. "By checking their annual reports and profit margins" (N=1)
2. "By making sure that they are an old and well-established company" (N=86)
3. "By hoping for the best" (N=10)
4. "By asking to speak to previous customers" (N=32)

Analysis of variance shoved no significant relationship with cultural biases. Most respondents (67%) chose the third response, and indicated that they were no so much interested in whether the travel agent was old and established as whether it was a member of ABTA.

Overall, these scenarios did not reveal any particularly interesting results. One reason for this was the homogeneity among responses (especially for Scenarios 1 and 3) indicating that, at least for the sample interviewed, the choice of options was not optimal to distinguish between different opinions. Further development of the scenarios might improve this, but it is also possible that such scenarios, presented out of context within a structured interview, are not effective instruments for measuring cultural biases.

6.7 Conclusions from the cultural theory data

A modified version of the British Edition of Dake's Cultural Biases Questionnaire was used to measure cultural biases. This revised version measured egalitarianism and fatalism effectively, but the hierarchy and individualism scales were still confounded. When analysed at the level of individuals, only 14% of respondents could, strictly, be allocated to a single cultural bias, indicating either that the method used was not an effective tool to measure cultural biases, or that most individuals cannot be categorised in this way. The scales could, however, be used as continuous 'worldview' scales, and this approach revealed interesting results.

Correlations between cultural biases (used as continuous scales) and, in turn: risk perceptions, trust in institutions, environmentalism; myths of Nature; and membership of groups were measured. Each cultural bias produced distinct patterns of correlations, and these were all consistent with the predictions of cultural theory. None of the correlations obtained were very high: in particular only 11%, at most, of the variation in risk perceptions could be explained by cultural biases. The number of significant correlations was, however, much higher than would be expected from random variation alone. Thus, it was comparisons between the four cultural biases, considered collectively, which provided the most interesting insights, rather than any single correlation examined in isolation from the others.

Stronger correlations between cultural biases and risk perceptions would probably be obtained if the questionnaire used to measure cultural biases was further developed. Dimensions such as worldviews are, however, by definition multi-dimensional and therefore difficult to measure using a questionnaire instrument of the type used here. The fact that a consistent pattern emerged at all indicates that cultural theory does indeed seem to be able to provide insights into some of the underlying factors which shape risk perceptions.

7. Integrating the 'Psychometric Paradigm' and Cultural Theory Data

Section 5.2 revealed that the risk characteristics used in the 'psychometric paradigm' were not rated in the same way by all respondents. In this section, we investigate whether any of the variability observed in the scores from the 'psychometric paradigm' questions can be explained by differences in the worldviews held by the respondents. Correlations between cultural bias scores and responses to the 'psychometric paradigm' scales were calculated in two different ways. Table 7.1 lists correlations using the scores aggregated for all thirteen risk issues, and Table 7.2 lists correlations using scores for individual risk issues (both tables refer to scores for individual respondents).

None of the correlations in Table 7.1 were significant for either individualism or hierarchy. A few significant correlations were obtained for egalitarianism and fatalism, but these were not very high. There was therefore no clear pattern of relationships between the cultural bias of respondents and their general tendency to rate risk characteristics high or low. Even when the results were disaggre-gated by risk issue (see Table 7.2), the largest correlation was only 0.34, which meant that only 11% of the variation in the scores given to risk characteristics could be explained by cultural biases. The number of significant correlations obtained, was, however, relatively high. All together, for the nine risk character-istics, a total of 468 separate correlations were measured, and 103 of these (22%) were found to be significant at the 95% confidence level (see Table 7.2).

'Harm to future generations' was the risk characteristic which revealed the higher number of significant correlations. Table 7.2 shows that egalitarianism was correlated with high scores on this scale for many of the risk issues (7 out of 13), especially those perceived, within an egalitarian worldview, as environmental threats (nuclear power, ozone depletion, sunbathing and car driving). In contrast, individualism and hierarchy tended to correlate with *low* scores on the 'harm to future generations' scale for all of the issues. Indeed, the results suggested that, within a hierarchical worldview, it was social problems, rather than environ-mental threats, which were perceived as the issues with the most pervasive ill-effects on society. Thus, hierarchy was correlated with high scores on the 'delayed effects' and 'harm to future generations' scales with respect to mugging and terrorism, but low scores on these two scales with respect to environmental (nuclear power and ozone depletion) and 'unnatural' (genetic engineering and food colourings) risk issues. This might also be because these were the risk issues for which there has been either uncertainty or conflicting opinions between official experts and public pressure groups about the potential for delayed or long-lasting impacts. Hierarchy was also correlated with high scores for the 'catastrophic potential' associated with mugging and terrorism, whereas, within the egalitarian worldview, it was environmental threats (genetic engineering, nuclear power, ozone depletion and car driving) which were perceived as having the greatest 'catastrophic potential'.

Egalitarian views on nuclear power were particularly striking (see Table 7.2). Egalitarianism correlated with higher scores for 'dread', 'involuntariness', 'catastrophic potential', 'harm to future generations', 'delayed effects', and 'severity'. In contrast, for nuclear power, individualism and hierarchy correlated negatively with all these scales (though not always significantly so). These results also confirmed that the egalitarian worldview led to a distinct outlook towards the risks associated with car driving. Egalitarianism correlated with high scores for car driving on the 'harm to future generations', 'delayed effects', and 'catastrophic potential' scales. Individualism, in contrast, correlated with *low* scores for harm to future generation caused by car driving. This fitted in with the results discussed in Section 6.2, which suggested that the egalitarian worldview considers the wider effects of car driving, such as air pollution and environmental degradation associated with road building, whereas the other worldviews (especially individualism) interpret the issue more narrowly in terms of road traffic accidents (this was also confirmed in the focus groups).

Table 7.2 therefore reveals a pattern of correlations between cultural biases and responses to the 'psychometric paradigm' questions which is consistent with the predictions of cultural theory, and provides some insights into the underlying meanings given to the risk characteristics in the context of each worldview. These differences were further investigated in the focus groups.

Finally, Table 7.3 shows correlations between cultural bias scores and answers to the question "when you think about risks in general, do you think [characteristic X] is important?". Most of these correlations were very low and not significant, and no obvious pattern emerged. It should be noted that virtually all respondents (94%) gave high scores (3, 4 or 5) to *all* the risk characteristics in response to this question. This was probably due to the leading way in which the question was introduced, with the statement "you have just scored nine factors which some people say are important when thinking about risks. I would like to know how important *you* feel each of these factors is.". The only exception was 'dread', where 23 respondents (18%) scored 1 or 2, and this was indeed the characteristic for which the highest correlation (0.34) with cultural bias (fatalism) was observed. It is also perhaps worth noting that both individualism and hierarchy were correlated with the opinion that 'involuntariness' was an important factor when making decisions about risk.

8. Relationship Between Socio-demographic Variables and Risk Perceptions

Do socio-demographic variables predict risk perceptions?

8.1 Relationship between socio-demographic variables and 'general risk perceptions'

Risk perceptions (defined in five different ways as Riskiness, Fatalities, Injuries, Environmental Harm and Unacceptability) were first analysed for all thirteen risk issues aggregated. What was analysed was risk perception in a *general sense*, across a range of thirteen disparate issues.

Sex: Women tended to rate risk higher than men (except when defined as Environmental Harm), and analysis of variance indicated that this difference was statistically significant at the 95% confidence level.
Age: Older respondents tended to rate risk lower than younger people, but only when risk perception was defined as Fatalities, Injuries or Environmental Harm (see Table 8.1).
Level of education: Respondents were divided into four categories: those with no educational qualifications at all, those with at least one 'O' level, those with at least one 'A' level, and those with a university degree. Analyses of variance indicated that the only statistically significant difference ($p=0.038$) was between respondents with or without a university degree: those with a degree tended to rate the Riskiness scale lower across all risk issues.
Household income: Respondents with higher household incomes tended to rate risk lower than those with lower incomes, on all the scales except Injuries (see Table 8.1).

In summary, 'general risk perceptions' were related to socio-demographic variables (especially sex, age and income), but the correlations were not very high. The highest was 0.32, indicating that, at most, only 10% of the variation could be explained by any one variable.

8.2 Relationship between socio-demographic variables and perceptions of single risk issues

The previous section analysed risk perceptions aggregated for all thirteen risk issues (from sunbathing to alcoholic drinks). In order to analyse the data at the level of individual risk issues, multiple regression analyses were carried out using all the socio-demographic variables together, and the results are summarised in Table 8.2.
Some of the R^2 values obtained were higher than those obtained for 'general' risk perceptions, but the correlations were still not very strong (the highest R^2 value was 28%). A large number of significant correlations were, however, obtained: 38 out of the 65 R^2 values in Table 8.3 were significant at the 95% level (with $R^2 \geq 6.0\%$). This indicated that these correlations were unlikely to be due to random variation, and that there was a statistically significant (but weak) relationship between the socio-demographic attributes of respondents and the risk ratings they gave to individual risk issues. In general, socio-demographic variables seemed to be more closely related to the Fatalities, Injuries and Environmental Harm scales than to the Riskiness and Unacceptability scales. It is also interesting to note that it was the issues associated with 'social ills' such as mugging, terrorism, and alcoholic drinks which obtained the highest R^2 values. The only other issue with R^2 values above 16% was accidents in the home.

9. Relationship Between Socio-demographic Variables and Risk Characteristics

The socio-demographic attributes of respondents were compared to the mean of the scores (for the thirteen risk issues) they gave to each of the nine risk characteristics in turn. Some weak relationships were revealed between some of the socio-demographic attributes of the respondents and their tendency to rate particular risk characteristics high or low. The statistically significant relationships revealed (at the 95% level) were (see Table 9.1):

- 'Delayed effects' was rated higher by women; and by respondents with lower incomes.
- 'Severity' was rated higher by women; and by younger respondents.
- 'Harm to future generations' was rated higher by women; and by respondents with lower incomes.
- 'Catastrophic potential' was rated higher by younger respondents.
- 'Lack of knowledge to those exposed' was rated higher by respondents with no formal educational qualifications.
- 'Dread' was rated higher by respondents with lower incomes.
- 'Unfairness' was rated higher by respondents with lower incomes.

10. Relationship Between Socio-demographic Variables and Cultural Biases

The socio-demographic attributes of respondents were compared to the scores they obtained for each cultural bias.

Sex: Women tended to have higher egalitarian scores, and lower fatalist scores, than men, and analyses of variance indicated that these differences were statistically significant. There was no statistically significant relationship with individualism or hierarchy.
Age: Older respondents tended to have higher hierarchy and individualism scores than younger respondents, but there was no statistically significant relationship with fatalism or egalitarianism (see Table 10.1).
Level of education: Analyses of variance revealed that there was a very strong relationship between the fatalism, hierarchy and individualism scores of respondents and their education level. Egalitarianism was less closely related to education level. Furthermore, for egalitarianism, the relationship was in the opposite direction than for the other three cultural biases: respondents with higher levels of education tended to have higher egalitarian scores but lower fatalist, hierarchy and individualism scores.
Household income: Respondents with lower incomes tended to have higher fatalism and hierarchy scores, but there was no statistically significant with egalitarianism or individualism (see Table 10.1).

Multiple regression analyses were carried using all the socio-demographic variables together, and the results are summarised in Table 10.2. The results indicated a statistically significant relationship with all four cultural biases, but the highest R^2 value obtained (for fatalism) was only 23%. The correlation between socio-demographic variables and egalitarianism was weaker than for the other three cultural biases. In summary:

- Fatalists tended to be men, have less formal education, and lower incomes.
- Hierarchists tended to be older, have less formal education, and lower incomes.
- Individualists tended to be older and have less formal education.
- Egalitarians tended to be women and have higher educational qualifications.

Results from this study (see Section 8) and previous studies have indicated that, although not very strong, there are some relationships between socio-demographic attributes and risk perceptions (reviewed in Marris *et al*., 1996; Rohrmann, 1995; Sjöberg and Drottz-Sjöberg, 1994). Some of the other results discussed in this paper, indicating relationships between cultural biases and risk perceptions, may therefore have been influenced by socio-demographic attributes of the respondents as well as or instead of cultural biases.

11. Conclusions from Sample A: Does the 'Psychometric Paradigm' or Cultural Theory Provide the Best Framework for Explaining Risk Perceptions?

Are risk perceptions best explained by the risk characteristics proposed by the 'psychometric paradigm', cultural biases, socio-demographic variables, or a combination of these factors? Does the 'psychometric paradigm' or cultural theory provide the best framework to understand risk perceptions?

One recurrent criticism of cultural theory has been that, when using the quantitative methodology proposed by Dake, it has failed to explain much of the variation in risk perceptions between people. Some researchers have argued that correlations obtained between cultural biases and risk perceptions are so low that the theory should be dismissed. Sjöberg (e.g. 1995) has been particularly vocal about this point, and concludes his *Empirical Evaluation of Cultural Theory* as follows: "Cultural Theory dimensions added very little to the explanatory power of the psychometric scales of Fischhoff and Slovic. It is concluded that Cultural Theory explains only a very minor share of the variance of perceived risk and that it adds even less to what is explained by different approaches." (Sjöberg, 1995, p. 1). The results reported here are not significantly different to those described by Sjöberg, but we argue that they lend more support to the validity of cultural theory than Sjöberg suggests.

Table 11.1 combines results given earlier in this paper and lists the percentage of variance in risk perceptions explained by each of the three types of variables analysed in this study, namely: risk characteristics, cultural biases, and socio-demographic variables. Table 11.1 refers only to risk perception defined as Riskiness, but results using the other four definitions of risk were very similar. This table clearly shows that the risk characteristics proposed by Slovic *et al*. generated a greater number of statistically significant correlations, and that these were far higher than correlations obtained using either cultural biases or socio-demographic variables. Cultural biases could only explain 12%, at most, of the variation in risk perceptions, compared to 50%, at most, for the risk characteristics proposed by the 'psychometric paradigm'. Controlling for socio-demographic variables and *then* modelling risk characteristics and cultural biases against risk perceptions did not alter the results to any significant degree (this analysis is not reported here). At first sight Table 11.1 therefore suggests that the 'psychometric paradigm' provides a much better explanation for risk perceptions than cultural theory.

We argue, however, that the relative weakness of correlations with cultural biases is not surprising and does not necessarily invalidate the claims made by cultural theorists. Risk characteristics such as 'dread' and 'severity' are so closely related to public interpretations of 'risk' that they are practically indistinguishable from 'risk perception'. The other risk characteristics of the 'psychometric paradigm' tap into other dimensions of risk, but all are extremely close to the original question "how much risk do you think is associated with X?". Cultural biases (and socio-demographic variables), in contrast, are far more distant variables. None of the questionnaire items used in this study to measure cultural biases referred directly to views on risk, health, technology or the environment (see Table 6.1). We therefore believe that even though the correlations between risk perceptions and cultural biases were low, they should not be dismissed. As discussed in Section 6.2, the *number* of significant correlations obtained was high; and, moreover, the *pattern* of correlations obtained was consistent with the predictions of cultural theory. Thus, it was comparisons *between* the four cultural biases, considered collectively, which provided the most interesting insights, rather than any single correlation examined in isolation from the others. When analysed in this way, the results clearly demonstrated that the four worldviews generated distinct patterns of risk perceptions and these were consistent with our prior predictions based on cultural theory (compare Table 3.1 with Table 6.6).

In addition, cultural biases were also correlated with views about the trustworthiness of different institutions, and also views about Nature, industry and technology (see Tables 6.7 and 6.8). Some of these correlations were of the same order as those obtained for risk characteristics; and, interestingly, the highest correlations related to feelings of powerlessness in the face of change imposed by business and government. These dimensions, we argue, point to important factors which are not captured using the 'psychometric paradigm'. Risk perceptions are not just about abstract ratings of 'risk'. People use environmental and other threats as a focus to express their anxieties about the world around them, and in particular their inability to influence the way it is changing. This was particularly apparent in the focus group discussions.

We argue that the 'psychometric paradigm' methodology generates robust quantitative results, but does not provide much insight into the reasons *why* particular risk characteristics are closely correlated with risk perceptions. Similarly, while some of the correlations obtained between socio-demographic variables and risk perceptions were interesting, they do not, in themselves, provide any explanation about *why* those relationships should exist. Cultural theory, on the other hand, *does* suggest an explanation for risk perceptions by showing how they fit coherently into worldviews held by respondents.

Moreover, by combining the 'psychometric paradigm' and cultural theory data, we have been able to provide insights into the underlying meanings of the risk characteristics derived from the 'psychometric paradigm' (see Section 7). Cultural theory and the 'psychometric paradigm' are therefore very different in nature and it would therefore be more appropriate to consider the two approaches as being complementary to each other rather than trying to judge their comparative value according to the strict quantitative criteria proposed by Sjöberg. We believe that the two approaches measure importantly different dimensions of risk perceptions, and that careful use of both frameworks together provides more interesting insights into risk perceptions than either approach used on its own.

We also believe that further development of the cultural biases questionnaire would undoubtedly increase the strength of correlations obtained between cultural biases and risk perceptions. The cluster analysis performed on the cultural biases items used in our questionnaire suggested that they *were* measuring significant dimensions of worldviews, and results from the focus groups demonstrated that Dake's questionnaire could be used to identify 'extreme' individuals who held the four archetypal worldviews suggested by cultural theory (these results will be reported fully elsewhere). Worldviews are, however, by definition multidimensional and therefore difficult to measure using a questionnaire instrument of the type used here. It would be more appropriate, when trying to test cultural theory empirically, to ask questions which were less abstract and more embedded within a specific social context.

Finally, it is important to note that all the results discussed so far refer only to Sample A, and used *individuals* as the unit of analysis. As noted in Section 1, some cultural theorists argue that this is inappropriate and that the theory can and should only be applied at a collective level. The results presented derived from Sample A and in Sections 4 to 11 fail, like Dake's original study, to investigate the first tenet of cultural theory, which is that adherence to a certain pattern of social relationships generates a distinctive way of viewing the world (see Section 1.2). Thus, although cultural theory is supposed to be about social relations, the quantitative methodology developed by Dake (the abstract risk ratings and the cultural bias items) is psychometric in nature and focuses only on individual traits. Interestingly, although the 'psychometric paradigm', in contrast to cultural theory, focuses on cognitive process of individuals rather then their social context, previous analysis has actually used *mean* scores and therefore produced results at a collective, rather than individual level. As shown in

Section 5.3, different results were obtained when the same data was analysed using individual scores.

12. Results from Sample B

12.1 Introduction

In order to address some of these methodological problems discussed above in Section 11 (see also Section 1), the research design for this study incorporated two additional features:

1. A functionalist element:
A second sample, Sample B, was designed to investigate whether there was any association between cultural biases, measured using Dake's cultural biases questionnaire, and association with association with institutions with specific grid and group characteristics. This was intended to address the first tenet of cultural theory, that social relations and cultural biases are inextricably inter-linked. The results are presented below, in Section 12.

2. A qualitative element:
Participants from both Sample A and Sample B participated in a series of focus groups. Each focus group brought together people who, according to their responses to Dake's cultural biases questionnaire, held one of the four cultural biases (for Sample B, the participants were from the same institution). The format of the focus groups enabled the participants to discuss the issues raised by the questionnaire survey in more depth, and in a far less abstract fashion. In particular, issues surrounding trust, accountability and fairness were further explored during the group discussions (the results from the focus groups will be published in full elsewhere).

Sections 4 to 11 referred only to results from Sample A, which consisted of a cluster sample of Norwich residents. This last section of the paper describes the results obtained from Sample B, which consisted of three sub-samples, with respondents selected according to their association with a particular institution with specific grid and group characteristics.

The questions addressed in the analysis of data from Sample B were different to those for Sample A, namely:

- Did association with these institutions correlate with cultural biases, as measured by Dake's questionnaire? (see Section 12.3)
- Did association with these institutions correlate with risk perceptions, and in a way which fits the predictions of cultural theory? (see Section 12.4)
- Did association with these institutions correlate with particular views on trust? (see Section 12.5)

12.2 Sample B

Sample B (N=70) was a purposive sample, which consisted of participants associated with specific local institutions. Three distinct institutions were selected on the basis of their hypothesised grid and group characteristics: Scouts (hierarchist); The Greenhouse (egalitarian); and the Chamber of Commerce (individualist).

The *Scouts* (N=23) sub-sample consisted of adults who worked (voluntarily) with the Scouts, organising and supervising activities for young people in Norwich. They were recruited from several Norwich local divisions, via the District Commissioner.

The *Greenhouse* (N=28) is a Norwich-based network of radical environ-mentalists who are engaged in a range of educational and campaigning activities about issues such as road building, nuclear power, AIDS, the veal trade and animal rights. They also run a shop selling a range of 'fair-traded' and environmentally sustainable products, and are in the process of renovating an old building which will serve as a base for their activities. The participants recruited were engaged in one or more activities associated with the Greenhouse (e.g.

assisting in the shop or with the building renovation, or using the facilities in the office for campaigning activities).

The *Chamber of Commerce* (N=19) sub-sample consisted of individuals who were running (or planned to run) their own business. They were recruited through their involvement with one of two organisations based at the Norwich and Norfolk Chamber of Commerce and Industry. The first was the Norwich Enterprise Agency Trust, which provides advice, counselling and training for people wishing to set up their own business. The second was the Prince's Youth Business Trust, which provides financial and other support to young unemployed people (18-29) to help them start their own business[14].

Socio-demographic profile of Sample B:
Respondents for Sample B were selected according to their association with one of the three selected institutions, and no prior assumptions were made about any relationship between association with these institutions and socio-demographic characteristics. Some effort was made to balance the number of men and women interviewed, and the percentage of men in the Greenhouse, Scouts and Chamber of Commerce sub-samples were, respectively, 56%, 56% and 58%. Each sub-sample covered a fairly broad range of household incomes, ages, and levels of education, but some differences were observed between them:

- The Scouts and Chamber of Commerce sub-samples represented a range of household incomes (though not as great as the range for Sample A), but most of the Greenhouse sample were on low incomes (85% under £10,000 per annum). This reflected the fact that most of the Greenhouse partici-pants were either unemployed, students, or retired.
- The spread of ages in the Scouts and Chamber of Commerce sub-samples was broadly similar to that of Sample A (except that there were no participants over 60 years of age); but the Greenhouse sub-sample tended to be younger, and, rather than consisting of an overall spread, consisted mostly of participants who were either under 29 or over 60.
- The Greenhouse and Chamber of commerce sub-samples were much more highly educated than either the Scouts sub-sample or Sample A.

Overall, the socio-demographic profiles of the Scouts and Chamber of Commerce sub-samples were therefore fairly similar to that of Sample A, but the Greenhouse participants appeared to be more unusual, with very low incomes yet very high educational attainment. This reflected the fact that many of the partici-pants had voluntarily 'opted out' of conventional careers and were devoting much of their time, unpaid, to campaigning about environmental issues (but note that results from Sample A demonstrated that egalitarianism was the only cultural bias which correlated with higher levels education).

Differences in risk perception and trust between the three sub-samples discussed in the next three sections may have been influenced by these differences in socio-demographic characteristics (instead of or in addition to cultural biases). Results from Sample A indicated that, although not very strong, there were some relationships between socio-demographic characteristics and risk perceptions (see Section 8).

12.3 Relationship between cultural biases and association with specific institutions

[14] The authors would like to take this opportunity to thank all the respondents for their participation in this study, and also to those within these institutions who very kindly and efficiently helped us recruit suitable participants. Our special thanks go to: Hugh Fetherston (Scouts), Tigger (Greenhouse), Peter Smith (NEAT) and Anne Lavery (PYBT).

Table 12.1 lists the mean cultural bias scores obtained for each sub-sample; and Table 12.2 reveals which variations in cultural bias scores between the sub-samples were statistically significant. Table 12.3 lists the percentage of respondents which fell into particular cultural bias groups for each of sub-sample, using criteria C (the basis for these criteria was explained in Section 6.1.)
The Greenhouse sample did, as hypothesised, have a relatively high mean score for egalitarianism and low mean scores for all three other cultural biases, compared to the other two sub-samples of Sample B and to Sample A. Most, but not all, of these differences were statistically significant. In particular, the fatalism scores of the Greenhouse sample was not statistically different from either Sample A or the Scouts and Chamber of Commerce sub-samples. The Greenhouse sub-sample was, however, clearly egalitarian: *all* of the Greenhouse respondents had an egalitarian score above that for Sample A, and for 43% of the Greenhouse respondents, the only score above the mean for Sample A was their egalitarian score. Using criteria C, 23 respondents (85% of the Greenhouse sub-sample) were categorised as 'pure' egalitarians. If the Greenhouse is accepted as an archetype for an egalitarian institution, these results indicated that the set of items utilised in this study were very effective in picking out an egalitarian worldview (see Tables 12.1, 12.2 and 12.3).

The Scouts sub-sample, as expected, showed a clear tendency toward hierarchy (see Tables 12.1, 12.2 and 12.3). It had a higher mean score for hierarchy than Sample A and the Greenhouse and Chamber of Commerce sub-samples, and all of these differences were statistically significant. The relationship between association with the Scouts and a hierarchical worldview was not, however, as clear-cut as the relationship between egalitarianism and association with the Greenhouse. Thus, although 78% of the respondents had a hierarchy score above the mean for Sample A, only 5 respondents (22% of the Scouts sub-sample) could be categorised as 'pure' hierarchists. This indicated that the Scouts were not an archetype for a hierarchical institution but may also reflect the fact that the set of questionnaire items used in this study were not very effective in picking out a hierarchical cultural bias (see Section 6.1 and Table 6.2).

The Chamber of Commerce sample did not show any bias toward any particular worldview : all four mean scores were slightly below the mean for Sample A, and none of these differences were statistically significant (see Table 12.1). The only statistically significant difference between the Chamber of Commerce sample and the others was that it had lower hierarchy scores than the Scouts sample (see Table 12.2). This suggests that self-employed people do not share a particular worldview and/or that association with the Chamber of Commerce was not a good criteria for selection of an individualist worldview. Several characteristics of this particular sample, were however, worth noting. Because of the way in which the respondents were selected (see Section 12.2), the sample consisted of people who had only recently set up their own business. Additional information gathered during the interviews suggested that the respondents fell into one of three broad categories:

1. Those in their late forties or early fifties who had been made redundant due to economic recession, mostly from large hierarchical institutions (e.g. Anglian Water, Anglia Television, Police Force, Civil Service). Although they were pleased to have started their own business (usually related to a previous hobby, sometimes to their previous occupation), they probably would never had done so if they had been able to keep their previous jobs.
2. Those who were younger (under 30) and had never had any formal employment. They did not expect to be able to find suitable employment in the formal sector due to a lack of formal training and the current state of the job market. Self-employment, for them, was a way to work in their field of interest and their business were mostly related to artistic skills (e.g. pet portraits, graphic design, sculpture).

3. Mothers who wished to find some occupation as their children were growing up and no longer took up so much of their time. They had no wish or opportunity to enter the formal job market.

In addition, most of the respondents were given financial incentives to set up their own business either through the state-funded "Enterprise 2000" scheme or the Prince's Youth Business Trust. Thus, none of these respondents were truly committed self-employed people, who had chosen to set up their own business because that was the strategy which fitted in best with their worldview. It is therefore perhaps not surprising that this sample did not have a strikingly high score for individualism. It is possible that many of these respondents were in a period of transition from one cultural bias to another, in view of the major life-changes they were experiencing, but it is not possible to determine this from the questionnaire survey data (the proportion of respondents with mixed cultural biases or none at all was similar to that in Sample A, around 54%, which does not support this idea) [15].

12.4 Relationship between risk perceptions and association with specific institutions

Table 12.4 lists the mean risk perception ratings, for each of the five definitions of risk (Riskiness, Fatalities, Injuries, Harm and Unacceptability), obtained by each of the sub-samples (Greenhouse, Scouts and Chamber of Commerce). In order to determine whether any of the differences observed between the sub-samples were significant, Tukey's pairwise comparisons were made for all the possible pairs, using each of the five different definitions of risks. Table 12.5 shows the results when risk was defined as Unacceptability. This was the definition which revealed the most significant differences, but a few additional significant differences were obtained using the other definitions. For the sake of simplicity, Table 12.6 summarises these results across all five definitions of risk, i.e. it shows the strongest statistically significant difference in risk perceptions between each of the pairs of sub-samples, obtained *using any one of the definitions of risk* (Riskiness, Fatalities, Injuries, Environmental Harm *or* Unacceptability).

Significant differences between the Greenhouse and Scouts sub-samples were observed for nine out of the thirteen risk issues, and this indicated that these two samples, did, indeed, represent two distinctive worldviews in relation to risk. Very few significant differences were, however, observed for the other two possible pairs (Greenhouse versus Chamber of Commerce; and Scouts versus Chamber of Commerce). This was probably due to the fact, discussed above, that the Chamber of Commerce sub-sample was not particularly homogeneous and/or typical in its worldview.

Differences in risk perceptions between the Greenhouse and Scouts sub-samples resembled those obtained from Sample A for egalitarian and hierarchist cultural biases, and were consistent with the predictions of cultural theory (see Section 6.2). Thus, the Greenhouse sub-sample had significantly higher risk ratings than the Scouts sub-sample for environmental threats such as nuclear power and ozone depletion; and also for car driving. The Scouts respondents, on the other hand, tended to give higher risk ratings to accidents in the home and mugging. As for Sample A, the relationship between perceptions of the risks associated with war and cultural biases was the opposite to what had been hypothesised: the Greenhouse sub-sample gave significantly higher ratings to war than the Scouts sample, and this relationship held for all the risk definitions except Unacceptability (where there was no significant difference). As mentioned in Section 6.2, most respondents were focusing on the Balkans war when they responded to the questionnaire. This war, and other wars happening 'far away', often in developing countries, are much more likely to be selected for

[15] Results from the Chamber of Commerce focus group did, however, suggest that these participants were, indeed, in a period of transition.

attention within a worldview which focuses on global issues, and on disadvantaged people. Thus it is not surprising that the Greenhouse participants, many of whom are involved in organisations such as Campaign Against the Arms Trade, selected war as a risk issue of high concern.

12.5 Relationship between trust and association with specific institutions

As discussed in Section 6.3, cultural biases were also expected to be expressed through views on trust. Association with the Scouts, Greenhouse or Chamber of Commerce was therefore also expected to correlate with varying levels of trust in different institutions.

Table 12.7 lists the mean trust scores given to ten different institutions by each of the three sub-samples, and Table 12.8 reveals which of the differences between the sub-samples were statistically significant. Very few significant differences were observed when the Chamber of Commerce sub-sample was compared to either of the other two sub-samples (or to Sample A), further indicating that this sample did not reflect a particularly different or homogeneous worldview.

When comparing the Greenhouse and Scouts sub-samples, however, a number of interesting differences were observed. As expected, the Scouts had significantly higher levels of trust for companies, religious organisations, scientists, and doctors than the Greenhouse respondents. Levels of trust in the Government were higher among the Scouts than the Greenhouse respondents, but the difference was not significant. The Scouts respondents also trusted their friends and families more, and this reflects the correlation observed in Sample A between hierarchy and trust in friends and families. The Greenhouse sample did, as expected, have a higher mean rating of trust for environmental organisations than the Scouts, but this difference was not statistically significant. It is important to note, however, that these sub-samples were relatively small. The percentage of Scouts and Chamber of Commerce respondents who trusted environmental organisations was fairly high (65% and 68% respectively), indicating perhaps that environmental organisations have gained more credibility among a wider public over the last decade. Furthermore, the level of trust in environmental organisations among the Greenhouse respondents, although high (81%), was not much higher than that for Sample A (79%). This rating was probably negatively affected by the perception among activists at the Greenhouse that many environmental organisations have become too institutionalised and should no longer be trusted (the Greenhouse was set up in part as a break away group from Greenpeace UK, because Greenpeace was felt to have lost touch with the grass-roots issues which these activists were most concerned about[16]).

12.6 Conclusions from Sample B

As discussed in Section 1.2, previous quantitative studies of cultural theory failed to investigate the relationship between cultural biases and social relationships, and therefore ignored the first tenet of cultural theory, which is that adherence to a certain pattern of social relationships generates a distinctive way of viewing the world. In this study, respondents were recruited from three institutions selected according to their hypothesised grid and group characteristics, and the results demonstrated that participants from two of these (the Scouts and the Greenhouse) did, indeed, reflect distinct worldviews, and that, in both cases, the worldviews were consistent with the cultural bias which would, according to cultural theory, be associated with the specific grid and group characteristics of those two institutions. Furthermore, these two sub-samples also generated distinct patterns of risk perceptions, and these were also consistent with the predicators of cultural theory (and with the results from Sample A).

[16] This ambiguity toward established environmental organisations was confirmed in the Greenhouse focus group.

Respondents from the third institution (the Chamber of Commerce) did not, however, hold a common worldview and this was probably due to weaknesses in the procedure used to select the participants for the study. Further developments in methodologies to measure grid and group characteristics of institutions would be necessary to investigate this aspect of cultural theory more satisfactorily.

Tables

Table 3.1: Hypothesised relationship between cultural biases and risk perceptions

Risk Issue	Individualism	Heirarchy	Egalitarianism
Sunbathing			✯
Food colourings	□	□	✯
Genetic engineering	□	□	✯
Nuclear power	□	□	✯
Mugging		✯	
Home accidents	□	✯	
Ozone depletion	□	✯	✯
Car driving	□		
Microwave ovens			✯
AIDS	□	✯	✯
War	✯	✯	
Terrorism		✯	
Alcoholic drinks	□		

Notes:
Asterisks indicate a *positive* relationship between the risk issue and risk perception. For example, *high* levels of concern about genetic engineering were expected from an egalitarian worldview. Squares indicate a *negative* relationship between the risk issue and risk perception. For example, *low* levels of concern about genetic engineering were expected from an individualist worldview.

Cells left blank indicate that no relationship was expected, or that the relationship was not easily predictable from cultural theory.

No predictions were made for fatalism because cultural theorists have made few statements about the relationship between fatalism and risk perception.

Table 3.2: The nine characteristics selected for this study

Involuntariness Do you think people are exposed to X voluntarily or involuntarily? (risk assumed voluntarily / risk assumed involuntarily)
Delayed effects Do you think the harmful effects of X are likely to occur at some later time? (no effect delayed / many effects delayed)
Severity Do you think people will die from X when things go wrong? (certain not to be fatal / certain to be fatal)
Dread Are the risks of X ones that you can think about reasonably calmly, or are they ones that you have a great dread for – on the level of gut reaction? (think about calmly / think about with dread)
Catastrophic potential Do you think X can harm a large number of people at once or only one person at a time (one person at a time / many people at once)
Harm to future generations Do you think X poses risks to future generations? (very little threat / very great threat)
Lack of knowledge to those exposed Do you think the risks associated with X are well known by the persons who are exposed to the risk? (risk well known / risk not known)
Lack of knowledge to scientists Do you think the risks associated with X are well known by scientists? (risk well known / risk not known)
Unfairness Do you think that the people who are exposed to the risks of X are the same as those who receive the benefits? (same people / not same people)

Notes:
This table lists the characteristics used in the questionnaire, the exact questions asked to the respondents for each of the thirteen risk issues (X); and the definitions of the end-points of the 5-point scales. These descriptions of the risk characteristics proposed by the 'psychometric paradigm' were adapted from Slovic *et al*. (1985), but are not identical to those original ones.

Table 4.1: Mean risk perception scores for each risk issue from Sample A, with 'risk' defined in five different ways

Risk issues	Riskiness	Fatalities	Injuries	Environmental Harm	Unacceptability
Sunbathing	4.1	2.4	***2.7***	***3.3***	***3.6***
Food colourings	4.0	2.0	2.3	***3.4***	4.0
Genetic engineering	3.9	2.1	***3.0***	1.6	***2.9***
Nuclear power	3.7	1.8	1.9	***2.5***	***3.3***
Mugging	***3.6***	***3.7***	3.7	***3.7***	4.3
Home accidents	***3.5***	***3.7***	3.9	***3.4***	***3.5***
Ozone depletion	***3.4***	***3.1***	***3.2***	1.8	3.8
Car driving	***3.4***	***2.5***	***3.0***	1.8	***4.0***
Microwave ovens	***3.3***	***2.7***	***2.9***	***2.6***	4.1
AIDS	***3.2***	***2.58***	***3.4***	1.7	***3.2***
War	***3.0***	***3.0***	***3.4***	1.7	***3.0***
Terrorism	***2.8***	1.3	1.8	1.5	***2.5***
Alcoholic drinks	2.0	1.2	1.4	1.4	1.9

Notes:
Scores shown in normal type indicate risk ratings which were virtually universal, i.e. less than 15% of respondents gave a rating at one or other end of the 5-point scale (1 and 2; or 4 and 5). Scores shown in bold italics indicate scores for which there was more variability.

Table 4.2: Ordered mean risk perception scores for each risk issue from Sample A, with 'risk' defined in five different ways

Riskiness		Fatalities		Injuries		Env. Harm		Unacceptability	
Nuclear power	4.1	Car driving	3.7	Car driving	3.9	War	3.7	War	4.3
Ozone depletion	4.0	War	3.7	War	3.7	Car driving	3.4	Terrorism	4.1
Sunbathing	3.9	AIDS	3.1	Home accidents	3.4	Ozone depletion	3.4	Ozone depletion	4.0
Genetic eng.	3.7	Alcohol	3.0	Alcohol	3.4	Nuclear power	3.3	Mugging	4.0
War	3.6	Home accidents	2.8	AIDS	3.2	Terrorism	2.6	AIDS	3.8
Car driving	3.5	Terrorism	2.7	Mugging	3.0	Genetic eng.	2.5	Nuclear power	3.6
Mugging	3.4	Mugging	2.5	Sunbathing	3.0	Alcohol	1.9	Car driving	3.5
AIDS	3.4	Nuclear power	2.4	Terrorism	2.9	AIDS	1.8	Genetic eng.	3.3
Terrorism	3.3	Sunbathing	2.1	Nuclear power	2.7	Mugging	1.8	Home accidents	3.2
Home accidents	3.2	Ozone depletion	2.0	Ozone depletion	2.3	Home accidents	1.7	Alcohol	3.0
Alcohol	3.0	Genetic eng.	1.8	Genetic eng.	1.9	Sunbathing	1.6	Sunbathing	2.9
Food colourings	2.8	Food colourings	1.3	Food colourings	1.8	Food colourings	1.5	Food colourings	2.5
Microwave ovens	2.0	Microwave ovens	1.2	Microwave ovens	1.4	Microwave ovens	1.4	Microwave ovens	1.9

Notes:
This table represents exactly the same data as Table 4.2, but in this case the mean risk perception scores are listed in decreasing order in each column.

Table 4.3: Correlations between the five different definitions of 'risk'

	Riskiness	Fatalities	Injuries	Unacceptability
Fatalities	0.33	-	**0.96****	**0.64***
Injuries	0.38	**0.96****	-	**0.58***
Unacceptability	**0.69****	**0.64***	**0.58***	-
Environmental Harm	**0.63***	0.50	0.38	**0.67***

Notes:

This table lists correlations between:

1. the mean risk perception scores obtained for each of the thirteen risk issues for one particular definition of 'risk'; and
2. the mean risk perception scores obtained for the same thirteen risk issues using a different definition of 'risk'.

For example, the first cell in the table shows the correlation between mean ratings obtained for each of the thirteen issues on the Riskiness scale with mean ratings obtained for those same risk issues on the Fatalities scale. This particular correlation (0.33) was low and was not significant at the 95% confidence level, indicating that these two scales seemed to be measuring different dimensions of 'riskiness'. In contrast, the correlation between Fatalities and Injuries was very high (0.96) indicating (unsurprisingly) that these two scales were very closely related.

Throughout this paper, asterisks indicate the level of statistical significance of correlations:

$* = p < 0.05$ $** = p < 0.01$ $*** = p < 0.001$

Table 5.1: Factor analysis of the nine risk characteristics

Risk characteristic	Factor 1	Factor 2	Factor 3	Communality
Delayed effects	**0.91**	-0.15	-0.03	0.86
Harm to future generations	**0.89**	0.33	-0.31	1.00
Catastrophic potential	**0.83**	0.21	-0.20	0.78
Involuntariness	0.30	**0.89**	-0.13	0.90
Unfairness	0.26	**0.89**	-0.22	0.91
Lack of knowledge to scientists	-0.30	**0.88**	0.19	0.91
Lack of knowledge to exposed	-0.02	0.07	**0.96**	0.92
Severity	**0.50**	0.23	**-0.83**	0.99
Dread	**0.53**	**0.60**	**-0.60**	1.00
Variance	3.10	2.97	2.20	8.27
% Variance	0.34	0.33	0.24	0.92

Table 5.2: Correlations between the nine risk characteristics

	Future generations	Dread	Catastrophic	Severity	Involuntariness	Unfairness	Lack knowledge by scientists	Lack knowledge by exposed
Delayed effects	0.78**	0.80**	0.72**	0.45	0.16	0.14	-0.43	-0.05
Future generations	-	0.85***	0.88***	0.78**	0.61*	0.60*	-0.03	-0.29
Dread	0.85**	-	0.69**	0.90***	0.77**	0.80**	0.26	-0.54
Catastrophic	0.88***	0.69**	-	0.62*	0.55	0.50	-0.18	-0.23
Severity	0.78**	0.90***	0.62*	-	0.47	0.52	-0.10	-0.78**
Involuntariness	0.61*	0.77**	0.55	0.47	-	0.96***	0.64*	-0.08
Unfairness	0.60*	0.80**	0.50	0.52	0.96***	-	0.67*	-0.18
Lack knowledge scientists	-0.03	0.26	-0.18	-0.10	0.64*	0.67*	-	0.27
Lack knowledge exposed	-0.29	-0.54	-0.23	-0.78**	-0.08	-0.18	0.27	-

Notes:

This table lists correlations between:

1. the mean scores obtained for each of the thirteen risk issues for one specific risk characteristic; and
2. the mean scores obtained for the same thirteen risk issues for a second risk characteristic.

For example, the correlation between mean scores for ‘unfairness’ and for ‘involuntariness’ was very high (0.96) indicating that, on average, risk issues which were felt to be involuntary were also felt to be unfair.

Table 5.3: Correlations between 'lack of knowledge to those exposed' and other characteristics: comparison with Slovic *et al*. (1980)

	Our results	Slovic's results
Severity	-0.78	-0.12
Dread	-0.54	0.05
Harm to future generations	-0.29	0.35
Lack of knowledge to science	0.27	0.50
Catastrophic potential	-0.23	0.24
Unfairness	-0.18	0.28
Involuntariness	-0.07	0.63
Delayed effects	-0.05	0.77

Table 5.4: Mean scores obtained for each of the nine risk characteristics on each of the thirteen issues

	Lack know. exp.	Unfairness	Dread	Future generations	Catastrophic potential	Delayed effects	Involuntariness	Severity	Lack know. sci.
Sunbathing	***2.5***	1.8	1.9	***2.7***	***3.4***	4.3	1.7	***3.3***	1.3
Food colourings	***3.7***	***3.1***	***1.5***	2.2	***2.8***	***3.2***	***3.4***	2.2	1.8
Genetic engineering	3.7	***3.7***	***2.8***	3.6	***3.1***	4.0	***3.6***	***3.3***	***2.1***
Nuclear power	***2.8***	3.9	***3.6***	4.3	4.6	4.4	4.5	4.5	1.7
Mugging	***2.2***	4.6	***3.3***	***2.6***	1.9	***2.9***	4.5	3.9	***2.3***
Home accidents	***2.6***	***2.7***	2.2	1.9	1.9	2.3	***3.0***	***3.3***	1.9
Ozone depletion	***3.3***	***3.8***	***3.2***	4.4	4.4	4.5	4.3	3.6	1.9
Car driving	***2.2***	***3.0***	***2.9***	***3.3***	***3.3***	***3.1***	***2.9***	4.1	1.8
Microwave ovens	***3.6***	2.1	1.4	1.5	1.4	***2.4***	1.9	2.2	1.9
AIDS	2.0	***2.8***	***3.4***	4.0	***3.1***	4.2	***2.9***	4.7	1.5
War	***1.9***	4.4	3.9	***4.2***	4.8	3.8	4.3	4.6	1.8
Terrorism	2.2	4.3	***3.6***	***3.6***	4.2	***3.3***	4.5	4.4	2.0
Alcoholic drinks	***2.4***	***2.3***	2.0	***2.5***	***2.3***	3.7	1.6	3.6	1.5

Notes:

Scores shown in normal type indicate ratings for which there was a virtual consensus among the respondents, i.e. where less than 15% of the respondents gave a rating at one or other end of the 5-point scale (1 and 2; or 4 and 5). Scores shown in bold italics indicate scores for which there was more variability.

Table 5.5: Correlations between risk perceptions and the nine risk characteristics *using mean scores*

	Riskiness	Environmental Harm	Unacceptability	Fatalities	Injuries
Delayed effects	***0.74***	0.44	0.41	0.07	0.06
Harm to future generations	***0.76***	***0.80***	***0.80***	0.42	0.30
Catastrophic potential	***0.73***	***0.82****	***0.66****	0.34	0.27
Involuntariness	0.49	***0.59****	***0.74***	0.14	0.05
Unfairness	0.45	***0.59****	***0.78***	0.24	0.14
Lack knowledge to exposed	-0.26	-0.23	***-0.60****	***-0.89****	***-0.91****
Severity	***0.62****	***0.61****	***0.87****	***0.80***	***0.72***
Dread	***0.64****	***0.72***	***0.95****	***0.60****	0.48
Lack knowledge scientists	-0.07	0.14	0.23	-0.18	-0.27
Factor 1	***0.69***	***0.67****	0.49	0.18	0.09
Factor 2	0.19	0.40	0.55	-0.02	-0.13
Factor 3	-0.26	-0.22	***-0.60****	***-0.85****	***-0.85****

Notes:

This table lists correlations between:

1. the mean risk perception scores for each of the thirteen risk-issues (with risk defined in five different ways); and
2. the mean scores obtained for the same thirteen risk issues on each of the risk characteristics.

Table 5.6: Correlations between risk perceptions and the nine characteristics *using individual scores*

Table 5.6.1: Riskiness

	Future generations	Severity	Dread	Delayed effects	Catastrophic potential	In-voluntariness	Unfairness	Lack know. of scientists	Lack know. of exposed
Sunbathing	***0.38***	***0.44***	***0.29***	***0.30***	0.13	-0.07	0.06	-0.06	0.07
Food colourings	***0.58***	***0.37***	***0.45***	***0.23***	***0.28***	0.08	0.00	0.06	-0.10
Genetic engineering	***0.47***	***0.31***	***0.44***	***0.38***	***0.20***	***0.21***	-0.02	***-0.20***	0.13
Nuclear power	***0.54***	***0.40***	***0.42***	***0.40***	***0.30***	***0.19***	0.14	-0.01	0.13
Mugging	***0.37***	***0.36***	***0.48***	***0.30***	0.14	***0.27***	***-0.19***	0.14	0.14
Home accidents	***0.30***	***0.31***	***0.34***	0.13	***0.20***	0.03	***0.18***	0.09	0.07
Ozone depletion	***0.31***	***0.28***	***0.38***	***0.27***	0.07	0.01	0.10	***-0.23***	-0.13
Car driving	***0.30***	***0.36***	***0.41***	***0.23***	***0.23***	0.13	-0.11	0.13	0.07
Microwave ovens	***0.27***	***0.29***	***0.51***	***0.37***	***0.29***	***0.25***	0.11	-0.07	0.00
AIDS	***0.36***	***0.20***	***0.37***	***0.26***	***0.15***	0.03	-0.04	-0.06	-0.01
War	***0.27***	***0.18***	0.14	***0.16***	***0.18***	0.11	0.14	0.08	-0.04
Terrorism	***0.46***	***0.22***	***0.41***	***0.24***	***0.24***	***0.16***	0.03	-0.01	***-0.15***
Alcoholic drinks	***0.30***	***0.30***	***0.32***	0.12	***0.25***	0.10	0.02	0.14	0.05

Table 5.6.2: Fatalities

	Future generations	Severity	Dread	Delayed effects	Catastrophic potential	In-voluntariness	Unfairness	Lack know. of scientists	Lack know. of exposed
Sunbathing	***0.45***	***0.36***	***0.36***	0.14	0.00	0.08	***0.17***	0.05	0.04
Food colourings	***0.23***	***0.28***	***0.24***	0.10	0.01	***-0.15***	0.02	***-0.18***	0.00
Genetic engineering	***0.15***	***0.37***	***0.26***	***0.15***	***0.18***	***0.22***	0.02	***-0.17***	***-0.15***
Nuclear power	***0.34***	***0.35***	***0.32***	***0.35***	***0.20***	***0.17***	***0.21***	***0.19***	0.11
Mugging	***0.45***	***0.27***	***0.44***	***0.52***	***0.27***	***0.16***	***-0.34***	0.08	0.11
Home accidents	***0.32***	***0.29***	***0.25***	***0.19***	0.13	0.08	0.04	0.06	0.09
Ozone depletion	***0.31***	***0.29***	***0.27***	0.14	***0.16***	0.01	-0.03	***-0.17***	0.00
Car driving	***0.38***	***0.37***	***0.27***	***0.26***	***0.28***	0.10	***-0.16***	0.11	-0.07
Microwave ovens	***0.38***	***0.31***	***0.41***	***0.28***	***0.48***	***0.18***	***0.17***	-0.07	-0.03
AIDS	***0.44***	***0.29***	***0.24***	***0.26***	***0.28***	-0.06	0.04	-0.03	***-0.15***
War	***0.28***	***0.18***	***0.21***	***0.31***	***0.24***	0.11	-0.08	0.12	0.00
Terrorism	***0.42***	***0.25***	***0.30***	***0.35***	***0.31***	0.07	-0.05	0.04	-0.06
Alcoholic drinks	***0.32***	***0.35***	***0.19***	***0.24***	***0.20***	-0.04	0.00	0.06	-0.13

Table 5.6.3: Injuries

	Future generations	Severity	Dread	Delayed effects	Catastrophic potential	In-voluntariness	Unfairness	Lack know. of scientists	Lack know. of exposed
Sunbathing	***0.29***	***0.29***	***0.20***	***0.14***	***0.16***	-0.04	0.09	-0.05	0.09
Food colourings	***0.41***	***0.35***	***0.43***	***0.31***	***0.32***	***0.16***	0.07	0.05	-0.12
Genetic engineering	***0.23***	***0.44***	***0.20***	***0.08***	***0.20***	0.12	0.00	-0.07	***-0.19***
Nuclear power	***0.35***	***0.36***	***0.26***	***0.36***	***0.26***	***0.27***	0.13	0.12	0.05
Mugging	***0.39***	***0.32***	***0.42***	***0.45***	***0.32***	***0.25***	***-0.29***	-0.09	0.10
Home accidents	***0.31***	***0.28***	***0.12***	0.06	***0.18***	0.06	0.05	0.02	0.04
Ozone depletion	***0.38***	***0.39***	***0.27***	***0.25***	***0.22***	0.01	-0.02	-0.04	0.00
Car driving	***0.34***	***0.35***	***0.23***	***0.21***	***0.31***	0.09	***-0.20***	0.09	-0.04
Microwave ovens	***0.35***	***0.41***	***0.46***	***0.25***	***0.32***	***0.22***	***0.22***	-0.02	-0.05
AIDS	***0.38***	***0.30***	***0.20***	***0.24***	***0.26***	0.06	0.03	0.03	-0.14
War	***0.30***	***0.19***	***0.23***	***0.40***	***0.25***	0.08	-0.04	0.12	0.04
Terrorism	***0.47***	***0.27***	***0.33***	***0.36***	***0.34***	0.11	-0.03	0.08	-0.05
Alcoholic drinks	***0.22***	***0.37***	***0.15***	***0.25***	***0.25***	-0.14	-0.02	0.01	-0.08

Table 5.6.4: Environmental Harm

	Future generations	Severity	Dread	Delayed effects	Catastrophic potential	In-voluntariness	Unfairness	Lack know. of scientists	Lack know. of exposed
Sunbathing	***0.27***	0.12	***0.19***	0.08	0.10	-0.05	***0.22***	***-0.20***	0.13
Food colourings	***0.37***	***0.15***	***0.35***	***0.21***	***0.24***	***0.17***	0.03	-0.03	-0.09
Genetic engineering	***0.44***	***0.28***	***0.23***	***0.30***	***0.37***	***0.23***	0.04	0.10	-0.10
Nuclear power	***0.37***	***0.37***	***0.16***	***0.39***	***0.18***	***0.40***	***0.24***	0.03	0.14
Mugging	***0.50***	***0.15***	***0.38***	***0.32***	***0.37***	0.10	***-0.44***	0.08	0.08
Home accidents	***0.24***	0.10	***0.30***	***0.21***	***0.32***	0.13	0.05	-0.13	***0.18***
Ozone depletion	***0.51***	***0.50***	***0.53***	***0.37***	***0.49***	0.12	0.13	-0.08	0.00
Car driving	***0.42***	***0.35***	***0.21***	***0.36***	***0.36***	***0.18***	0.05	***0.16***	-0.05
Microwave ovens	***0.51***	***0.50***	***0.46***	***0.32***	***0.60***	***0.25***	***0.20***	-0.02	0.02
AIDS	***0.19***	-0.02	0.08	***0.17***	***0.33***	0.08	0.05	0.13	0.08
War	***0.26***	***0.19***	0.06	***0.28***	***0.23***	0.07	-0.07	0.13	-0.06
Terrorism	***0.41***	***0.29***	***0.20***	***0.32***	***0.36***	0.05	-0.13	0.11	0.01
Alcoholic drinks	***0.20***	***0.18***	***0.24***	-0.09	***0.27***	***0.16***	***0.25***	0.10	***0.20***

Table 5.6.5: Unacceptability

	Future generations	Severity	Dread	Delayed effects	Catastrophic potential	In-voluntariness	Unfairness	Lack know. of scientists	Lack know. of exposed
Sunbathing	***0.42***	***0.45***	***0.44***	***0.33***	***0.16***	0.03	0.14	0.03	0.06
Food colourings	***0.46***	***0.45***	***0.31***	***0.44***	***0.24***	***0.23***	0.09	0.11	-0.02
Genetic engineering	***0.51***	***0.34***	***0.51***	***0.44***	***0.30***	***0.41***	***0.21***	-0.08	0.14
Nuclear power	***0.51***	***0.42***	***0.48***	***0.48***	***0.32***	***0.28***	***0.19***	0.06	***0.16***
Mugging	***0.28***	***0.41***	***0.44***	***0.24***	0.06	***0.50***	0.04	-0.13	0.00
Home accidents	***0.29***	***0.27***	***0.33***	0.04	***0.23***	***0.23***	0.09	-0.14	0.09
Ozone depletion	***0.62***	***0.53***	***0.58***	***0.52***	***0.52***	***0.24***	0.02	-0.10	-0.01
Car driving	***0.30***	***0.34***	***0.41***	***0.19***	***0.21***	0.14	0.07	0.12	0.00
Microwave ovens	***0.40***	***0.41***	***0.50***	***0.50***	***0.40***	***0.27***	***0.20***	0.12	0.13
AIDS	***0.43***	***0.30***	***0.37***	***0.40***	***0.25***	0.10	0.02	-0.09	***-0.15***
War	***0.29***	***0.27***	***0.17***	***0.18***	***0.34***	***0.18***	0.14	0.06	0.08
Terrorism	***0.32***	***0.37***	***0.24***	***0.24***	***0.37***	***0.29***	***0.23***	-0.05	***-0.16***
Alcoholic drinks	***0.45***	***0.38***	***0.35***	***0.25***	***0.27***	0.09	0.07	0.04	-0.01

Notes (for Tables 5.6.1 to 5.6.5):
These tables list correlations between:

1. the risk perception scores given to a particular risk-issue by each of the 131 respondents; and
2. the scores given by those same respondents to that particular risk-issue for each risk characteristic in turn.

For example, the first cell of Table 5.6.1 shows the correlation between the Riskiness scores given to sunbathing by each of the 131 respondents and the scores those same respondents gave to the 'harm to future generations' caused by sunbathing. In this particular case, the correlation was 0.38, and was significant at the 99.9% level. This indicated that, if a respondent thought that sunbathing would harm future generations they also tended to feel it was very 'risky'.

See Figure 5.3 for a graphical illustration of the difference between the correlations listed in Table 5.4 and 5.5.

Correlations shown in bold italics were significant at the 95% confidence level ($p < 0.05$). Correlations above 0.144 were significant at the 95% confidence level; correlations above 0.201 were significant at the 97.5% confidence level; and the correlations above 0.268 were significant at the 99% confidence level.

Table 5.7: Percentage of variance in individual risk perceptions explained by the nine risk characteristics together

	Riskiness	Fatalities	Unacceptability
Food colourings	**41*** **	**15** **	**29*** **
Nuclear power	**34*** **	**26*** **	**42*** **
Genetic engineering	**32*** **	**15** **	**36*** **
Mugging	**31*** **	**40*** **	**35*** **
Microwave ovens	**27*** **	**26*** **	**35*** **
Car driving	**26*** **	**23*** **	**19*** **
Sunbathing	**25*** **	**26*** **	**34*** **
Terrorism	**22*** **	**19*** **	**23*** **
Ozone depletion	**21*** **	**11** **	**50*** **
Accidents in the home	**17*** **	**13** **	**21*** **
AIDS	**15** **	**17*** **	**27*** **
Alcoholic drinks	**14** **	**14** **	**25*** **
War	6	**13** **	**13** **

Notes:

This table lists the adjusted multiple R^2 values obtained from regression analyses of risk perceptions using all nine psychometric characteristics as independent variables (i.e. 'involuntariness', 'delayed effects', 'severity', 'dread', 'catastrophic potential', 'harm to future generations', 'lack of knowledge to those exposed', 'lack of knowledge to scientists', and 'unfairness'). Asterisks indicate the level of significance of the correlations obtained.

Table 6.1: Cultural bias items used in the questionnaire

Hierarchy (15 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.

We should have stronger armed forces than we do now.

The police should have the right to listen to private phone calls when investigating crime.

Those in power often withhold information about things which are harmful to us.

One of the problems with people is that they challenge authority too often.

It is important to preserve our customs and heritage.

I think it is important to carry on family traditions.

In my household, family members have their own places at the dinner table.

I always sort out clothes into separate categories before washing.

I value regular routines highly.

I think being on time is important.

My time-tabling of meals is haphazard. (score reversed)

I like to plan carefully so that financial risks are not taken.

Individualism (9 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.

Continued economic growth is the answer to improved quality of life.

This country would be better off if we didn't worry so much about how equal people are.

Making money is the main reason for hard work.

I don't join clubs of any kind. (score reversed)

I tend to be sceptical of health food fads.

Egalitarianism (11 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.

Social Security tends to stop people from trying harder to get on. (score reversed)
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 (11 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.
I don’t worry about politics because I can’t influence things very much.
Most people make friends only because friends are useful to them.
I feel that life is like a lottery.
Even if you work hard, you never know if that will help you do better.
It seems to me that, whoever you vote for, things go on pretty much the same.
I have few financial investments.

(total: 46 items)

Table 6.2: Correlations between the four cultural bias scales

Table 6.2.1: Correlations between cultural bias scales using all the cultural bias items from our questionnaire (but excluding the 'behavioural strategy' items)

	Individualism	Hierarchy	Egalitarianism
Hierarchy	**0.65*** **		
Egalitarianism	**-0.45*** **	**-0.37*** **	
Fatalism	**0.38*** **	**0.28** **	-0.12

Table 6.2.2: Correlations between cultural bias scales reported by Dake (1991)

	Individualism	Hierarchy
Hierarchy	**0.54*** **	
Egalitarianism	**-0.30*** **	**-0.28*** **

Table 6.2.3: Correlations between cultural bias scales using the 'UEA set' of items

	Individualism	Hierarchy	Egalitarianism
Hierarchy	**0.53*** **		
Egalitarianism	**-0.42*** **	-0.16	
Fatalism	**0.25** **	0.21	0.07

Table 6.3: The 'UEA set' of cultural bias items used for the analysis of the data

Statement	Bias

CB1	Those who get ahead should be taxed more to support the less fortunate.	E
CB2	~~Continued economic growth is the answer to improved quality of life.~~	I
CB3	Cooperating with others rarely works.	F
CB4	~~The police should have the right to listen to private phone calls when investigating crime.~~	H
CB5	If people in this country were treated more equally we would have fewer problems.	E
CB6	I have often been treated unfairly.	F
CB7	It is just as well that life tends to sort out those who try harder from those who don't.	I
CB8	~~I don't worry about politics because I can't influence things very much~~.	F
CB9	In a fair system people with more ability should earn more.	I
CB10	If a person has the get-up-and-go to acquire wealth, that person should have the right to enjoy it.	I
CB11	~~We should have stronger armed forces than we do now.~~	H
CB12	Racial discrimination is a very serious problem in our society.	E
CB13	~~Those in power often withhold information about things which are harmful to us. (score reversed)~~	H
CB14	The future is too uncertain for a person to make serious plans.	F
CB15	I would support the introduction of compulsory National Service.	H
CB16	A person is better off if he or she doesn't trust anyone.	F
CB17	~~It is important to preserve our customs and heritage.~~	H
CB18	I would support a tax change that made people with large incomes pay more.	E
CB19	I think there should be more discipline in the youth of today.	H
CB20	There is no use doing things for people – you only get it in the neck in the long run.	F
CB21	Making money is the main reason for hard work.	I
CB22	The government should make sure everyone has a good standard of living.	E
CB23	~~One of the problems with people is that they challenge authority too often.~~	H
CB24	~~It seems to me that, whoever you vote for, things pretty much go on the same.~~	F
CB25	I feel like life is like a lottery.	F
CB26	~~This country would be better off if we didn't worry so much about how equal people~~	I
CB27	~~are.~~	I
CB28	A free society can only exist by giving companies the opportunity to prosper.	E
CB29	The world could be a more peaceful place if its wealth were divided more equally amongst its nations.	H
CB30	I am more strict than most people about what is right and wrong.	E
CB31	What this country needs is a 'fairness revolution' to make the distribution of goods more equal.	F
CB32	Most people only make friends because friends are useful to them.	E
CB33	~~Social Security tends to stop people from trying harder to get on. (score reversed)~~	F
BS1	~~Even if you work hard you never know if that will help you do better.~~	H

BS2	I think it is important to carry on family traditions.	H
BS3	~~In my household, family members always sit at the same place at the dinner table.~~	H
BS4	~~I always sort out clothes into separate categories before washing.~~	H
BS5	I value regular routines highly.	H
BS6	I think being on time is important.	H
BS7	~~My time-tabling of meals is haphazard. (score reversed)~~	I
BS8	~~I don't join clubs of any kind.~~	I
BS9	~~I tend to be sceptical of health food fads.~~	E
BS10	Most of the meals I eat are vegetarian.	E
BS11	Health requirements are very important in my choice of foods.	E
BS12	I prefer simple and unprocessed foods.	H
BS13	~~I like to plan carefully so that financial risks are not taken.~~	F
	~~I have few financial investments.~~	

Notes:

Items which are struck-through were included in the questionnaire, but, following cluster analysis, were not used for analysis of the results. The 'UEA set' was composed of ten egalitarian items, five individualism items, six hierarchy items and seven fatalism items (28 items in total). Some of these were designed by Dake as 'cultural bias' items while others were 'behavioural strategy' items, but no distinction was made between these in the analysis (see Section 6.1).

Table 6.4: Identifying cultural biases at the level of individuals

Cultural bias	A	B	C
Pure egalitarians	15	22	27
Pure individualists	3	9	13
Pure hierarchists	1	5	11
Pure fatalists	3	5	8
Subtotal of respondents with a single 'pure' cultural bias	***22***	***41***	***59***
Mixed cultural biases	60	80	42
No cultural biases	47	8	28

Notes:

This table shows the number of respondents from Sample A (N=129) which fell into particular cultural bias categories when using criteria A, B or C. These results relate only to Sample A. See Table 12.4 for equivalent results from Sample B.

The cultural bias scores were all centred around the mean for the whole of Sample A and the criteria were defined as follows:

Criteria A: In order to be classified as being of cultural bias X, the respondent has to have:
score for X $\geq$ 0.5 and the other three scores < 0.0

Criteria B: In order to be classified as being of cultural bias X, the respondent had to have:
score for X > 0.0 and the other three scores $\leq$ 0.0

Criteria C: In order to be classified as being of cultural bias X, the respondent had to have:
score for X > 0.0 and the other three scores $\leq$ 0.0 (i.e. the same as Criteria B)
OR
score for X $\geq$ 0.5 and the other three scores < 0.5

Table 6.5: Correlations between cultural biases and risk perceptions, for each of the five definitions of 'risk'

Table 6.5.1: Correlations between cultural biases and Riskiness

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	**-0.15***	0.06	**0.23****	0.04
Food colourings	**-0.20***	0.01	**0.34*****	0.12
Genetic engineering	**-0.19***	0.01	0.11	-0.14
Nuclear power	**-0.20***	-0.13	0.16*	0.02
Mugging	**0.15***	0.09	-0.03	**0.26****
Home accidents	0.06	0.01	0.00	-0.05
Ozone depletion	**-0.25****	0.05	**0.21****	0.01
Car driving	-0.14	-0.13	0.02	-0.13
Microwave ovens	0.07	**0.15***	**0.15***	**0.18***
AIDS	0.05	0.12	-0.08	**0.15***
War	**-0.18***	-0.12	0.11	0.00
Terrorism	-0.09	-0.05	**0.16***	0.13
Alcoholic drinks	-0.03	0.08	0.09	-0.06

Table 6.5.2: Correlations between cultural biases and Fatalities

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	**-0.17***	-0.03	0.10	0.02
Food colourings	0.04	**0.17***	0.08	0.13
Genetic engineering	0.07	**0.16***	0.13	**0.16***
Nuclear power	**-0.23****	-0.05	**0.17***	0.09
Mugging	0.05	0.06	0.02	0.14
Home accidents	-0.03	-0.10	0.12	-0.13
Ozone depletion	**-0.18***	-0.11	-0.01	-0.01
Car driving	**-0.25****	**-0.18***	0.11	-0.05
Microwave ovens	0.01	0.01	0.05	0.01
AIDS	-0.05	0.09	0.02	-0.04
War	-0.11	0.01	0.10	-0.04
Terrorism	-0.07	0.14	0.11	0.08
Alcoholic drinks	**-0.28*****	**-0.20***	**0.15***	-0.12

Table 6.5.3: Correlations between cultural biases and Injuries

	Individualism	Hierarchy	Egalitarianism	Fatalism

Sunbathing	-0.09	0.04	0.05	0.02
Food colourings	**-0.15***	-0.05	0.12	0.05
Genetic engineering	-0.07	0.05	0.07	**0.17***
Nuclear power	**-0.31*****	-0.14	**0.26****	0.06
Mugging	0.05	**0.17***	0.01	0.11
Home accidents	-0.12	-0.10	0.14	**-0.16***
Ozone depletion	**-0.15***	0.01	0.04	0.04
Car driving	**-0.17***	-0.11	0.14	-0.07
Microwave ovens	0.08	0.11	-0.02	0.04
AIDS	-0.04	0.10	0.06	-0.06
War	-0.14	-0.02	0.05	-0.03
Terrorism	0.01	**0.19***	0.04	0.10
Alcoholic drinks	**-0.20****	-0.10	**0.19***	**-0.25****

Table 6.5.4: Correlations between cultural biases and Environmental Harm

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	0.01	0.13	-0.06	0.14
Food colourings	**-0.16***	**-0.16***	0.00	0.03
Genetic engineering	**-0.21****	-0.09	0.06	0.03
Nuclear power	**-0.31*****	**-0.20***	**0.23****	-0.02
Mugging	0.11	**0.28*****	0.04	**0.18***
Home accidents	-0.00	**0.16***	0.13	0.14
Ozone depletion	**-0.32*****	**-0.31*****	**0.18***	-0.04
Car driving	**-0.32*****	-0.18*	**0.33*****	-0.01
Microwave ovens	-0.05	0.02	0.09	0.13
AIDS	-0.01	**0.15***	0.04	**0.21****
War	**-0.16***	-0.09	0.14	0.03
Terrorism	-0.04	**0.21****	**0.18***	0.14
Alcoholic drinks	-0.03	0.10	0.14	**0.19***

Table 6.5.5: Correlations between cultural biases and Unacceptability

	Individualism	Hierarchy	Egalitarianism	Fatalism

Sunbathing	-0.12	0.03	**0.24****	0.09
Food colourings	-0.12	-0.09	**0.23****	-0.02
Genetic engineering	**-0.19***	-0.10	**0.21****	-0.01
Nuclear power	**-0.29*****	**-0.20***	**0.31*****	0.04
Mugging	0.13	0.07	0.11	0.04
Home accidents	0.06	0.04	**0.20***	-0.05
Ozone depletion	**-0.23****	**-0.19***	**0.17***	-0.09
Car driving	**-0.16***	-0.07	0.07	-0.11
Microwave ovens	-0.06	-0.04	**0.26****	0.01
AIDS	0.08	0.03	**0.16***	0.00
War	-0.08	-0.11	0.13	-0.13
Terrorism	0.02	0.03	0.07	-0.10
Alcoholic drinks	-0.11	0.10	**0.24****	-0.08

Notes:

Tables 6.5.1 to 6.5.5 list correlations between:

1. the risk perception scores (with risk defined, respectively, as Riskiness, Fatalities, Injuries, Environmental Harm and Unacceptability) given to each risk issue by each of the respondents in Sample A; and
2. the cultural bias scores obtained by those same respondents.

For example, the first cell of Table 6.5.1 shows the correlation between the scores given by each respondent to the Riskiness of sunbathing and the individualism score of those same respondents. In this particular case, the correlation (-0.15) was significant ($p < 0.05$), and negative, indicating that respondents who had a high score for individualism tend to give a low rating for the Riskiness of sunbathing.

Table 6.6: Relationship between cultural biases and risk perceptions, summarised across all five definitions of 'risk'

	Individualism	Hierarchy	Egalitarianism	Fatalism

Sunbathing	□		★★	
Food colourings	□	□and★	★★★	
Genetic engineering	□□	★	★★	★
Nuclear power	□□□	□	★★★	
Mugging	★	★★★		★★
Home accidents	□□□	★	★	□
Ozone depletion	□□□	□□□	★★	
Car driving		□	★★	
Microwave ovens		★	★★	★
AIDS		★	★	★★
War	□	★★		
Terrorism		□	★	
Alcoholic drinks	□□	□	★★	□□and★

Notes:

This table indicates the highest correlation obtained from Sample A between cultural biases and risk perceptions *using any one of the definitions* of 'risk' (Riskiness, Fatalities, Injuries, Environmental Harm or Unacceptability); i.e. it shows the strongest correlation listed in Tables 6.6.1 to 6.6.5. This Table should be compared to Table 1.1, which listed the relationships between cultural biases and risk perceptions predicted before the data was collected.

Asterisks indicate a positive relationship between the risk issue and risk perception. For example, there was a statistically significant correlation between high levels of concern about genetic engineering and an egalitarian worldview. Squares indicate a negative relationship between the risk issue and risk perception. For example, there was a statistically significant correlation between low levels of concern about genetic engineering and an individualist worldview. The number of symbols indicates the level of significance of the correlation: one symbol means $p < 0.05$; two symbols means $p < 0.01$; and three symbols means $p < 0.001$.

Table 6.7: Correlations between cultural biases and trust in institutions

	Individualism	Hierarchy	Egalitarianism	Fatalism
Government	**0.26****	**0.22****	-0.08	**-0.19***

Companies	**0.27****	**0.39*****	**-0.15***	0.03
Environmental orgs.	-0.05	-0.05	0.05	**-0.15***
Media	-0.12	0.01	**0.19***	0.13
Scientists	0.07	**0.15***	0.11	-0.06
Trade Unions	**-0.30*****	**-0.28*****	**0.29*****	-0.04
Religious orgs.	-0.02	**0.22****	**0.21****	-0.10
Friends	-0.03	0.13	0.08	**0.15***
Family	0.13	**0.20****	0.12	**0.19***
Doctors	0.11	**0.23****	0.02	**0.26****

Notes:

This table lists correlations between the cultural bias scores obtained by each of the respondents in Sample A 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 the respondents were given 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.

Table 6.8: Correlations between cultural biases and environmentalism (and myths of Nature)

	Statement	Individualism	Hierarchy	Egalitarianism	Fatalism
ENV1	The environment is very adaptable and will recover from any harm caused by people. [*Nature benign*]	**0.23****	0.11	**-0.17***	0.07
ENV2	With expert management, we can prevent environmental disasters. [*Nature perverse/tolerant*]	**0.28*****	**0.16***	0.05	-0.07
ENV3	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****
ENV4	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***
ENV5	Large businesses have too much influence on ordinary people.	-0.13	-0.08	**0.43*****	0.14
ENV6	Big corporations are responsible for most of the evil in the world.	-0.04	0.03	**0.33*****	**0.45*****
ENV7	Industry left to itself will harm the environment.	-0.11	**-0.22****	**0.29*****	0.11
ENV8	The misuse of technology is a serious problem in the world today.	**-0.26****	-0.06	**0.37*****	0.12
ENV9	Decisions in business and government should rely more heavily on participation by members of the public.	**-0.23****	-0.03	**0.45*****	**0.19***
ENV10	There are too many laws controlling technology.	0.20*	**0.32*****	0.00	**0.24****
ENV11	Concern about the environment restricts industry too much.	**0.41*****	**0.46*****	**-0.26****	**0.22****

Table 6.9: Relationship between cultural biases and group membership

	No. of members	Individualism	Hierarchy	Egalitarianism	Fatalism
Conservation orgs.	40	□			□□□
Environmental orgs.	24	□□□	□□□	✯	□□□
Trade unions	36			✯✯✯	
Sports clubs	46	✯		□	
Religious orgs.	21				
Political parties	16				

Notes:

The first column in this table lists the number of respondents in Sample A (N=131) who stated that they were members of each specific type of group. Columns 3 to 6 indicate the relationship between each cultural bias and membership of groups, as revealed by analysis of variance. Asterisks indicate that the cultural bias was associated *with* membership of the specific type of group; and squares indicate that the cultural bias was associated with *non*-membership of that type of group. The number of symbols indicates the level of significance of the correlation: one symbol means $p < 0.05$; two symbols means $p < 0.01$; and three symbols means $p < 0.001$.

Table 7.1: Correlations between cultural biases and scores given to the nine risk characteristics, *aggregated for all thirteen risk issues*

	Individualism	Hierarchy	Egalitarianism	Fatalism
Delayed effects	-0.02	0.02	0.10	-0.01
Involuntariness	-0.08	-0.11	**0.15***	0.06
Unfairness	-0.11	-0.07	-0.04	0.02
Harm to future generations	-0.12	0.00	**0.25****	**0.17***
Catastrophic potential	-0.04	0.02	**0.24****	**0.17***
Dread	-0.01	-0.02	0.13	**0.24****
Severity	0.01	0.01	**0.25****	0.08
Lack of knowledge to exposed	-0.13	-0.11	-0.01	0.08
Lack of knowledge to science	-0.09	-0.07	-0.01	**0.16***

Notes:

This table lists correlations between:

1. the scores obtained by each respondent for each of the four cultural biases in turn; and
2. the mean ratings (for the thirteen risk-issues) given by those same respondents to each of the psychometric risk characteristics in turn.

For example, the first cell shows the correlation between the individualism scores obtained by each of the 131 respondents and the mean of the thirteen separate scores those same respondents gave to ‘delayed effects’ for each of the thirteen risk issues. In this particular case, the correlation in very low (0.02) and is not significant at the 95% significance level. The highest correlation in the table is between egalitarianism and ‘harm to future generations’ (0.25), and this is significant at the 97.5% level. This indicates that respondents who had high egalitarian scores tended to feel that all thirteen risk issues caused harm to future generations.

Table 7.2: Correlations between cultural biases and scores given to the nine risk characteristics *for each risk issue*

Table 7.2.1: Harm to future generations

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	-0.11	0.08	**0.15***	**0.15***
Food colourings	**-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*****
Home accidents	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

Table 7.2.2: Delayed effects

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	-0.06	-0.10	-0.03	-0.11
Food colourings	-0.12	**-0.19***	0.06	-0.08
Genetic engineering	-0.13	**-0.21****	0.05	**-0.22****
Nuclear power	**-0.22****	**-0.18***	**0.21****	-0.04
Mugging	0.13	**0.17***	-0.03	0.14
Home accidents	**0.16***	**0.24****	0.08	**0.18***
Ozone depletion	-0.07	**-0.16***	-0.02	**-0.23****
Car driving	-0.06	0.04	**0.20***	0.08
Microwave ovens	-0.06	-0.12	**0.19***	-0.02
AIDS	0.14	0.12	-0.04	0.05
War	0.01	**0.17***	-0.02	0.08
Terrorism	0.05	**0.22****	0.00	0.10
Alcoholic drinks	-0.03	-0.09	0.03	-0.12

Table 7.2.3: Catastrophic potential

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	-0.08	**-0.17***	0.02	0.11
Food colourings	-0.07	-0.13	0.04	-0.01
Genetic engineering	-0.11	-0.10	**0.24****	0.06
Nuclear power	-0.03	-0.04	**0.27****	-0.03
Mugging	0.13	**0.22****	0.06	**0.34*****
Home accidents	-0.02	0.01	0.08	**0.16***
Ozone depletion	-0.13	**-0.17***	**0.16***	0.05
Car driving	-0.02	0.14	**0.17***	0.11
Microwave ovens	0.00	0.12	0.02	0.03
AIDS	-0.04	0.03	0.07	0.09
War	-0.02	0.05	**0.18***	-0.08
Terrorism	**0.21****	**0.27****	0.03	0.05
Alcoholic drinks	0.02	0.05	0.04	-0.01

Table 7.2.4: Dread

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	0.01	0.08	0.06	**0.21****
Food colourings	-0.09	**-0.16***	0.09	**0.18***
Genetic engineering	-0.08	-0.07	0.14	-0.02
Nuclear power	-0.03	-0.02	**0.30*****	**0.28*****
Mugging	0.13	0.14	0.00	**0.32*****
Home accidents	0.04	-0.01	-0.04	0.09
Ozone depletion	**-0.26****	**-0.17***	**0.22****	0.07
Car driving	-0.06	-0.10	0.01	0.10
Microwave ovens	0.03	0.00	0.10	0.06
AIDS	0.09	0.04	0.02	**0.21****
War	-0.03	-0.04	0.09	**0.15***
Terrorism	0.09	-0.02	0.00	0.14
Alcoholic drinks	-0.08	-0.05	0.09	-0.06

Table 7.2.5: Severity

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	-0.09	-0.02	**0.25****	0.10
Food colourings	-0.08	-0.07	0.13	**0.18***
Genetic engineering	0.07	0.07	**0.17***	0.10
Nuclear power	-0.10	-0.07	**0.17***	0.11
Mugging	0.14	-0.04	0.08	0.07
Home accidents	0.13	0.02	0.07	-0.13
Ozone depletion	-0.14	**-0.18***	0.11	0.02
Car driving	-0.00	-0.02	0.13	0.06
Microwave ovens	-0.07	-0.03	0.14	0.01
AIDS	0.08	0.02	**0.21****	0.04
War	0.11	**0.15***	0.10	**0.19***
Terrorism	0.13	**0.20***	**0.19***	0.09
Alcoholic drinks	-0.13	-0.05	0.05	**-0.16***

Table 7.2.6: Involuntariness

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	-0.06	-0.10	0.00	**0.15***
Food colourings	-0.12	**-0.24****	-0.01	**-0.22****
Genetic engineering	-0.08	**-0.17***	0.11	-0.02
Nuclear power	-0.06	-0.13	**0.29*****	-0.09
Mugging	0.01	0.02	**0.15***	-0.01
Home accidents	0.13	0.10	0.07	**0.20***
Ozone depletion	-0.11	-0.11	0.09	-0.08
Car driving	-0.06	-0.04	0.03	**0.19***
Microwave ovens	-0.12	-0.04	-0.03	0.07
AIDS	0.10	0.02	0.03	0.11
War	0.03	0.09	0.10	-0.07
Terrorism	0.05	0.06	0.08	-0.09
Alcoholic drinks	0.06	0.00	**-0.16***	-0.08

Table 7.2.7: Unfairness

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	**0.16***	**0.23****	**-0.29*****	**0.16***
Food colourings	-0.12	0.01	-0.03	-0.05
Genetic engineering	-0.04	-0.05	-0.01	0.03
Nuclear power	-0.12	-0.12	-0.01	-0.04
Mugging	-0.08	**-0.30*****	-0.04	**-0.18***
Home accidents	0.01	0.00	-0.09	0.10
Ozone depletion	-0.03	-0.04	-0.01	0.04
Car driving	-0.00	0.03	0.08	0.06
Microwave ovens	-0.05	0.06	-0.03	0.02
AIDS	**-0.15***	-0.09	0.06	-0.03
War	-0.13	**-0.30*****	0.07	-0.08
Terrorism	-0.07	-0.13	0.04	-0.08
Alcoholic drinks	0.07	0.06	-0.11	0.07

Table 7.2.8: Lack of knowledge to science

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	0.12	0.01	-0.08	**0.16***
Food colourings	-0.02	0.02	-0.04	0.06
Genetic engineering	**-0.19***	**-0.24****	0.04	-0.02
Nuclear power	-0.13	**-0.15***	0.12	0.00
Mugging	-0.00	-0.04	-0.03	**0.21****
Home accidents	0.12	0.08	-0.04	**0.27*****
Ozone depletion	-0.04	-0.05	-0.04	-0.00
Car driving	-0.02	0.00	-0.11	**0.26****
Microwave ovens	-0.04	-0.02	0.00	0.04
AIDS	**-0.15***	-0.03	0.04	-0.09
War	-0.12	-0.01	-0.02	0.08
Terrorism	-0.12	-0.04	0.01	0.10
Alcoholic drinks	0.02	-0.01	-0.04	-0.08

Table 7.2.9: Lack of knowledge to those exposed

	Individualism	Hierarchy	Egalitarianism	Fatalism
Sunbathing	-0.10	**-0.19***	-0.02	-0.09
Food colourings	-0.02	-0.04	-0.01	-0.03
Genetic engineering	-0.07	-0.12	-0.06	0.09
Nuclear power	**-0.18***	-0.07	0.06	-0.05
Mugging	-0.11	-0.07	0.05	0.12
Home accidents	-0.13	-0.14	-0.06	-0.02
Ozone depletion	0.05	0.14	**-0.15***	0.03
Car driving	-0.14	**-0.16***	0.00	0.12
Microwave ovens	-0.09	**-0.18***	-0.06	-0.01
AIDS	0.01	-0.06	0.08	-0.01
War	0.01	0.11	-0.03	**0.21****
Terrorism	-0.04	0.09	0.08	**0.16***
Alcoholic drinks	0.02	-0.11	0.01	-0.01

Notes:

Tables 7.2.1 to 7.2.9 list correlations between:

1. the scores given by each of the respondents for each risk issue on each risk characteristic; and
2. the cultural bias scores obtained by those same respondents.

For example, the first row of Table 7.2.1 lists the correlation between the 131 scores given by each of the respondents to the harm to future generations caused by sunbathing with the cultural bias scores of those same respondents. In this particular case, the correlation is low for individualism and hierarchy, but higher (and significant at the 95% confidence level) for egalitarianism and fatalism. This indicates that the egalitarian and fatalist worldviews were associated with feeling that future generations will be harmed by sunbathing.

Table 7.3: Correlations between cultural biases and the perceived importance of the nine risk characteristics

	Individualism	Hierarchy	Egalitarianism	Fatalism
Involuntariness	**0.16***	**0.19***	0.06	0.06
Delayed effects	0.01	-0.05	0.05	**0.19***
Severity	-0.06	-0.05	0.11	-0.04
Dread	0.10	**0.16***	0.11	**0.34*****
Catastrophic potential	-0.05	-0.00	0.11	0.00
Harm to future generations	-0.10	**0.15***	0.20**	-0.11
Lack of knowledge to exposed	0.08	0.11	-0.05	0.00
Lack of knowledge to science	0.07	**0.15***	0.04	0.01
Unfairness	-0.03	**0.20***	0.13	0.05

Notes:

This table lists correlations between the cultural bias scores obtained by each of the respondents and their answer to the question ”when you think about risks in general, do you think [risk characteristic X] is important?”. For example, the highest correlation obtained was between fatalism and dread (0.34), and this was significant at the 99% level, indicating that respondents who had a high score for fatalism tended to feel that dread was an important factor when making decisions about risk.

Table 8.1: Correlations between ‘general risk perceptions’ and age, and income

Definition of 'risk'	Age	Income
Riskiness	-0.03	**-0.18***
Fatalities	**-0.24****	**-0.19***
Injuries	**-0.32*****	-0.10
Environmental Harm	**-0.17***	**-0.23****
Unacceptability	0.12	**-0.17***

Notes:

This table lists correlations between:

1. the mean scores (for the thirteen risk-issues) given by each of the respondents for the risk associated with the thirteen issues (with 'risk' defined in five different ways as Riskiness, Fatalities, Injuries, Environmental Harm and Unacceptability); and
2. the age and household income of those same respondents.

Table 8.2: Percentage variance in individual risk perceptions explained by socio-demographic variables

Risk issues	Riskiness	Fatalities	Injuries	Environmental Harm	Unacceptability
Sunbathing	5	3	**8***	**7***	3
Food colourings	4	**11****	3	**8***	0
Genetic engineering	0	**12****	**12****	0	1
Nuclear power	4	**10****	**15****	**12****	**6***
Mugging	**16*****	**21*****	**28*****	**16*****	**12****
Home accidents	**7***	9	**9***	**8***	**19*****
Ozone depletion	3	0	0	**11****	3
Car driving	3	**11****	**10****	**10****	0
Microwave ovens	**12****	0	1	1	0
AIDS	5	**10****	**11****	4	**13****
War	0	5	6	**6***	5
Terrorism	**6***	**13****	**18*****	**16*****	5
Alcoholic drinks	**8***	**20*****	**20*****	**11****	**9****

Notes:

This table lists the adjusted multiple R^2 values obtained from regression analysis of risk perceptions for each of the thirteen risk issues. The independent variables were: sex (categorical); age (continuous); class (categorical: classes 1 and 2 versus 3, 4, 5 and 6); level of education (categorical: university degree versus no university degree); and household income (continuous).

Table 9.1: Correlations between risk characteristics and age, and income

	Age	Income
Involuntariness	-0.06	0.04
Delayed effects	-0.05	**-0.15***
Severity	**-0.17***	0.00
Dread	-0.04	**-0.26****
Catastrophic potential	**-0.19***	-0.03
Harm to future generations	-0.09	**-0.17***
Lack of knowledge to exposed	-0.14	0.09
Lack of knowledge to science	0.00	-0.11
Unfairness	-0.03	**0.18***

Notes:

This table lists correlations between:

1. the mean scores (for the thirteen risk issues) given by each of the respondents to the nine risk characteristics; and
2. the age and household income of those same respondents.

Table 10.1: Correlations between cultural biases and age, and income

Cultural bias	Age	Income
Individualism	**0.23****	-0.09
Hierarchy	**0.37*****	**-0.19***
Egalitarianism	0.08	-0.06
Fatalism	0.13	**-0.36*****

Notes:

This table lists correlations between:

1. the cultural bias scores obtained by each respondent; and
2. the age and household income of those same respondents.

Table 10.2: Percentage of variance in cultural biases explained by socio-demographic variables

Cultural biases	R^2 adjusted
Individualism	**16*****
Hierarchy	**16*****
Egalitarianism	**7***
Fatalism	**23*****

Notes:

This table lists the adjusted multiple R^2 values and p-values obtained from regression analyses for each set of cultural bias scores. The independent variables were: sex (categorical); age (continuous); class (categorical: classes 1 and 2 versus 3, 4, 5 and 6); education (categorical: university degree versus no university degree); and household income (continuous).

Table 11.1: Percentage of variance in individual risk perceptions explained by the 'psychometric paradigm' and by cultural theory

Risk issues	Psychometric paradigm	Cultural theory	Socio-demographic variables
Food colourings	**41*** **	**12** **	4
Nuclear power	**34*** **	2	4
Genetic engineering	**32*** **	3	0
Mugging	**31*** **	**5***	**16*** **
Microwave ovens	**27*** **	**5***	**12** **
Car driving	**26*** **	0	3
Sunbathing	**25*** **	**5***	5
Terrorism	**22*** **	2	**6***
Ozone depletion	**21*** **	**9** **	3
Home accidents	**17*** **	0	**7***
AIDS	**15** **	1	5
Alcoholic drinks	**14** **	0	**8***
War	6	1	0

Notes:

This table lists the adjusted multiple R^2 values obtained from regression analyses of scores for risk perception (defined as Riskiness) using:

Column 2: 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). (This is the same data as that presented in Table 5.6).

Column 3: all four cultural biases together (individualism, hierarchy, egalitarianism and fatalism).

Column 4: all socio-demographic variables together (sex, age, class, education and income). (This is the same data as that presented in Table 8.2).

Table 12.1: Mean cultural bias scores for the Greenhouse, Scouts, and Chamber of Commerce sub-samples of Sample B

Cultural bias	Sample A	Greenhouse	Scouts	Chamber of Commerce
Egalitarianism	3.70	**4.54*** **	3.47	3.54
Individualism	3.37	**1.96*** **	3.49	3.29
Hierarchy	3.79	**2.89*** **	**4.19***	3.54
Fatalism	2.28	2.14	2.50	2.26

Notes:

Asterisks indicate statistically significant differences with the mean cultural bias scores for Sample A, as determined by Tukey's pairwise comparisons (* = $p < 0.05$, ** = $p < 0.01$, and *** = $p < 0.001$). For example, the mean egalitarian, individualist and hierarchy scores for the Greenhouse were all significantly different from those in Sample A, with $p < 0.001$ in all three cases.

Table 12.2: Statistical significance of differences between mean cultural bias scores for the Greenhouse, Scouts and Chamber of Commerce sub-samples of Sample B

Cultural bias	Greenhouse vs Scouts	Greenhouse vs Chamber of Commerce	Scouts vs Chamber of Commerce
Egalitarianism	★ ★ ★	★ ★ ★	-
Individualism	★ ★ ★	★ ★	★ ★
Hierarchy	★ ★ ★	★ ★ ★	-
Fatalism	-	-	-

Notes:

Asterisks indicate statistically significant differences between mean cultural bias scores for each pair of sub-samples of Sample B, as determined by Tukey's pairwise comparisons (* = $p < 0.05$, ** = $p < 0.01$, and *** = $p < 0.001$).

Table 12.3: Percentage of respondents from each sub-sample of Sample B who fell into particular cultural bias categories

Cultural bias	Sample A (N = 129)	Greenhouse (N = 28)	Scouts (N = 23)	Chamber of Commerce (N = 19)
Pure egalitarians	21	85	4	16
Pure individualists	10	0	9	5
Pure hierarchists	9	0	22	5
Pure fatalists	6	0	9	21
Subtotal of respondents with a single 'pure' cultural bias	***46***	***85***	***43***	***47***
Mixed cultural biases	33	11	57	47
No cultural bias	22	4	0	5
Total	**101**	**100**	**101**	**99**

Notes:

Respondents were allocated into cultural bias categories according to Criteria C, as described in Section 6.1.

Table 12.4: Mean risk perception scores for each risk issue from Sample B

Table 12.4.1: Mean risk perception scores for each risk issue from the Greenhouse sub-sample

Risk issues	Riskiness	Fatalities	Injuries	Environmental Harm	Unacceptability
Nuclear power	4.7	2.7	3.4	4.0	4.8
War	4.5	4.6	4.7	4.5	4.9
Car driving	4.4	4.2	4.4	4.4	4.5
Ozone depletion	4.3	2.4	3.1	3.5	4.7
Genetic engineering	4.2	1.4	1.9	4.0	4.1
AIDS	3.6	3.4	3.6	1.8	4.1
Sunbathing	3.4	2.3	3.1	2.0	3.4
Alcoholic drinks	3.3	3.4	3.9	2.1	3.3
Terrorism	3.3	2.5	2.8	2.2	4.3
Food colourings	2.9	1.4	2.0	1.9	3.4
Mugging	2.8	2.3	2.9	1.3	3.8
Home accidents	2.7	2.9	3.5	2.0	2.7
Microwave ovens	2.0	1.3	1.4	1.5	2.2

Table 12.4.2: Mean risk perception scores for each risk issue from the Scouts sub-sample

Risk issues	Riskiness	Fatalities	Injuries	Environmental Harm	Unacceptability
Sunbathing	4.0	2.3	3.1	1.9	2.9
Nuclear power	4.0	2.7	2.9	3.4	3.6
Ozone depletion	4.0	2.3	2.6	3.2	4.0
Mugging	3.8	3.0	3.5	1.7	3.8
Genetic engineering	3.7	2.1	2.3	2.8	3.0
AIDS	3.7	3.0	3.2	1.9	4.0
Home accidents	3.5	3.4	3.8	1.9	3.3
Car driving	3.5	4.2	4.2	3.1	3.4
War	3.5	3.6	3.7	3.5	4.5
Alcoholic drinks	3.4	3.3	3.6	2.6	3.6
Terrorism	3.3	3.0	3.2	2.8	4.4
Food colourings	3.0	1.5	2.1	1.7	2.5
Microwave ovens	2.6	1.5	1.7	1.6	2.2

Table 12.4.3: Mean risk perception scores for each risk issue from the Chamber of Commerce sub-sample

Risk issues	Riskiness	Fatalities	Injuries	Environmental Harm	Unacceptability
Nuclear power	4.2	2.4	2.7	3.6	4.1
Genetic engineering	4.2	1.6	1.8	3.0	3.8
Ozone depletion	4.0	1.7	2.2	3.5	4.2
Sunbathing	3.8	1.9	2.8	1.9	3.1
Car driving	3.8	3.6	3.7	3.7	3.6
War	3.4	3.9	3.9	3.7	4.3
AIDS	3.3	2.8	3.1	2.0	3.4
Mugging	3.3	2.7	3.2	1.7	3.5
Home accidents	3.2	3.0	3.3	1.5	2.7
Terrorism	3.1	2.4	2.6	2.4	3.8
Food colourings	2.8	1.2	2.0	1.7	3.0
Alcoholic drinks	2.8	3.0	3.3	2.1	2.9
Microwave ovens	2.1	1.2	1.4	1.4	1.8

Table 12.5: Statistical significance of differences in Unacceptability ratings between the Greenhouse, Scouts and Chamber of Commerce sub-sample of Sample B

	Greenhouse vs Scouts	Greenhouse vs Chamber of Commerce	Scouts vs Chamber of Commerce
Sunbathing			
Food colourings	☆		
Genetic engineering	☆ ☆		☆
Nuclear power	☆ ☆ ☆	☆	
Mugging			
Home accidents			
Ozone depletion	☆ ☆ ☆	☆	
Car driving	☆ ☆ ☆	☆☆	
Microwave ovens			
AIDS			
War		☆	
Terrorism			
Alcoholic drinks			

Notes:

Statistically significant differences were determined by Tukey's pairwise comparisons. The number of asterisks indicate the level of significance of the differences.

Table 12.6: Statistical significance on differences in risk perception between Greenhouse, Scouts and Chamber of Commerce sub-samples of Sample B, summarised across all five definitions of risk

	Greenhouse vs Scouts	Greenhouse vs Chamber of Commerce	Scouts vs Chamber of Commerce
Sunbathing	✯		
Food colourings	✯		
Genetic engineering	✯ ✯	✯	✯
Nuclear power	✯ ✯ ✯	✯	
Mugging	✯		
Home accidents	✯		
Ozone depletion	✯ ✯ ✯	✯	
Car driving	✯ ✯ ✯	✯	
Microwave ovens			
AIDS			
War	✯ ✯ ✯	✯ ✯	
Terrorism			
Alcoholic drinks			

Notes:

Asterisks indicate statistically significant differences in risk perception scores obtained for each pair of sub-samples of Sample B, as determined by Tukey's pairwise comparisons (* = $p < 0.05$, ** = $p < 0.01$, and *** = $p < 0.001$). The strongest difference revealed when *any one of the five definitions of risk* was used is shown here (i.e. *either* Riskiness, Fatalities, Injuries, Environmental Harm *or* Unacceptability).

For sunbathing, genetic engineering, nuclear power, ozone depletion, car driving and war, the risk ratings were higher for the Greenhouse than for the Scots. For food colourings, mugging and home accidents, the risk ratings were higher for the Scouts than for the Greenhouse. In all cases where statistical significance was observed, the risk ratings for the Greenhouse were higher than those for the Chamber of Commerce. For genetic engineering, the Chamber of Commerce risk ratings were higher than those for the Scouts.

Table 12.7: Trust in institutions for each of the sub-samples of Sample B

	Sample A	Sample B	Greenhouse	Scouts	Chamber of Commerce
The Government	8	3	0	4	5
Companies	13	4	0*	9	5
The Media	16	13	7	26	5
Religious orgs.	22	22	7	39	21
Trade unions	28	26	37	22	16
Scientists	60	33	11***	57	37
Doctor	76	70	52*	91	68
Environmental orgs.	79	72	81	65	68
Friends	80	75	78	74	74
Family	87	84	74	96	84

Notes:

This table lists the percentages of respondents who said they would “often” or “always” trust each institution to “tell them the truth about risks”. Asterisks indicate significant differences between Sample B and Sample A, as determined by Tukey’s pairwise comparisons (e.g. respondents from the Greenhouse sub-sample showed significantly less trust in scientists than those from Sample A).

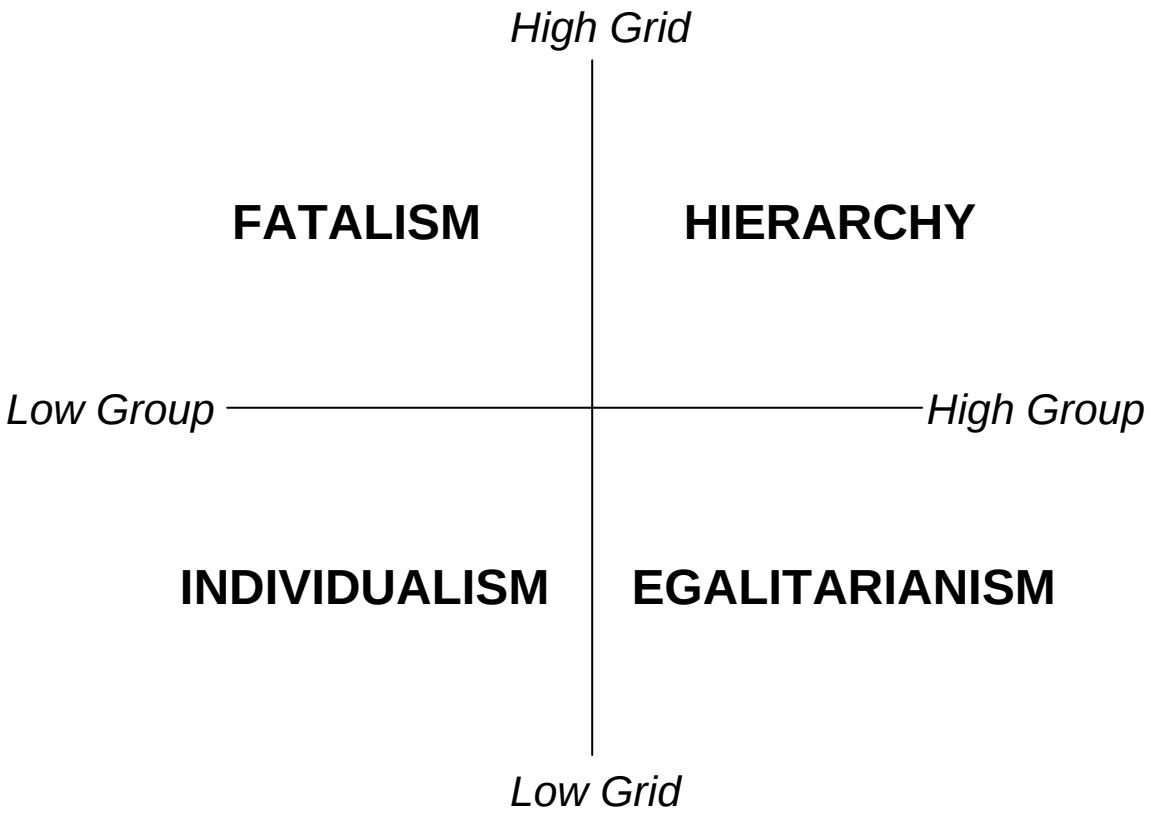
Table 12.8: Statistical significance of differences in trust ratings between the Greenhouse, Scouts and Chamber of Commerce sub-samples of Sample B

	Greenhouse vs Scouts	Greenhouse vs Chamber of Commerce	Scouts vs Chamber of Commerce
The Government			
Companies	✯ ✯ ✯		
The Media			
Religious orgs.	✯		
Trade unions		✯	
Scientists	✯ ✯		
Doctor	✯ ✯ ✯		
Environmental orgs.			
Friends			
Family	✯ ✯		✯

Notes:

Statistically significant differences were determined by Tukey's pairwise comparisons. In all cases where statistically significant differences were found, the Scouts sub-sample had higher levels of trust than the Greenhouse sub-sample.

Figure 1.1: Grid-group taxonomy of cultural theory[17]



[17] Adapted from Thompson *et al*. (1990).

Figure 5.1: Factor space for Factors 1 and 2

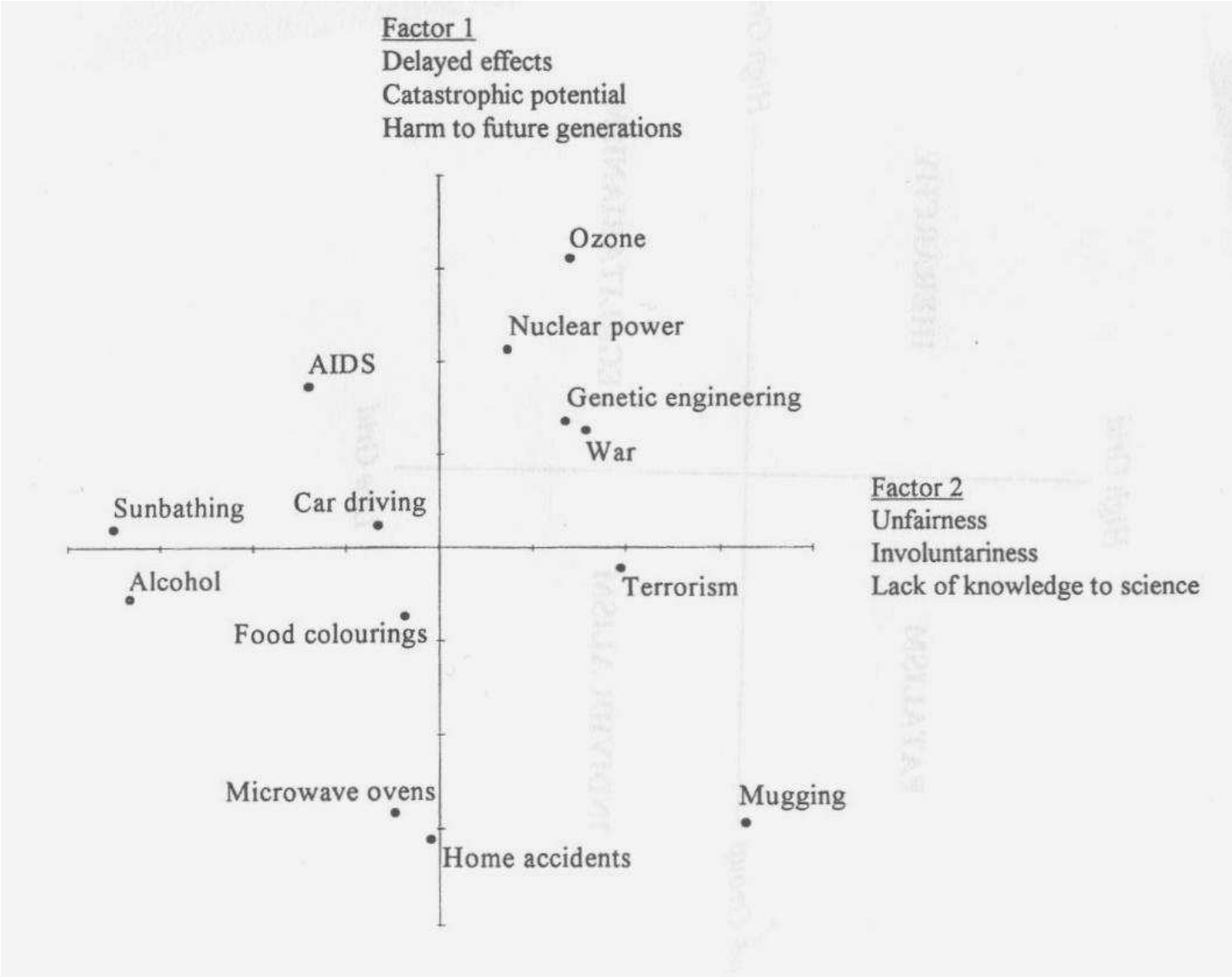


Figure 5.2: Hierarchical cluster analysis of the nine risk characteristics

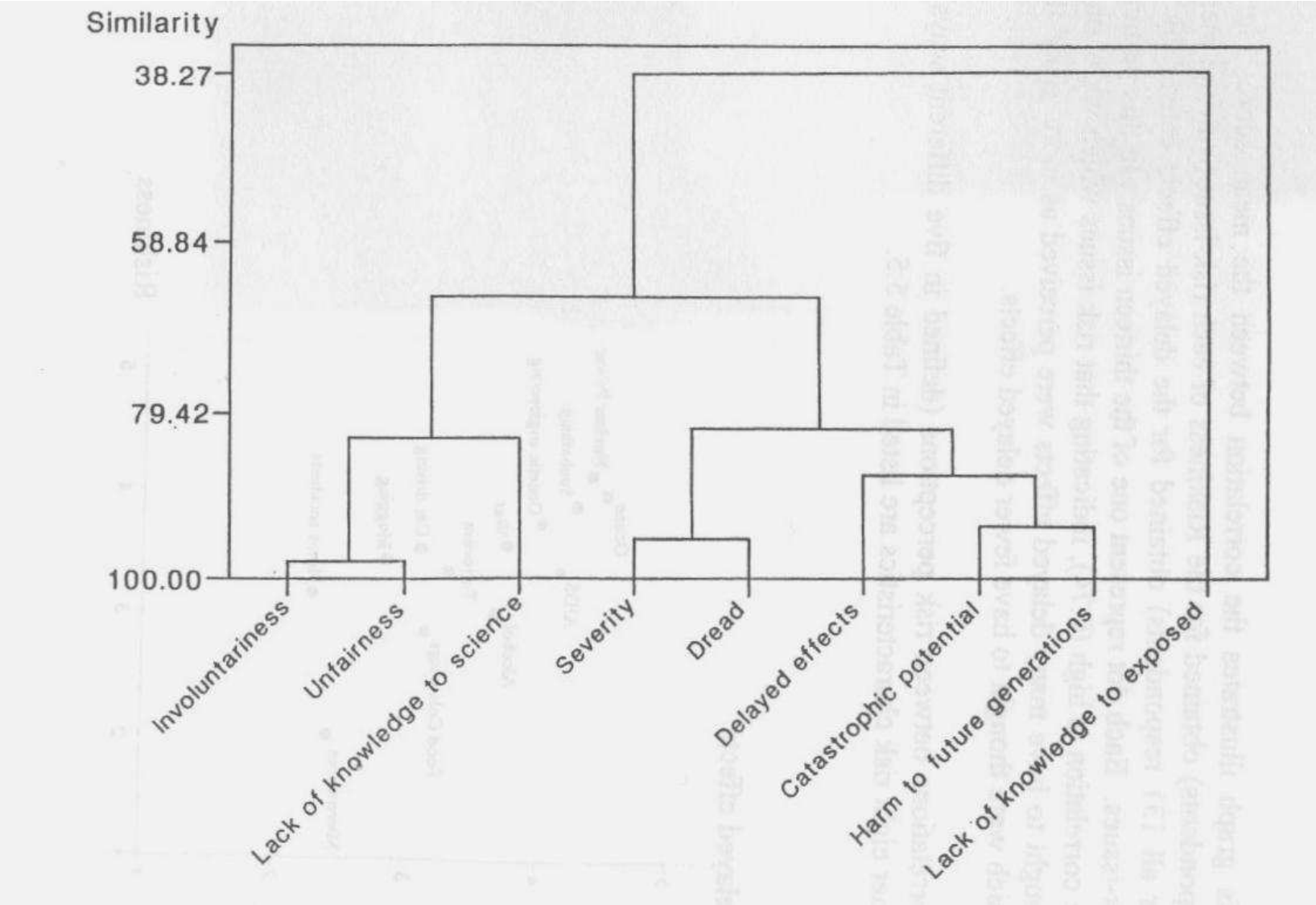


Figure 5.3: Graphical illustration of the difference between correlations using mean risk perception scores and those using individual scores

Figure 5.3.1: Scatter plot of mean scores

This graph illustrates the correlation between the mean scores (for all 131 respondents) obtained for the Riskiness of each risk0issue with the mean scores (for all 131 respondents) obtained for the delayed effects caused by those 13 risk-issues. Each dot represents one of the thirteen issues. In this particular case, the correlation is high (0.74), indicating that risk issues which were, on average, thought to have many delayed effects were perceived as more 'risky' than those which were thought to have fewer delayed effects.

Correlations between risk perceptions (defined in five different ways) and the other eight risk characteristics are listed in Table 5.5.

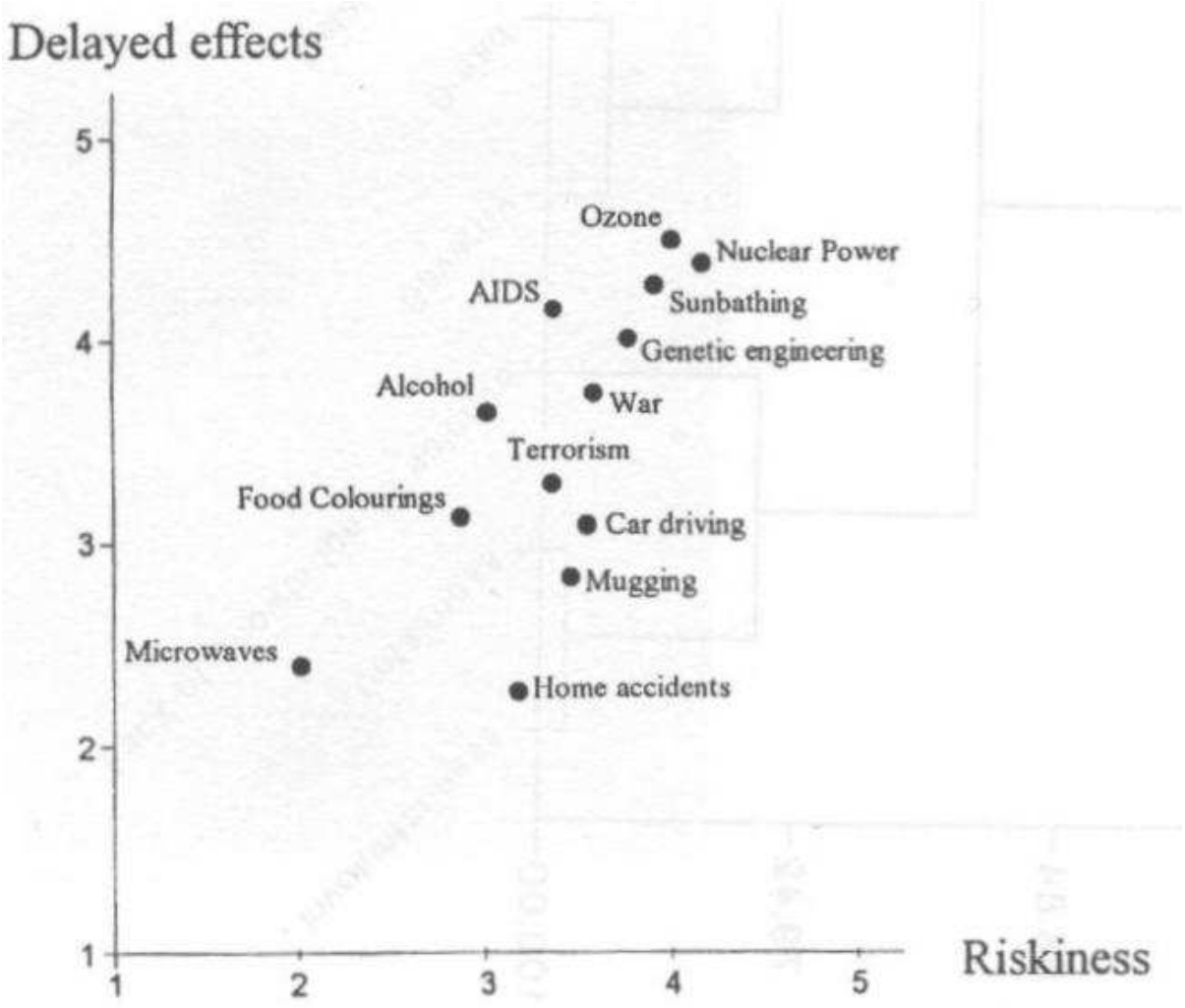


Figure 5.3.2: Scatter plot of individual scores

This graph illustrates the correlation between individuals' score for the Riskiness of sunbathing and their scores for 'delayed effects' associated with sunbathing. The size of the dots represents the number of respondents who gave that particular score. In this particular case, the correlation was 0.30 and was highly significant ($p < 0.001$), indicating that when an individual felt that sunbathing caused many delayed effects, they also tended to feel that it was highly risky.

Correlations between individual scores for risk perceptions (defined as Riskiness) and scores for the other eight risk characteristics, for each risk-issue, are listed in Table 5.6.

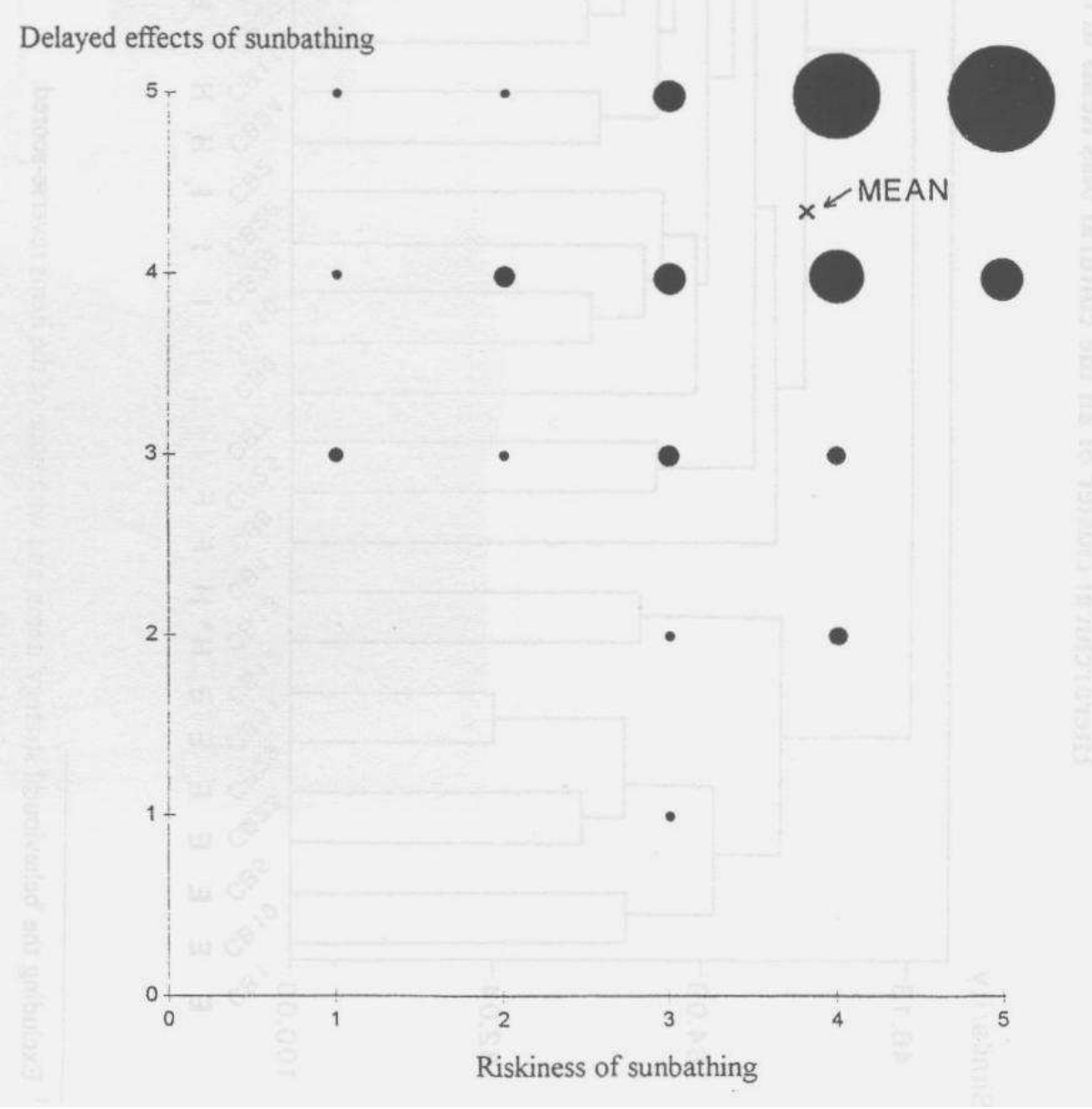
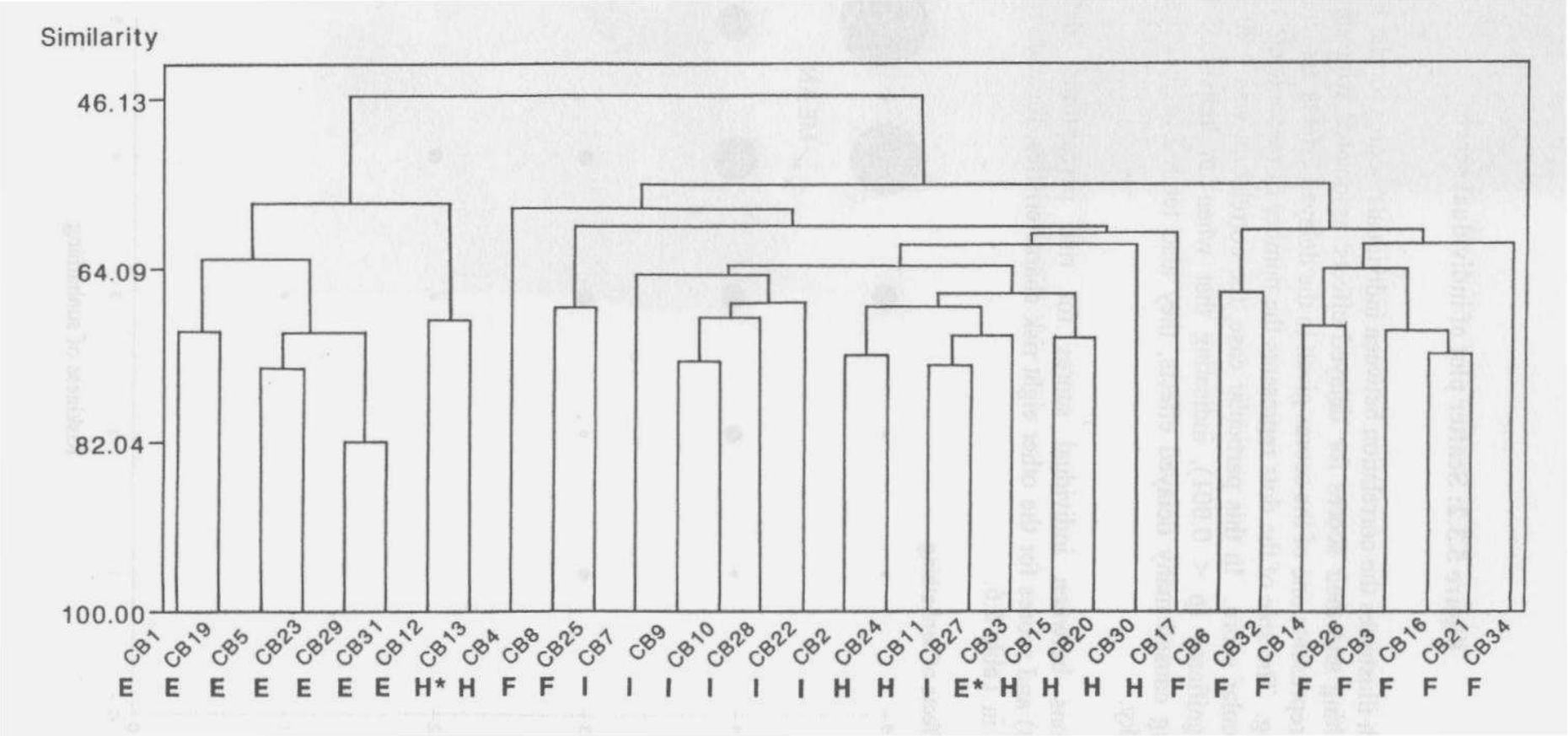


Figure 6.1: Hierarchical cluster of all the cultural bias items in the questionnaire[18]



[18] Excluding the 'behavioural strategy' items, and with none f the items reversed-scored.

Figure 6.2: Hierarchical cluster of the 'UEA set' of cultural bias items

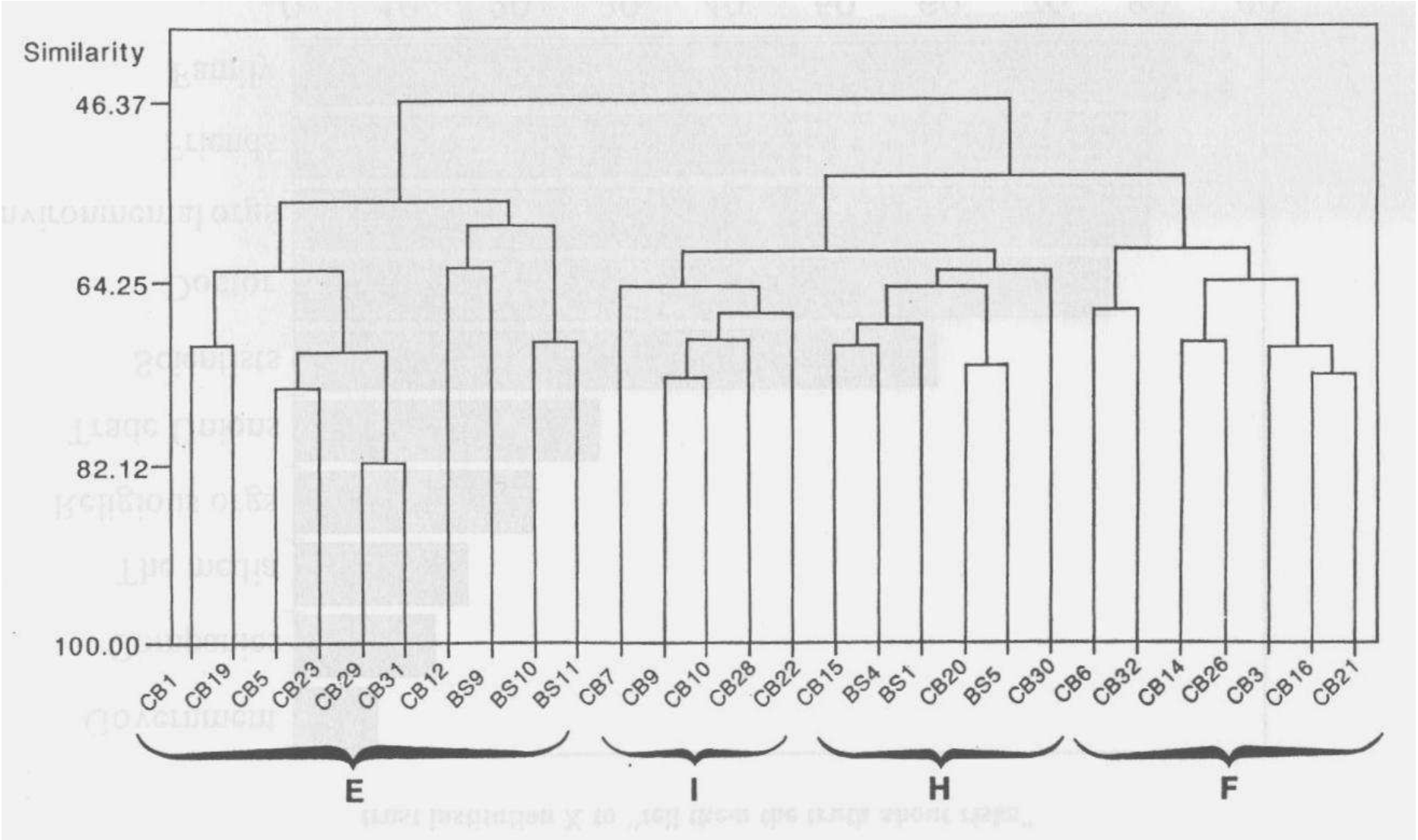
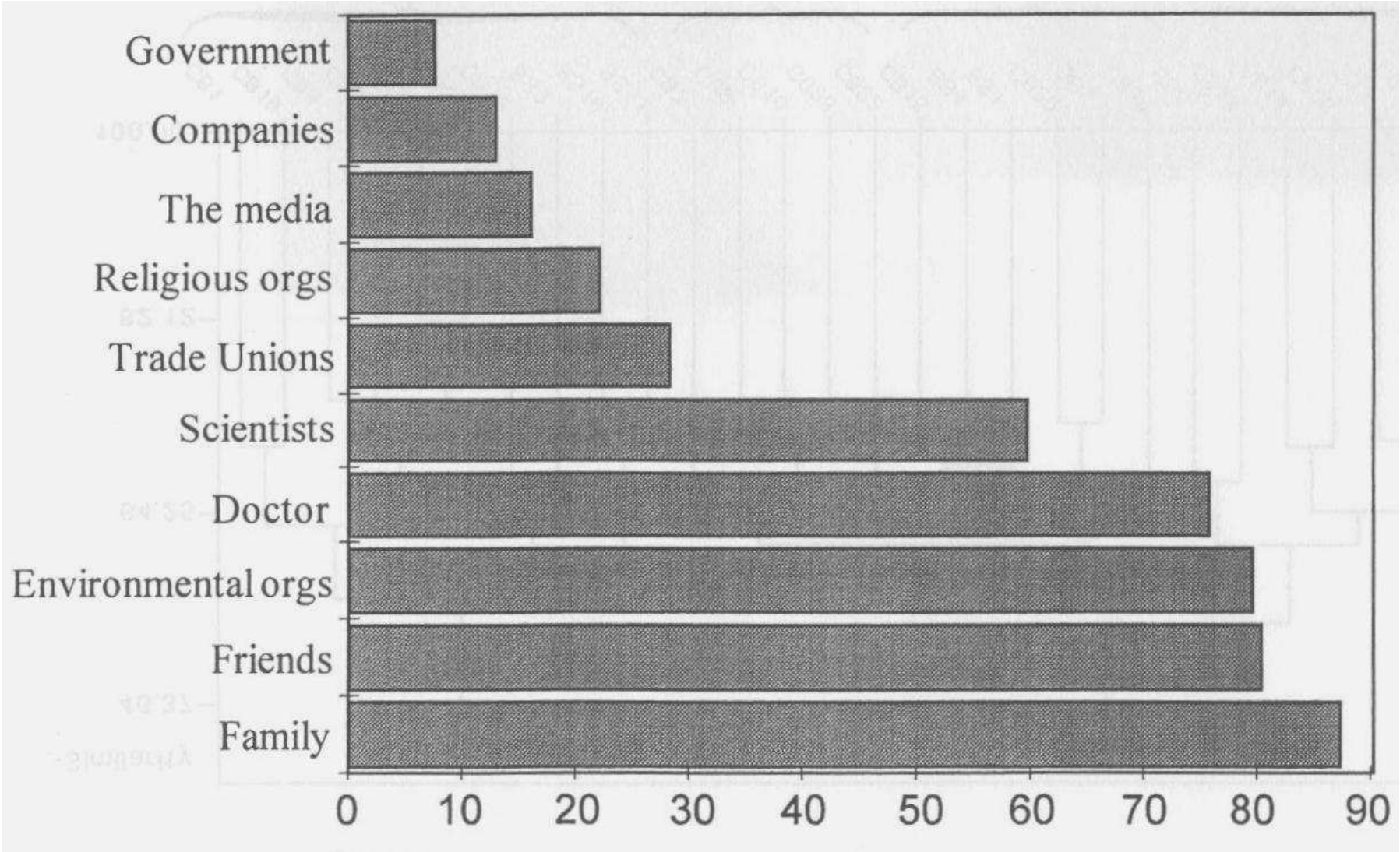


Figure 6.3: Percentage of respondents in Sample A who said they would "often" or "always" trusts institution X to "tell them the truth about risks"



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